“Emission & Regeneration” Unified Field Theory

Definition of a space with fundamental particles with longitudinal and transversal rotational momenta, and deduction of the linear momenta which generate electrostatic, magnetic, induction and gravitational forces.

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\[
\vec{J}_{n_2}^{(s)} = \text{sign}(\vec{J}_{e_1}) \text{sign}(\vec{J}_{e_2}) (\sqrt{J_{e_1}} \, \vec{e}_1 \times \sqrt{J_{e_2}} \, \vec{e}_2)
\]

\[
\vec{J}_{n_2}^{(n)} = \text{sign}(\vec{J}_{e_1}) \text{sign}(\vec{J}_{e_2}) (\sqrt{J_{n_1}} \, \vec{n}_1 \times \sqrt{J_{n_2}} \, \vec{n}_2)
\]

\[
dE = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{2c}{\pi} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| W \sin \varphi \, d\varphi
\]

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Abstract

The methodology of today’s theoretical physics consists in introducing first all known forces by separate definitions independent of their origin, arriving then to quantum mechanics after postulating the particle’s wave, and is then followed by attempts to infer interactions of particles and fields postulating the invariance of the wave equation under gauge transformations, allowing the addition of minimal substitutions.

The origin of the limitations of our standard theoretical model is the assumption that the energy of a particle is concentrated in a small volume in space. The limitations are bridged by introducing artificial objects and constructions like particle’s wave, gluons, strong force, weak force, gravitons, dark matter, dark energy, etc.

The proposed approach models subatomic particles such as electrons and positrons as focal points in space where continuously fundamental particles are emitted and absorbed, fundamental particles where the energy of the electron or positron is stored as rotations defining longitudinal and transversal angular momenta (fields). Interaction laws between angular momenta of fundamental particles are postulated in that way, that the basic laws of physics (Coulomb, Ampere, Lorentz, Maxwell, Gravitation, bending of particles and interference of photons, Bragg, etc.) can be derived. This methodology makes sure, that the approach is in accordance with the basic laws of physics, in other words, with well proven experimental data.

Due to the dynamical description of the particles the present approach has not the limitations of the standard model and is not forced to introduce artificial objects or constructions.

All forces are mathematically derived from one vector field generated by the longitudinal and transversal angular momenta of fundamental particles and not introduced through individual fittings as it is done by our Standard Theory.

The field equations are Lorentz invariant. Probability and quantification are inherent to the model.
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FP Fundamental particle.
SP Subatomic particle.
BSP Basic subatomic particle (electron, positron and constituent of photon).
CSP Complex subatomic particle (proton, neutron, nuclei of atoms and photon).
LRM Longitudinal rotational (angular) momentum.
TRM Transversal rotational (angular) momentum.
\( \vec{J}_e \) Longitudinal rotational (angular) momentum (LRM) of emitted fundamental particle.
\( \vec{J}_s \) Longitudinal rotational (angular) momentum (LRM) of regenerating fundamental particle.
\( \vec{J}_n \) Transversal rotational (angular) momentum (TRM) of regenerating fundamental particle.
\( \vec{J}^{(s)}_n \) Transversal angular momentum generated by the longitudinal angular momentum of two meeting regenerating fundamental particles.
\( \vec{J}^{(v)}_n \) Angular momentum generated by the transversal angular momentum of two meeting regenerating fundamental particles.
\( \vec{v}_l \) Low velocity of fundamental particle \( \vec{v}_l \approx c \).
\( \vec{v}_h \) High velocity of fundamental particle \( \vec{v}_h \approx \infty \).
\( \vec{v}_e \) Emission velocity of fundamental particle.
\( \vec{v}_r \) Velocity of regenerating fundamental particle.
\( \vec{v} \) Velocity of basic subatomic particle (BSP).
\( \varphi \) Emission angle of fundamental particle.
\( \psi \) Regenerating angle of fundamental particle.
\( \alpha \) Angle between emitted and regenerating fundamental particles.
\( \beta \) Angle between regenerating fundamental particles.
\( dE_s \) Energy stored in the longitudinal rotational momentum of regenerating fundamental particle.
\( dE_n \) Energy stored in the transversal rotational momentum of regenerating fundamental particle.
\( E \) Relativistic energy of a basic subatomic particle (BSP).
\( H \) Square root of the relativistic energy of a basic subatomic particle.
\( d\kappa \) Space distribution function of the relativistic energy \( E \) of a BSP and of its square root \( H \).
1 Methodology.

As a mathematical theory, physics should have a pyramidal shape, where few postulates at the top allow the deduction of all known laws from top to bottom. Each law in the theoretical building, expressed as an equation, is deduced from equations that are placed at a higher level. The deduction of laws from equations that are placed at the same level or below is not allowed.

Figure 1: Methodology

Figure 1 shows a schematic comparison between the methodology used in mainstream physics and the proposed approach. The standard theory starts formulating mathematically the basic laws for individual particles, namely, Coulomb, Ampere, Lorentz, Maxwell and Gravitation. At a second level thermodynamic laws are introduced to describe assemblies of particles with state variables. Then the particle’s wave is postulated (de Broglie) to explain the analogy between diffraction patterns obtained with electromagnetic rays and rays of particles. The particle’s wave allows the def-
inition of differential equations of the wave function to describe mathematically the quantized behavior of particles in nature (Schroedinger). Up to this point of the theory, no explanation is given about the origin of the forces and momenta obtained by measurements between particles. Efforts made to find explanations are:

- of experimental nature, scattering particles in particle accelerators and
- of theoretical nature, trying to infer interactions between fundamental particles postulating the invariance of wave equations under gauge transformations.

The present approach intends to explain what happens in the space between two charged particles or two masses that generates the forces we measure at the particles. The methodology followed starts postulating fundamental particles (FPs) based on the idea, that the energy of a subatomic particle like the electron is not concentrated at a point but distributed in space and, that the energy is stored in fundamental particles that are emitted continuously from a focal point in space and to which regenerating fundamental particles continuously return. FPs store the energy as rotations which are independent of coordinate systems and which define longitudinal and transversal angular momenta. In a second step the interactions between FPs are postulated as interactions between their angular momenta, which mathematically is expressed as scalar and vector products. Finally, the interaction laws between FPs are determined in a recursive process so that the fundamental laws of physics, namely, Coulomb, Ampere, Lorentz, Maxwell and Gravitation can be derived. The methodology makes sure, that the approach is in accordance with experimental data.
2 General theoretical part.

The present theory is based on the following postulates and physical laws:

- Postulates that define a space through the definition of fundamental particles and its characteristics.
- Postulates that define the interactions of fundamental particles.
- Relativistic energy of a moving particle

\[ E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} \]  

(1)

- Inertial force

\[ F = \frac{dp}{dt} \quad \text{with} \quad p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}} \]  

(2)

In this section, fundamental particles (FPs) with longitudinal and transversal angular momenta are postulated, filling the whole space.

Basic subatomic particles (BSPs) are defined (electron, positron and neutrino as a constituent of the photon) and laws are postulated that describe the generation of angular momenta when fundamental particles cross.

With the idea, that basic subatomic particles emit and are continuously regenerated by fundamental particles, an equation for the distribution in space of the energy of a BSP is introduced.

The regenerating fundamental particles and the requirements their angular momenta must comply to generate linear momenta are defined.

The energy of a BSP that moves with constant velocity is distributed at the longitudinal and transversal angular momenta of its regenerating fundamental particles.

The vector \( d\vec{H} \) is defined.

The probability equation for the crossing in space of emitted and regenerating fundamental particles is defined, and the balance of energy and angular momenta is shown.

The transition of BSPs with \( v < c \) to BSPs with light speed is deduced and the photon is introduced as a complex subatomic particle (CSP).

The different forms of polarizations for BSPs are defined.
2.1 Postulates that define a space with fundamental particles (FPs) with longitudinal and transversal rotational momenta.

- **Postulate 1**: A space exists with two types of fundamental particles (FPs) that have strongly differing velocities designated by \( v_h \) (high) and \( v_l \) (low). The FPs have longitudinal rotational momenta (LRMs) and move in a straight line relative to a given system of coordinates. A right rotation of the LRM in the moving direction of the FP is defined as positive LRM and designated by \( \bar{J}_s^+ \). A left rotation of the LRM in the moving direction of the FP is defined as negative LRM and designated by \( \bar{J}_s^- \).

Normal (orthogonal) to its moving direction the FP can have transversal rotational momenta (TRM) designated by \( \bar{J}_n \). In a neutral space the TRM of the FPs are not oriented in a special direction and their vector sum over time or space neutralize.

- **Postulate 2**: Through each point in the space the two types of FPs flow continuously in and from all directions. When two FPs cross in space, their directions and velocities don’t change.

- **Postulate 3**: In the same space there are focal points where the FPs change their velocities and the rotations of their LRM. These focal points are the points where our standard theory assumes that the basic subatomic particles (BSPs), namely the electrons and positrons are located.

The concept is shown in Fig. 2.

Fig. 2 shows the emitted FPs with their longitudinal angular momenta \( \bar{J}_e \) and the regenerating FPs with their longitudinal and transversal angular momenta \( \bar{J}_s \) and \( \bar{J}_n \) respectively. The configuration has an axial symmetry around the speed vector \( \bar{v} \).

The transversal angular momenta follow the right screw law in the direction of the speed \( \bar{v} \), independent of the charge of the BSP. Our standard theory defines the magnetic field \( \bar{H} \) in the right screw direction for positively charged particles and in the left screw direction for negatively charged particles.
The BSPs are classified according to the change of the velocity of their FPs at the focal point in accelerating and decelerating BSPs.

The concept is shown in Fig. 3.

1. Accelerating basic subatomic particles radiate fundamental particles (FPs) with high velocity $v_h = v_e$ ($e$=emission) and are regenerated by FPs with low velocity $v_l = v_r$ ($r$=regeneration).

2. Decelerating basic subatomic particles radiate fundamental particles (FPs) with low velocity $v_l = v_e$ ($e$=emission) and are regenerated by FPs with high velocity $v_h = v_r$ ($r$=regeneration).

The BSPs are also classified according to their longitudinal rotational momenta in positive and negative BSP.

1. Positive basic subatomic particles transform negative LRM $\vec{J}_s^-$ in positive LRM $\vec{J}_s^+$.
   The concept is shown in Fig. 4.

2. Negative basic subatomic particles transform positive LRM $\vec{J}_s^+$ in negative LRM $\vec{J}_s^-$.
   The concept is shown in Fig. 5.
Basic Subatomic Particles (BSP/ÜP)

Accelerating BSP

Positive BSP

Decelerating BSP

Positive BSP

Negative BSP

Figure 3: Basic Subatomic Particles

Positive ÜP/BSP

Figure 4: Positive basic subatomic particle (positron)

Negative ÜP/BSP

Figure 5: Negative basic subatomic particle (electron)
• **Postulate 4**: The FPs that are radiated by the basic subatomic particles have no transversal rotational momenta $\vec{J}_n$ and they possess well defined radiation velocities relative to a system of coordinates that is fix to the basic subatomic particles.

1. Accelerating basic subatomic particles emit fundamental particles (FPs) with high velocity $v_e \to \infty$ relative to a system of coordinates that is fix to the basic subatomic particle.

2. Decelerating basic subatomic particles emit fundamental particles (FPs) with low velocity $v_e = c$ relative to a system of coordinates that is fix to the basic subatomic particles.

**2.2 Postulates that define the interactions of fundamental particles.**

• **Postulate 5**: The FPs with the longitudinal rotational momenta $\vec{J}_e$ emitted by a BSP generate, when they cross with the regenerating FPs of the same BSP, longitudinal $\vec{J}_s$ and transversal $\vec{J}_n$ rotational momenta on the regenerating FPs. The sense of rotation of the transversal rotational momenta $\vec{J}_n$ is the direction in that the vector $\vec{J}_s$ must move over the smallest angle to coincide with the vector $\vec{J}_e$ of the BSP.

The FPs emitted by a BSP deliver the energy stored in their LRM $\vec{J}_e$ to the LRM $\vec{J}_s$ and TRM $\vec{J}_n$ of the regenerating FPs. The distribution of the energy between the LRM and the TRM of the regenerating FPs is a function of the angle $\alpha$ between the velocity vectors of the emitted and regenerating FPs.

The concept is shown on Fig. 6.
In Fig. 6 the convention for unit vectors of emitted and regenerating fundamental particles is shown.

In Fig. 7 the convention for unit vectors of emitted and regenerating fundamental particles is shown.
• **Postulate 6:** If two FPs from different BSPs cross, their LRM $\vec{J}_s$ generate two opposed TRM $\vec{J}_n^{(s)}$ that are defined by the cross product of the square roots of their original LRM. The sign of the generated TRM is opposed to the product of the signs of their original LRM.

\[
\vec{J}_n^{(s)} = \text{sign}(\vec{J}_s) \text{sign}(\vec{J}_s) (\sqrt{\vec{J}_s} \vec{s}_1 \times \sqrt{\vec{J}_s} \vec{s}_2)
\]  

For the two generated transversal rotational momenta (TRM) we have that

\[
\vec{J}_n^{(s)} = -\vec{J}_n^{(s)}
\]

The concept is shown on Fig. 8.

![Figure 8: Generation of transversal rotational momenta $J_n^{(s)}$ out of longitudinal rotational momenta $J_s$ of FPs that belong to different BSPs](image)

The vectors $\vec{s}_1$ and $\vec{s}_2$ are unit vectors with the direction of the velocity vectors of the FPs.

The upper $(s)$ means that the rotational momenta were generated by longitudinal rotational momenta.
The sign of the TRM $\vec{J}_n^{(s)}$ is a function of the signs of the LRM of the FPs.

If the LRM of the FPs that cross have different signs, than opposed TRM $\vec{J}_n^{(s)}$ are generated on the FPs that rotate to each other if seen against the moving direction of the FPs.

If the LRM of the FPs that cross have the same signs, than opposed TRM $\vec{J}_n^{(s)}$ are generated on the FPs that rotate from each other if seen against the moving direction of the FPs.

**Postulate 7**: If two FPs from different BSPs cross, their TRM $\vec{J}_n$ will generate two opposed rotational momenta $\vec{J}^{(n)}$ that are defined by the cross product of the square roots of their original TRM. The sign of the generated rotational momenta is given by the product of the signs of their original LRM. Additionally TRM $\vec{J}_n^{(s)}$ according to postulate 6 are generated.

$$\vec{J}_2^{(n)} = \text{sign}(\vec{J}_{s_1}) \text{sign}(\vec{J}_{s_2}) (\sqrt{J_{n_1}} \, \vec{n}_1 \times \sqrt{J_{n_2}} \, \vec{n}_2)$$

(5)

with

$$\vec{J}_1^{(n)} = - \vec{J}_2^{(n)}$$

(6)

The concept is shown on Fig. 9.

The vectors $\vec{n}_1$ und $\vec{n}_2$ are unit vectors orthogonal to the direction of the velocity vectors of the FPs.

The upper $(n)$ means that the rotational momenta were generated by transversal rotational momenta.

The rotation of the rotational momenta $\vec{J}_2^{(n)}$ is opposed to the rotational momenta $\vec{J}_1^{(n)}$ and they can be expressed by their longitudinal and transversal components.
Figure 9: Generation of rotational momenta $J_i^{(n)}$ out of transversal rotational momenta $J_{ni}$ of FPs that belong to different BSPs

- **Postulate 8**: If a FP 1 with an angular momentum $\vec{J}_1$ crosses with a FP 2 with a longitudinal angular momentum $\vec{J}_{s_2}$, the orthogonal component of $\vec{J}_1$ to $\vec{J}_{s_2}$ is transferred to the FP 2, if at the same instant between two other FPs 3 and 4 an orthogonal component is transferred which is opposed to the first one.

## 2.3 Energy distribution of a basic subatomic particle (BSPs) that moves with the velocity $\vec{v}$.

Basic subatomic particles like the electron or the positron, that are at the time $t = 0$ at the point 1 with $x = 0$ and move with the velocity $v$, disintegrate by radiating fundamental particles of one of the two velocities and are regenerated, at the point 2 with $\vec{x} = \vec{v} t$ at the time $t$, by fundamental particles of the other velocity. The part of the total radiating energy of the basic subatomic particle that is in the conus with the rotational angle $\varphi$ and the thickness $d\varphi$ is given by the following expression:

$$ dE = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{c}{2 v} \left| \frac{\vec{v}_s}{||\vec{v}_e||} \times \frac{\vec{v}_r}{||\vec{v}_r||} \right| W d\varphi \quad dE = E \, dk \tag{7} $$

with
\[ E = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \]
\[ dk = \frac{c}{2v} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| W d\phi \] (8)

The concept is shown on Fig. 10.

Figure 10: Space diagram with emission \( v_s t_s \) and regeneration \( v_r t_r \) distances for a basic subatomic particle that moves with \( v \).

\( dk \) describes the part of the total energy \( E \) of a basic subatomic particle that moves with the velocity \( v \) contained in the angle \( d\phi \).

\( v_e \) is the emission velocity of the fundamental particles relative to a coordinate system that is fix with the basic subatomic particle that moves with \( v \). The velocity \( v_e \) is equal to \( v_h \to \infty \) for accelerating BSPs and equal to the speed of light \( c \) for decelerating BSPs.

\( v_s \) is the velocity of the emitted fundamental particles relative to a coordinate system in which the BSP moves with the velocity \( v \).

\[ v_s = \sqrt{v_e^2 + v^2 - 2 v_e v \cos \phi} \] (9)

\( v_r \) is the velocity of the fundamental particles that regenerate the BSP relative to a coordinate system in which the BSP moves with the velocity \( v \). For accelerating BSPs \( v_r = c \) is the velocity of light and for decelerating BSPs \( v_r \to \infty \).

\( W \) represents the probability that emitted fundamental particles cross with regenerating fundamental particles. For a basic subatomic particle that moves with constant velocity \( v \) the whole emitted energy must equal the whole regenerating energy to con-
serve the particle, so that the probability for the whole particle is \( W = 1 \).

### 2.4 Deduction of the angle \( \alpha \) between the speed vectors \( \vec{v}_s \) and \( \vec{v}_r \).

The time \( t \) that a BSP needs from point 1 to 2 must be equal to the time the emitted FP needs from the moment of its emission at \( t = 0 \) to the moment it crosses with the regenerating FP, plus the time the regenerating FP needs then to arrive at \( \bar{x} = \bar{v} \cdot t \).

The concept is shown in Fig. 10 and Fig. 11.

Fig. 11 shows the regeneration of a BSP at point \( x = 0 \) for two rays that were emitted at \( vt \) and \( vt' \).

![Figure 11: Space diagram showing the regeneration of a BSP

\[
0 \leq \varphi \leq \pi \\
\xi = \frac{\varphi}{2} + \arctan \left[ \frac{v_e - v}{v_e + v} \cot \frac{\pi - \varphi}{2} \right] \\
v_s^2 = v_e^2 + v^2 - 2v_v \cos(\pi - \varphi) \\
t_r = t - t_s
\]
\[
v_r^2(t - t_s)^2 = v^2 t^2 + v_s^2 t_s^2 - 2(v t) (v_s t_s) \cos \xi \\
(v_r^2 - v_s^2) t_s^2 + (2vv_s t \cos \xi - 2v_r^2) t_s + (v_r^2 - v^2) t^2 = 0
\]

The solution of the second order equation gives \( t_s \).

\[
\psi = \frac{\pi}{2} - \frac{\xi}{2} + \arctan \left( \frac{v_s t_s - v t}{v_s t_s + v t} \cot \frac{\xi}{2} \right) \\
\alpha = \psi + \xi
\]

The crossing angle \( \alpha \) is independent from the selected time \( t \) and varies as follows.

\[
0 \leq \varphi \leq \pi \left\{ \begin{array}{ll}
v = 0 & \alpha = \pi \\
0 \leq v \leq c & \pi > \alpha > \frac{\pi}{2}
\end{array} \right.
\]

A BSP is regenerated at the point \( x = 0 \) by all the rays the same BSP has emitted from \( x \to -\infty \) to \( x = 0 \).

### 2.5 Determination of a more simple distribution function \( d\kappa(\varphi) \).

The distribution function \( d\kappa(\varphi) \) is not adequate for analytic manipulation because of the complicate dependence of \( \alpha(\varphi) \). In what follows a more simple expression \( d\kappa(\varphi) \) will be introduced.

The equation (7), that defines the distribution of the energy, we can write with \( W = 1 \) as follows

\[
dE = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{c}{2} \frac{v_s}{v_e} \sin \alpha d\varphi
\]

Because of

\[
\int_{\varphi=0}^{\pi} dE = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \quad \text{we have} \quad \frac{c}{2} \int_{\varphi=0}^{\pi} \frac{v_s}{v_e} \sin \alpha d\varphi = 1
\]

For \( v = 0 \) we have that \( \int_{\varphi=0}^{\pi} dE = m c^2 \), and we select from the many possible functions for \( \int_{\varphi=0}^{\pi} f(\varphi) d\varphi = 1 \) the following function, selection that shows to be right in all what follows.

\[
\int_{\varphi=0}^{\pi} dE = m c^2 = m c^2 \frac{1}{2} \int_{\varphi=0}^{\pi} \sin \varphi d\varphi \quad \text{because} \quad \frac{1}{2} \int_{\varphi=0}^{\pi} \sin \varphi d\varphi = 1
\]
2.5.1 Analysis for BSPs with $v \to 0$.

For $v = 0$ we have also that $v_s = v_e$, valid for BSPs with $v_e = c$ as for BSPs with $v_e \to \infty$, what leads to the conclusion that

$$\lim_{v \to 0} \frac{\sin \alpha}{v} = \frac{1}{c} \sin \varphi \quad (14)$$

and for $d\kappa$ we get

$$d\kappa \approx \frac{1}{2} W \sin \varphi \, d\varphi \quad v = 0 \quad (15)$$

2.5.2 Analysis for accelerating BSPs with $v_e \to \infty$.

For accelerating BSPs we have to differentiate between $v = 0$ and $v \neq 0$.

For $v = 0$ results that:

If for $v_r = c$ the speed $v_e \to \infty$ then $t_e \to 0$, and for $v = 0$ results that

$$r_r = v_r \, t_r \to r_e = v_e \, t_s \quad \text{and} \quad dr_r \to dr_e \quad (16)$$

It results then that

$$\psi = \varphi \quad \text{and} \quad d\psi = d\varphi \quad (17)$$

For $v \neq 0$ results that:

$$r_r = v_r \, t_r \neq r_e = v_e \, t_s \quad \text{and} \quad dr_r \neq dr_e \quad (18)$$

and that

$$\psi \neq \varphi \quad \text{and} \quad d\psi \neq d\varphi \quad (19)$$

Now we analyse $d\kappa$ for $v \ll c$ and $v = c - \Delta v$ with $\Delta v \ll c$.

We start with

$$d\kappa = \frac{c}{2} v \frac{v_s}{v_e} \sin \alpha \, W \, d\varphi \quad (20)$$

a) With $v_e \to \infty$ it is $v_s \approx v_e$ and with $v \ll c$ the angle $\alpha$ can be approximated by (see Fig. 12)

$$\alpha \approx \pi - \frac{v}{c} \sin \varphi \quad (21)$$
and we have that

\[ d\kappa \approx \frac{2}{\pi} \frac{c}{v} \sin \left[ \pi - \frac{v}{c} \sin \varphi \right] W \sin \varphi \, d\varphi \]  

(22)

Because of

\[ \sin \left[ \pi - \frac{v}{c} \sin \varphi \right] = \sin \left[ \frac{v}{c} \sin \varphi \right] \approx \frac{v}{c} \sin \varphi \]  

(23)

we have that

\[ d\kappa \approx \frac{1}{2} W \sin \varphi \, d\varphi \]  

(24)

b) If we now take \( v = c - \Delta v \) with \( \Delta v \ll c \) the angle \( \alpha \) can be expressed by

(see Fig. 12)

\[ \alpha \approx \pi - \varphi \text{ for } 0 \leq \varphi \leq \pi/2 \text{ and } \alpha \approx \varphi \text{ for } \pi/2 \leq \varphi \leq \pi \]  

(25)

we get \( \sin \alpha = \sin \varphi \) for \( 0 \leq \varphi \leq \pi \) and for \( d\kappa \)

\[ d\kappa \approx \frac{1}{2} W \sin \varphi \, d\varphi \]  

(26)
Fig. 12 shows the relation between $\alpha$, $\varphi$ and the speed $v$ for accelerating BSPs where $v_e \to \infty$ and $v_r = c$.

Figure 12: $\alpha$ as a function of $\varphi$ and $v$ for accelerating BSPs
Fig. 13 shows the relation between $\psi$, $\varphi$ and the speed $v$ for accelerating BSPs.

2.5.3 Analysis for decelerating BSPs with $v_r \to \infty$.

If for $v_e = c$ the speed $v_r \to \infty$, then $t_r \to 0$ and

$$r_r = v_r t_r \to r_e = v_e t_s \quad \text{and} \quad \text{dr}_r \to \text{dr}_e \quad (27)$$

We conclude that for decelerating BSPs

$$\psi = \varphi \quad \text{and} \quad d\psi = d\varphi \quad (28)$$

Now we analyse $d\kappa$ for $v \ll c$ and $v = c - \Delta v$ with $\Delta v \ll c$.

We start with
\[ d\kappa = \frac{c}{2v} \frac{v_s}{v_e} \sin \alpha \ W \ d\varphi \] (29)

a) With \( v_e = c \) and \( v \ll c \) it is \( v_s \approx c \) and the angle \( \alpha \) can be approximated by (see Fig. 14)

\[ \alpha \approx \pi - \frac{v}{c} \sin \varphi \] (30)

and we have that

\[ d\kappa \approx \frac{c}{2v} \sin \left[ \pi - \frac{v}{c} \sin \varphi \right] \ W \ d\varphi \] (31)

Because of

\[ \sin \left[ \pi - \frac{v}{c} \sin \varphi \right] = \sin \left[ \frac{v}{c} \sin \varphi \right] \approx \frac{v}{c} \sin \varphi \] (32)

we have that

\[ d\kappa \approx \frac{1}{2} \ W \ \sin \varphi \ d\varphi \] (33)

b) If we now take \( v = c - \Delta v \) with \( \Delta v \ll c \) the angle \( \alpha \) can be expressed by (see Fig. 14)

\[ \alpha \approx \frac{1}{2} (\pi + \varphi) \quad \text{or} \quad \sin \alpha \approx \cos \frac{\varphi}{2} \] (34)

and

\[ v_s = \sqrt{v_e^2 + v^2 - 2 \ v_e \ v \ \cos \varphi} \approx 2 \ c \ \sin \frac{\varphi}{2} \] (35)

we get

\[ d\kappa \approx \frac{1}{2} \ W \ \sin \varphi \ d\varphi \] (36)

**Conclusion:** The function \( d\kappa \) has the following important characteristics:

- The equation for \( d\kappa \) is the same for the whole speed range \( 0 \leq v \leq c \) for accelerating and decelerating BSPs.

- The function \( d\kappa \) gives the energy distribution in space, which must be the same for all reference systems. This is expressed by the independence of \( d\kappa \) from the speed \( v \).

- The function \( d\kappa \) has a rotational symmetry around the velocity vector \( \vec{v} \).

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The function $d\kappa$ has the following symmetry, which is very important for the demonstrations of the conservation laws

$$d\kappa(\varphi) = d\kappa(\pi - \varphi)$$

(37)

Fig. 14 shows the relation between $\alpha$, $\varphi$ and the speed $v$, for decelerating BSPs with $v_e = c$ and $v_r \to \infty$.

Figure 14: $\alpha$ as a function of $\varphi$ and $v$ for decelerating BSPs
Fig. 15 shows the relation between $\psi$, $\varphi$ and the speed $v$ for decelerating BSPs.

![Graph showing $\psi$ as a function of $\varphi$ and $v$ for decelerating BSPs](image)

Figure 15: $\psi$ as a function of $\varphi$ and $v$ for decelerating BSPs

**Miscellaneous**

If we define

$$\frac{v}{c} = \sin \alpha_m$$

with $\alpha_m$ the minimum of the curve $\alpha/\varphi$ for a given speed $v$, we get for **decelerating** BSPs with $v_e = c$ and for **accelerating** BSPs with $v_e \rightarrow \infty$, expressions that depend only from angles.

Fig. 16 shows the angle $\alpha_m$ as function of the speed $v$, angle that is the same for accelerating and decelerating BSPs.
Figure 16: $\alpha_m$ for accelerating and decelerating BSPs

**Note:** The energy distribution function $d\kappa$ was selected between several possible functions like

$$dE = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{2 c}{\pi v} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| W \sin \varphi d\varphi dE = E \, d\kappa \quad (39)$$

with

$$d\kappa \approx \frac{2}{\pi} W \sin^2 \varphi \, d\varphi \quad (40)$$

With this distribution the force between two static BSPs expressed as rotor of the field $dH_n$ is zero for $\varphi = 0$ which is not the case for the distribution selected for the present approach (see 16.2).

2.5.4 **General observations to the energy distribution of BSPs.**

In sec. 2.5 we have introduced the function $d\kappa$ for the energy distribution in space for a BSP.

For an isolated BSP with $v = 0$ the distribution of the energy is point symmetric with no privileged direction and described by
\[ d\kappa = \frac{1}{2} \frac{r_o}{r_r^2} dr_r \]  

(41)

This is not expressed with

\[ d\kappa = \frac{1}{2} \frac{r_o}{r_r^2} dr_r \sin \varphi \]  

(42)

that is also valid for \( v = 0 \) and where we have a privileged direction defined by \( \varphi = 0 \).

We are not interested in isolated particles without interactions. Privileged directions exist always we have more than one BSP and are defined by the connecting directions of the BSPs.

We have also seen that all interactions at \( v = 0 \) between BSPs are generated by accelerations of the BSPs in the connecting directions.

This explains why the equation

\[ d\kappa = \frac{1}{2} \frac{r_o}{r_r^2} dr_r \sin \varphi \]  

(43)

is also valid for \( v = 0 \) where the privileged direction is the connecting line to the other BSP.

### 2.6 Energy of a BSP that moves with constant velocity \( v \).

To obtain the total energy of a basic subatomic particle that moves with constant \( v \), the equation (7) of section 2.3 for \( dE \) must be integrated over the whole spacial coordinates.

As \( dE \) represents the Energy in the angle \( d\varphi \) that has a rotational symmetry, the integration goes from \( \varphi = 0 \) to \( \varphi = \pi \).

\[
E = \frac{m \cdot c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{c}{2} v \int_{\varphi=0}^{\varphi=\pi} \left| \frac{\bar{v}_s}{|\bar{v}|} \times \frac{\bar{v}_r}{|\bar{v}|} \right| W \, d\varphi
\]

(44)

**Calculations.**

To calculate the energy we assumed as low speed \( v_l = c \) and as high speed for the fundamental particles \( v_h = 10^{17} \cdot c \frac{m}{s} \) and used the mass of the electron. The deviation in percent between \( E_{must} \) and \( E_{calc} \) in the range \( 0 \leq v \leq c \) was less than \( 10^{-6} \). The results were the same for accelerating and decelerating BSPs.

**Note:** With the energy distribution of eq.(39) and a low speed \( v_l = c \) and a high speed of \( v_h = 10^{17} \cdot c \frac{m}{s} \), the deviation in percent between \( E_{must} \) and \( E_{calc} \) in the range \( 0 \leq v \leq c \) was less than \( 10^{-12} \).
2.7 Linear momentum \( \vec{p} \) of a BSP that moves with constant velocity \( v \).

The linear momentum of a basic subatomic particle that moves with constant velocity \( v \) is given by

\[
\vec{p} = \int d\vec{p} = \frac{\vec{v}}{c^2} \int dE
\]

with

\[
d\vec{p} = \frac{m \vec{v}}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{c}{2} \frac{\vec{v}_s \times \vec{v}_r}{|\vec{v}_s| |\vec{v}_r|} W d\varphi d\bar{p} = \bar{p} d\kappa
\]

The equation is composed by the total linear momentum of the BSP and a dimensionless factor that gives the part of the linear momentum corresponding to the angle \( d\varphi \).

Calculations

To calculate the linear momentum we assumed as low speed \( v_l = c \) and as high speed for the fundamental particles \( v_h = 10^{17} \cdot c \) and used the mass of the electron. The deviation in percent between \( p_{\text{must}} \) and \( p_{\text{calc}} \) in the range \( 0 \leq v \leq c \) was less than \( 10^{-6} \). The results were the same for accelerating and decelerating BSPs.

2.8 Energies stored in longitudinal rotational momenta \( \vec{J}_s \) and transversal rotational momenta \( \vec{J}_n \) of regenerating FP.

We start with the total energy of a BSP with constant \( v \).

\[
E = \sqrt{E_o^2 + E_p^2}
\]

with

\[
E_o = m \ c^2 \quad E_p = p \ c \quad \text{and} \quad p = \frac{m \ v}{\sqrt{1 - \frac{v^2}{c^2}}}
\]

and through differentiation we get

\[
dE = \frac{E_o \ dE_o + E_p \ dE_p}{\sqrt{E_o^2 + E_p^2}}
\]

We define
\[ \frac{dE_s}{E_o} = \frac{dE_o}{\sqrt{E_o^2 + E_p^2}} \quad \text{and} \quad \frac{dE_n}{E_p} = \frac{dE_p}{\sqrt{E_o^2 + E_p^2}} \]  \hspace{1cm} (50)

and get

\[ dE = dE_s + dE_n \quad \text{with} \quad dE_o = c^2 \, dm \quad \text{and} \quad dE_p = \frac{c \, v}{\sqrt{1 - \frac{v^2}{c^2}}} \, dm \]  \hspace{1cm} (51)

Through integration we obtain

\[ E = E_s + E_n \quad \text{with} \quad E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \quad \text{and} \quad E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \]  \hspace{1cm} (52)

From

\[ dE = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} \left( \frac{c}{2 \, \sqrt{v^2}} \bar{v}_s \times \bar{v}_r \right) W \, d\varphi \]  \hspace{1cm} (53)

and

\[ E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} = E_s + E_n \]  \hspace{1cm} (54)

results that

\[ dE_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \left( \frac{c}{2 \, \sqrt{v^2}} \bar{v}_s \times \bar{v}_r \right) W \, d\varphi \quad \text{and} \quad dE_s = E_s \, d\kappa \]  \hspace{1cm} (55)

and

\[ dE_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \left( \frac{c}{2 \, \sqrt{v^2}} \bar{v}_s \times \bar{v}_r \right) W \, d\varphi \quad \text{and} \quad dE_n = E_n \, d\kappa \]  \hspace{1cm} (56)

The current densities \( \sigma_s \) and \( \sigma_r \) of the fundamental particles are proportional to their velocities \( v_s \) and \( v_r \).

\[ \sigma_s = \varrho_s \, v_s \quad \text{and} \quad \sigma_r = \varrho_r \, v_r \]  \hspace{1cm} (57)

The energy of a BSP is stored in the rotational momentum of the emitted and regenerating fundamental particles. The energy of a BSP is continuously transferred from the LRM of the emitted FP to the LRM and TRM of the regenerating FP. The
energy flows continuously from FPs with one velocity to FPs with the other velocity \((v_h / v_l)\).

The equation to calculate the energy \(E_p\) from \(E_s\) and \(E_n\) is

\[
E_p = \frac{E_o}{E_s} \sqrt{E_s} \sqrt{E_n}
\]

(58)

2.8.1 Common angular velocity \(\nu_g\) for all FPs.

If we assume that the longitudinal and transversal angular momenta of the regenerating fundamental particles from an isolated basic subatomic particle have a common angular velocity \(\nu_g\) we get

\[
\Delta E_e = \nu_g J_e \quad \Delta E_s = \nu_g J_s \quad \Delta E_n = \nu_g J_n
\]

(59)

\[
E_e = \nu_g \sum_i J_{ei} \quad E_s = \nu_g \sum_i J_{si} \quad E_n = \nu_g \sum_i J_{ni}
\]

(60)

where \(N_e, N_s\) and \(N_n\) are the corresponding numbers of \(\Delta E_e, \Delta E_s\) and \(\Delta E_n\).

The concept is shown in Fig. 17.

---

Figure 17: Spacial representation of L-(\(J_e\)) and T-(\(J_n\)) rotational momentum
If we now define equivalent rotational momenta $J$, $J_o$ and $J_p$ so that we obtain

$$E = \nu_g J \quad E_o = \nu_g J_o \quad E_p = \nu_g J_p$$  \hspace{1cm} (61)$$
and that

$$E = E_e = E_s + E_n = \sqrt{E_o^2 + E_p^2} = \nu_g \sqrt{J_o^2 + J_p^2} = \nu_g J = \nu_g \sum J_e$$  \hspace{1cm} (62)$$
then we get

$$J = \sqrt{J_o^2 + J_p^2} \quad \text{and} \quad J = \sum J_e = \sum J_s + \sum J_n$$  \hspace{1cm} (63)$$
a relation between the orthogonal rotational momenta $J_s$ and $J_n$ of the regenerating FP and the equivalent rotational momenta $J$, $J_o$ and $J_p$ of the basic subatomic particle.

If we consider the axial symmetry of the rotational momentum $\bar{J}_n$ we obtain the vector sum

$$\sum \bar{J}_n = 0$$  \hspace{1cm} (64)$$
Also for $v = 0$ the vector sum of $\bar{J}_s$ is

$$\sum \bar{J}_s = 0$$  \hspace{1cm} (65)$$
If all FPs have the same angular momentum $J_{FP}$ we get

$$J = N_e J_{FP} = N_s J_{FP} + N_n J_{FP} \quad \text{and} \quad N_e = N_s + N_n$$  \hspace{1cm} (66)$$
where now $N_e$ is the number of the total emitted FPs, $N_s$ the number of the total regenerating FPs with longitudinal angular momenta and $N_n$ the number of the total regenerating FPs with Transversal angular momenta.

For the energy we have

$$\nu_g J = N_e J_{FP} \nu_g = N_s J_{FP} \nu_g + N_n J_{FP} \nu_g \quad \text{or} \quad E = E_e = E_s + E_n$$  \hspace{1cm} (67)$$
where $E_{FP} = J_{FP} \nu_g$ is the energy of one FP.
2.8.2 Common angular momentum \( J_g \) for all FPs.

If we assume that the longitudinal and transversal angular momenta of the regenerating fundamental particles from an isolated basic subatomic particle are all equal to a common angular momentum \( J_g \) we get

\[
\Delta E_e = J_g \nu_e \quad \Delta E_s = J_g \nu_s \quad \Delta E_n = J_g \nu_n
\]

(68)

and

\[
E_e = J_g \sum_i N_e \nu_{e_i} \quad E_s = J_g \sum_i N_s \nu_{s_i} \quad E_n = J_g \sum_i N_n \nu_{n_i}
\]

(69)

where \( N_e, N_s \) and \( N_n \) are the corresponding numbers of \( \Delta E_e, \Delta E_s \) and \( \Delta E_n \).

If we define equivalent angular frequencies \( \nu, \nu_o \) and \( \nu_p \) so that we obtain

\[
E = J_g \nu \quad E_o = J_g \nu_o \quad E_p = J_g \nu_p
\]

(70)

and

\[
E = E_e = E_s + E_n = \sqrt{E_o^2 + E_p^2} = J_g \sqrt{\nu_o^2 + \nu_p^2} = \nu J_g
\]

(71)

then we get

\[
\nu = \sqrt{\nu_o^2 + \nu_p^2} \quad \text{and} \quad \nu = \sum_i \nu_{e_i} = \sum_i \nu_{s_i} + \sum_i \nu_{n_i}
\]

(72)

a relation between the angular frequencies \( \nu_s \) and \( \nu_n \) of the regenerating FP and the equivalent angular frequencies \( \nu, \nu_o \) and \( \nu_p \) of the basic subatomic particle.

If all FPs have the same angular frequency \( \nu_{FP} \) we get

\[
\nu = N_e \nu_{FP} = N_s \nu_{FP} + N_n \nu_{FP} \quad \text{and} \quad N_e = N_s + N_n
\]

(73)

where now \( N_e \) is the number of the total emitted FPs, \( N_s \) the number of the total regenerating FPs with longitudinal angular momenta and \( N_n \) the number of the total regenerating FPs with Transversal angular momenta.

For the energy we have

\[
\nu J_g = N_e \nu_{FP} \quad J_g = N_s \nu_{FP} J_g + N_n \nu_{FP} J_g \quad \text{or} \quad E = E_e = E_s + E_n
\]

(74)
where \( E_{FP} = \nu_{FP} J_s \) is the energy of one FP.

### 2.9 Definition of regenerating fundamental particles.

As *regenerating fundamental particles* of a BSP that moves with constant velocity \( v \) in a space that is not influenced by other BSPs, we define those FPs of the space that comply with the following requirements:

1. they are of the opposite type compared with the emitted FPs. This means, that they have from the two possible velocities \( v_h \) or \( v_l \) the opposite one.

2. they move in the direction in which they meet emitted FPs with the same velocity \( v_s \) and under the same angle \( \alpha \) from \( r_r = \infty \) to \( r_r = r_o \), where \( r_o \) is the radius of the nucleus of the basic subatomic particle.

The concept is shown on Fig. 18.

![Figure 18: Regeneration of a particle at \( t = 0 \) due to emissions at \( t_2 < 0 \) and \( t_1 < 0 \)](image)

The probability to meet in the space fundamental particles that comply with the first requirement is

\[
 w_o = 1
\]
The emitted FPs that the *regenerating particles* meet at the trajectory to the nucleus of the BSP, were emitted by the same BSP during the time \( t = -\infty \) to \( t = 0 \). The LRM\( s \) \( J_s \) and TRM\( s \) \( J_n \) that are generated on the regenerating FPs when they meet with the emitted FPs at the trajectory to the nucleus of the BSP are all identic. These regenerating FPs transport with their rotational momentums the energy that regenerates the basic subatomic particle.

Fundamental particles of the opposite type than the emitted one, that move in other directions, meet on their trajectory emitted FPs that have different velocities \( v_s \) and under different angles \( \alpha \). The generated LRM\( s \) and TRM\( s \) on these trajectories are not identic and don’t contribute to the regeneration of the basic subatomic particle.

The exchange of energy between emitted and regenerating FPs is given by the following equation

\[
\nu g J_e = \nu g J_s + \nu g J_n
\]  

with \( J_e \) the longitudinal rotational momentum of the emitted FP and \( \nu \) the common angular velocity.

For \( v = 0 \) only the FPs of the opposite type than the emitted FPs that move on radial trajectories to the nucleus of the basic subatomic particle, meet permanently emitted FPs with the same velocity \( v_s = v_e \) and under the same angle \( \alpha = \pi \).

Only on those FPs of the opposite type that move on radial trajectories to the nucleus of the basic subatomic particle, identical regenerating LRM\( s \) are produced along their trajectory, while on those FPs that move in other directions different LRM\( s \) are produced along their trajectory.

It is important to note, that while the FPs of the other type are equally distributed in the space and the probability to meet them is therefor \( w_o = 1 \), the regenerating FPs with the LRM \( J_s \) and TRM \( J_n \) move on radial trajectories to the BSP and the probability to meet them is therefor

\[
w_r = \frac{r_o}{r^2} dr_r
\]  

2.10 Requirements for the generation of linear momentum \( \bar{p} \) on basic subatomic particles (BSPs).

The requirements that must be fulfilled by rotational momentums of fundamental particles to generate linear momentum \( \bar{p} \) on a BSP are:

1. The rotational momentums must form pairs with the same amplitude and with parallel but opposed angular velocities.
2. The direction orthogonal (normal) to the plane that contains the opposed angular momentums and that goes through the center of the circle to which the opposed rotational momentums are tangential, must go also through the BSP.

The concept is shown on Fig. 19.

![Figure 19: Symmetry requirements for generation of linear momentums](image)

**Note:** The generation of linear momentum out of a pair of opposed angular momentum is similar to what can be observed when a cyclone and a anticyclone meet.

The pair of opposed transversal rotational momentum from a BSP that moves with constant velocity $v$, comply with the requirements for the generation of linear momentum $p$ in the direction of the velocity $v$.

**Note:** Isolated FPs have only angular momenta, they have no linear momenta. Linear momentum is the product of the energy stored in FPs with opposed angular momentum as previously defined. When FPs meet in space they interact changing the orientation of their angular momenta.

The concept is shown on Fig. 20.
2.11 Energy balance and rotational momentum balance between FPs of a BSP that moves with constant \( v \).

2.11.1 Energy conservation

The energy flow between the fundamental particles of a basic subatomic particle must not violate the energy conservation principle.

The total energy of a basic subatomic particle that moves with constant velocity \( v \) must remain unchanged. This means that the energy stored in the longitudinal rotational momentum \( J_e \) of an emitted FP must be transferred to the rotational momentums of the regenerating FP when they meet and regenerate the BSP. This means that

\[
\nu_g J_e = \nu_g J_s + \nu_g J_n \quad (78)
\]

The concept is shown on Fig. 21.
2.11.2 Conservation of the rotational momentum.

To demonstrate the conservation of the rotational momentums we assume that all the rotational momentums of the FPs that participate on the flow of energy of a BSP that moves with constant velocity \( v \) have the same angular velocity \( \nu \).

We make use of the function \( d\kappa(\varphi) = d\kappa(\pi - \varphi) \) and write

\[
dE = \nu_g J_e = E \ d\kappa(\varphi) = E \ d\kappa(\pi - \varphi) = \nu_g J'_e \quad J_e = J'_e \quad (79)
\]

\[
dE_s = \nu_g J_s = E_s \ d\kappa(\varphi) = E_s \ d\kappa(\pi - \varphi) = \nu_g J'_s \quad J_s = J'_s \quad (80)
\]

\[
dE_n = \nu_g J_n = E_n \ d\kappa(\varphi) = E_n \ d\kappa(\pi - \varphi) = \nu_g J'_n \quad J_n = J'_n \quad (81)
\]
For a plane that contains the axis of the axial-symmetric configuration we have

\[ \bar{J}_e = -\bar{J}_e' \quad \bar{J}_s = -\bar{J}_s' \quad \bar{J}_n = -\bar{J}_n' \]  

(82)

The whole process is dynamic where at the same instant opposed rotational momentums are generated and annihilated, so that the sum of all rotational momentums remain equal zero. At the nucleus, opposed \( \bar{J}_e \) rotational momentums are generated while at the same instant opposed \( \bar{J}_r \) rotational momentums are transformed in opposed \( \bar{J}_s \) and \( \bar{J}_n \) rotational momentums. At the same instant during the regeneration of the nucleus, opposed \( \bar{J}_s \) and \( \bar{J}_n \) rotational momentums are annihilated.

Note: There is a strong coupling between the opposed rotational momentums \( \bar{J} \), so that they are generated and annihilated at the same instant, independent of the distance between them (entanglement).

2.11.3 Conservation of the linear momentum \( p \).

The linear momentum \( p \) is a measurable variable of a BSP, generated by rotational momentums of the regenerating fundamental particles of the BSP when they fulfill the requirements for generation of linear momentum. The conservation of linear momentum has no validity for fundamental particles. They maintain, according to their definition the direction and velocity when they meet with other fundamental particles.

2.12 Basic subatomic particles that move with light speed.

2.12.1 Energy and linear momentum of a basic subatomic particle that moves with light speed.

Up to now we have seen basic subatomic particles that move with velocities smaller than the speed of light.

We start with the energy equation of a basic subatomic particle.

\[ dE = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} \left[ \frac{c}{2 v} \right] \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \times W \, d\varphi \]  

(83)

with

\[ \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}} = E_s + E_n \quad \text{and} \quad W = 1 \]  

(84)

and
\[ E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \quad \text{and} \quad E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \quad (85) \]

with

\[ E_o = m \ c^2 \quad \text{and} \quad E_p = \frac{m \ v}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (86) \]

and we define that for \( v \to c \) and the rest masse \( m \to 0 \)

\[ \lim_{m \to 0} \frac{m}{\sqrt{1 - \frac{v^2}{c^2}}} = m_c \quad (87) \]

with \( m_c \) the masse at light velocity.

We obtain, that

\[ E_o \to 0 \quad \text{and} \quad E_p \to m_c \ c^2 \quad (88) \]

and

\[ E_s \to 0 \quad \text{and} \quad E_n \to m_c \ c^2 \quad (89) \]

For \( v \to c \) the longitudinal rotational momentum \( \vec{J}_s \to 0 \) and only the transversal rotational momentum \( \vec{J}_n \) remain. The total energy of a basic subatomic particle with light speed is stored in the transversal rotational momentum. Longitudinal rotational momentums don’t exist and the particle does not emit FPs and is not regenerated by FPs. The transversal rotational momentums fulfill the requirements for generation of linear momentum in the direction of propagation or opposed to it. Due to the non existence of longitudinal rotational momentums they can simultaneously fulfill the requirements for generation of linear momentum in a direction that is transversal to the propagation direction.

An equivalent representation for the transversal rotational momentums responsible for the linear momentum \( p_c \| \) parallel to the propagation direction, is its tangential arrangement on a ring that is in a plane orthogonal to the propagation direction. The concept is shown in Fig. 22.

The vector sum of the transversal rotational momentums along the ring, that we designate with \( 0 \| \) must give zero. So we have that

\[ \sum_{0\|} \vec{J}_n = 0 \quad \text{and} \quad E_c \| = m_c \ c^2 = \oint_{\|} dE_n = \sum_{0\|} \nu_u \ J_n \quad (90) \]

The linear momentum is
An equivalent representation for the transversal rotational momentums responsible for the linear momentum \( p_c \) orthogonal to the propagation direction, is its tangential arrangement on a ring that is in a plane that contains the propagation direction.

The vector sum of the transversal rotational momentums along the ring, that we designate with \( 0 \) must give zero. So we have that

\[
\sum_{0} \tilde{J}_n = 0 \quad \text{and} \quad E_{c}^{\perp} = m_c \frac{1}{c} \int dE_n = \sum_{0} \nu_u J_n
\]  

The linear momentum is

\[
p_{z} = p_c^{\perp} = m_c \frac{1}{c} \oint dE_n
\]
\[ p_c^\perp = m_c^\perp \, c = \frac{1}{c} \oint dE_n \]  

For the total energy and the total linear momentum we have that

\[ [E_c]^2 = [E_c^\parallel]^2 + [E_c^\perp]^2 \quad [p_c]^2 = [p_c^\parallel]^2 + [p_c^\perp]^2 \]  

with

\[ [m_c]^2 = [m_c^\parallel]^2 + [m_c^\perp]^2 \]  

**Note.** The defined basic subatomic particles that move with light speed don’t emit and are not regenerated by fundamental particles. Their existence is independent from the space in which they move. The potential linear momentum they transport can be oriented in moving direction, opposed to the moving direction or orthogonal to the moving direction. They are not photons. Photons will be defined as complex subatomic particles that move with light speed.

### 2.12.2 Complex subatomic particles that move with light speed.

Complex subatomic particles that move with light speed (photons) are generated when negative basic subatomic particles (electrons) of an atom change to a lower energy level. The energy difference is stored in the transversal rotational momentum \( J_n \) of basic subatomic particles that move with light speed. A complex subatomic particle that moves with light speed consists of at least two basic subatomic particles that move with light speed, separated by a distance of \( \frac{\lambda}{2} \) in propagation direction. The two basic subatomic particles differ in their potential transversal linear momentums \( p_c^\perp \), that are opposed.

The longitudinal linear momentum \( p_c^\parallel \) is responsible for the particle character, while the opposed transversal linear momentums at the distance \( \frac{\lambda}{2} \) define the wave character of the complex subatomic particle that move with light speed (photon).

The concept is shown on Fig. 22.

### 2.13 Polarization of basic subatomic particles.

We have seen that the basic subatomic particles emit fundamental particles in all directions and are regenerated by fundamental particles of the opposed type from all directions.

To calculate the total energy or the total linear momentum we have to ingrate over
the angle \( \varphi \) from 0 to \( \pi \), and over the angle \( \gamma \) from 0 to 2 \( \pi \) as shown in Fig. 17.

The integration over the angle \( \gamma \) is not necessary with non polarized basic subatomic particles because of the rotational symmetry of these particles.

The polarized basic subatomic particles have an axial symmetry and the integrations over the angle \( \varphi \) or the angle \( \gamma \) are limited to part of the whole intervals, because over the remaining intervals the integrations are zero.

The following polarizations (spins) are possible:

1. Longitudinal polarization, when the integration over the angle \( \gamma \) can be limited to part of the whole interval.
2. Transversal polarization, when the integration over the angle \( \varphi \) can be limited to part of the whole interval.
3. Longitudinal and transversal polarization, when both integrations can be limited to part of the whole intervals.
4. Complex polarization, when the relation between \( \gamma \) and \( \varphi \) is given by a complex function.

### 2.14 Determination of the probability function \( W \) for basic subatomic particles.

The emitted fundamental particles expand with constant velocity in the space around the nucleus of the basic subatomic particle.

The density is therefore invers proportional to the square distance to the nucleus of the basic subatomic particle.

The density of the emitted beam of fundamental particles is because of the radial symmetry given by

\[
\rho_e = \frac{r_o}{r_e^2}
\]

Fundamental particles of the opposed type are equally distributed in the neutral space and the probability to meet them is

\[
w_o = 1
\]

The probability that fundamental particles of the emitted beam meet with fundamental particles of the opposed type in the neutral space in the volume
\[ dV = dr_e r_e d\varphi \ r_e \sin \varphi \ d\gamma \]  

(98)

and regenerate the basic subatomic particle is

\[ w = w_e w_o \quad \text{with} \quad w_e = \frac{r_o}{r_e^2} \ dr_e \]  

(99)

For a basic subatomic particle that moves with constant speed \( v \) in a neutral space the probability \( W \) that the emitted fundamental particles meet with fundamental particles of the opposed type is \( W = 1 \). This results from the consideration that the energy of the emitting basic subatomic particle at \( x = 0 \) and the energy of the basic subatomic particle that is regenerated at the distance \( x = vt \) is the same.

The integration of the probability along the emitted beam is given by

\[ W = \int_{r_o}^{\infty} w = \int_{r_o}^{\infty} \frac{r_o}{r_e^2} \ dr_e = 1 \]  

(100)

A basic subatomic particle that moves with the velocity \( v \) is regenerated at \( t = 0 \) by its emitted fundamental particles from \( t = -\infty \) to \( t = 0 \). The probability that fundamental particles meet in the defined volume \( dV \) is expressed as a time function by

\[ w = w_e w_o = \frac{(v_e t_o)}{(v_e t_s)^2} \ d(v_e t_s) \]  

(101)

with

\( v_e t_o = r_o \) Radius of the nucleus of the BSP  
\( v_e t_s = r_e \) Length of the emitted ray  
\( v_e \ dt_s = dr_e \)

Note: \( t_s = t_e \) for all BSP.

The concept is shown in Fig. 23.  
See also Fig. 18.

We define that inside the radius \( r_o \) of the nucleus of the BSP there are no emitted fundamental particles and that the probability to meet them there is zero. The time integration along the emitted beam is

\[ W = \int_{-\infty}^{-t_o} \frac{(v_e t_o)}{(v_e t_s)^2} \ d(v_e t_s) = 1 \]  

(102)

If we introduce the probability function in the equation for the energy
Figure 23: Space diagram showing the regeneration of a particle at \( vt = 0 \)
due to emissions at \( vt \) and \( vt' \)

\[
dE = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{c}{2v} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| \ W \ d\varphi \tag{103}
\]

we get

\[
dE = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{c}{2v} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| \int_{r_o}^{\infty} \frac{r_o}{r_c^2} dr_c \ d\varphi \tag{104}
\]

The linear momentum is given by

\[
dp = \frac{v}{c^2} \ dE \tag{105}
\]

2.15 Specific energy of a basic subatomic particle that moves with constant \( v \).

We start with the expression
\[ dE = E \, d\kappa \]  

(106)

with

\[ d\kappa = \frac{c}{2 \, v} \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \left| \frac{r_o}{r_r^2} \right| \, dr_r \, d\varphi \, \frac{d\gamma}{2\pi} \]  

(107)

For accelerating and decelerating BSPs we have for \( v \ll c \) that \( \varphi \approx \psi \) and \( r_s \approx r_r \).
For differences between accelerating and decelerating BSPs see Fig. 13 and Fig. 15.

We also have that

\[ v_s \approx v_c \quad \text{and} \quad \sin \alpha \approx \frac{v}{c} \sin \varphi \]  

(108)

We get

\[ d\kappa \approx \frac{1}{2} \frac{r_o}{r_r^2} \, dr_r \, \sin \varphi \, d\varphi \, \frac{d\gamma}{2\pi} \]  

(109)

With

\[ dr_\psi = r_r \, d\varphi \quad h = r_r \, \sin \varphi \quad dV = dr_r \, dr_\psi \, h \, d\gamma \]  

(110)

we get for the specific energy

\[ \frac{dE}{dV} = \frac{E}{4\pi} \frac{r_o}{r_r^4} \quad \text{for} \quad v \ll c \]  

(111)

The energy density varies only with the distance \( r_r \). There is no influence on the energy density distribution due to the speed \( v \).

2.16 Definition of the magnitudes \( dH_s \) and \( dH_n \).

We start with the expressions

\[ E = E_s + E_n \quad \text{and} \quad dE = dE_s + dE_n \]  

(112)

with

\[ dE_s = E_s \, \frac{c}{2 \, v} \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \left| \frac{r_o}{r_r^2} \right| \, w \, d\varphi \quad \text{and} \quad dE_s = E_s \, d\kappa \]  

(113)

and
\[ dE_n = E_n \frac{c}{2\nu} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| w \, d\varphi \quad \text{with} \quad dE_n = E_n \, d\kappa \quad (114) \]

with

\[ d\kappa = \frac{c}{2\nu} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| w \, d\varphi \quad dE = E \, d\kappa \quad (115) \]

We define the magnitudes

\[ dH_s = H_s \, d\kappa \quad \text{and} \quad dH_n = H_n \, d\kappa \quad (116) \]

with

\[ H_s^2 = E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \quad \text{and} \quad H_n^2 = E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \quad (117) \]

We define also the variable \( H \) so that

\[ H^2 = H_s^2 + H_n^2 \quad \text{with} \quad H^2 = E \quad (118) \]

For the longitudinal components at a point in the space we get

\[ dE = H^2 \, d\kappa = \nu \, J_e \quad dH = H \, d\kappa \quad (119) \]

\[ dE_s = H_s^2 \, d\kappa = \nu \, J_s \quad dH_s = H_s \, d\kappa \quad (120) \]

and for the transversal component we get

\[ dE_n = H_n^2 \, d\kappa = \nu \, J_n \quad dH_n = H_n \, d\kappa \quad (121) \]

Note:

\[ \left[ dH \right]^2 = \nu \, J_e \, d\kappa = dE \, d\kappa \neq dE \quad \left[ dH_s \right]^2 = \nu \, J_s \, d\kappa = dE_s \, d\kappa \neq dE_s \quad (122) \]

\[ \left[ dH_n \right]^2 = \nu \, J_n \, d\kappa = dE_n \, d\kappa \neq dE_n \quad dH \neq dH_s \, dH_n \quad (123) \]

For a particle moving with \( \nu \ll c \) we have

\[ E_s \approx E_o \quad E_n \approx \frac{p^2}{m} \quad H_s \approx \sqrt{m} \, c \quad H_n \approx \frac{p}{\sqrt{m}} \quad (124) \]
and

\[ dH_n = H_n \, d\kappa = \frac{p}{\sqrt{m}} \, d\kappa \quad \Rightarrow \quad p = \sqrt{m} \int dH_n \]  \hspace{1cm} (125)\\

with \( \int_s \) the spatial integral. From the last expression we see that \( dH_n \) is a measure of the linear momentum \( p \) of a particle.

If two fundamental particles from two BSPs cross, their longitudinal rotational momentums generate, according to postulate 6, the following transversal rotational momentum.

\[ \bar{J}_{n_2}^{(s)} = \text{sign}(\bar{J}_{e_1}) \, \text{sign}(\bar{J}_{e_2}) \left( \sqrt{J_{e_1}} \, \bar{e}_1 \times \sqrt{J_{e_2}} \, \bar{s}_2 \right) \]  \hspace{1cm} (126)\\

If we multiply both sides of the equation with \( \sqrt{\nu_{e_1}} \, d\kappa_1 \) and \( \sqrt{\nu_{s_2}} \, d\kappa_2 \) and take the absolute value we get

\[ dE_{n_2}^{(s)} = \left| \sqrt{\nu_{e_1}} \frac{J_{e_1}}{J_{e_1}} d\kappa_1 \, \bar{e}_1 \times \sqrt{\nu_{s_2}} \frac{J_{s_2}}{J_{s_2}} d\kappa_2 \, \bar{s}_2 \right| \]  \hspace{1cm} (127)\\

or

\[ dE_{n_2}^{(s)} = \left| dH_{e_1} \, \bar{e}_1 \times dH_{s_2} \, \bar{s}_2 \right| \quad \text{with} \quad dH_{s_i} \, \bar{s}_i = \sqrt{\nu_{s_i}} \frac{J_{s_i}}{J_{s_i}} d\kappa_1 \, \bar{s}_i \]  \hspace{1cm} (128)\\

If at the same time two other fundamental particles from the same two BSPs generate a transversal rotational momentum \(-\bar{J}_{n_2}^{(s)}\), so that the pair complies with the symmetry requirements for generation of linear momentum, we get for the linear momentum on the two BSPs

\[ dp = \frac{1}{c} \, dE_{p}^{(s)} \quad \text{with} \quad dE_{p}^{(s)} = \left| \int_{r_1}^{\infty} dH_{e_1} \, \bar{e}_1 \times \int_{r_2}^{\infty} dH_{s_2} \, \bar{s}_2 \right| \]  \hspace{1cm} (129)\\

If two fundamental particles from two BSPs cross, their transversal rotational momentums generate, according to postulate 7, the following rotational momentum.

\[ \bar{J}_2^{(n)} = \text{sign}(\bar{J}_{e_1}) \, \text{sign}(\bar{J}_{e_2}) \left( \sqrt{J_{n_1}} \, \bar{n}_1 \times \sqrt{J_{n_2}} \, \bar{n}_2 \right) \]  \hspace{1cm} (130)\\

If we multiply both sides of the equation with \( \sqrt{\nu_{n_1}} \, d\kappa_1 \) and \( \sqrt{\nu_{n_2}} \, d\kappa_2 \) and take the absolute value we get

\[ dE_1^{(n)} = \left| dH_{n_1} \, \bar{n}_1 \times dH_{n_2} \, \bar{n}_2 \right| \quad \text{with} \quad dH_{n_i} \, \bar{n}_i = \sqrt{\nu_{n_i}} \frac{J_{n_i}}{J_{n_i}} d\kappa_1 \, \bar{n}_i \]  \hspace{1cm} (131)
If at the same time two other fundamental particles from the same two BSPs cross, and their transversal rotational momentum generate a rotational momentum $-\bar{J}^{(n)}_2$, so, that the pair complies with the symmetry requirements for generation of linear momentum, we get for the linear momentum on the two BSPs

$$dp = \frac{1}{c} dE_p^{(n)} \quad \text{with} \quad dE_p^{(n)} = \left| \int_{r_{r_1}}^{\infty} dH_{n_1} \bar{n}_1 \times \int_{r_{r_2}}^{\infty} dH_{n_2} \bar{n}_2 \right|$$ (132)

### 2.16.1 Relations between fields from standard physics and the $dH$ fields.

The energy densities for the electric and the magnetic fields from standard physics are:

$$\omega_e = \frac{1}{2} E D = \frac{1}{2} \varepsilon_o E^2 \quad \omega_m = \frac{1}{2} H B = \frac{1}{2} \mu_o H^2$$ (133)

**Note:** Bold letters are used for the fields from standard physics.

For the fields of the present theory, the corresponding energy densities are:

$$\omega_s = \frac{dE_s}{dV} \quad \omega_n = \frac{dE_n}{dV} \quad \text{with} \quad dV = r^2 dr \sin \varphi \, d\varphi \, \frac{d\gamma}{2\pi}$$ (134)

With

$$dH_s = \sqrt{dE_s} \, d\kappa \quad \text{and} \quad dH_n = \sqrt{dE_n} \, d\kappa$$ (135)

we get with $\omega_e = \omega_s$ and $\omega_m = \omega_n$

$$dH_s = \sqrt{\frac{1}{2} \varepsilon_o dV} \, d\kappa \, \mathbf{E} \quad \text{and} \quad dH_n = \sqrt{\frac{1}{2} \mu_o dV} \, d\kappa \, \mathbf{H}$$ (136)

**Note:** The fields from standard physics generate the forces on charged particles directly while the $dH$ fields from the present approach require pairs of opposed $dH$ components to generate forces (see sec. 2.10).
3 Laws that describe the interactions at static basic subatomic particles.

In this section the linear momentum at two static BSPs that are separated by the distance \( d \) is deduced and the quantized momentum time \( \Delta t \) and the potential energy are calculated.

The general form of the Coulomb-law is deduced and the range is shown where it coincides with the classic Coulomb-law.

The induction between two static BSPs is derived and the energy-, angular and linear momenta balance presented.

The energy of the transversal angular momenta of FPs of a straight infinite conductor, and the current flow for a constant mass-current \( I_m \) are calculated. Subsequently, the linear momentum on two parallel straight conductors at the distance \( d \) and the general form of the Ampere-law are derived. The range is shown where the general Ampere-law coincides with the classic Ampere-law.

After calculation of the quantized momentum time \( \Delta t \) for two straight conductors and comparing it with the quantized momentum time \( \Delta t \) for two static BSPs, the coincidence in the range \( d \gg r_o \) is shown, where \( r_o \) is the radius of a BSP.

The force (Lorentz) on a BSP that moves with constant speed through a field of oriented transversal angular momenta and the force on a complex SP through the same field is explained.

Finally a classification of particles and fields is presented.

3.1 Linear momentum at two basic subatomic particles.

At an isolated basic subatomic particle with \( v = 0 \) the angle \( \alpha \) between emitted and regenerating fundamental particles is \( \alpha = \pi \) and no transversal rotational momentum \( J_n \) is generated. If there are two static basic subatomic particles at a distance \( d \), the emitted fundamental particles of one BSP will cross with the regenerating fundamental particles of the other BSP and their longitudinal rotational momentums will generate opposed transversal rotational momentums according to postulate 6. Because of the symmetry shown on Fig. 24, the opposed transversal rotational momentums \( J_n \) are generated at different but symmetric rays. These transversal rotational momentums have different magnitudes along a ray of regenerating fundamental particles because of the changing angle \( \beta \) along the ray, but all have the same rotational sense. The concept is shown on Fig. 24.
Figure 24: Generation of rotational momentums at regenerating fundamental particles of two static basic subatomic particles at the distance \( d \)

The generated opposed transversal rotational momentums \( \vec{J}^{(s)}_{n_2} \) at the regenerating rays of BSP 2 comply with the requirements for generation of linear momentum at BSP 2. The direction of the linear momentum coincides with the connection line between the two basic subatomic particles.

According postulate 6 it is

\[
\vec{J}^{(s)}_{n_2} = \text{sign}(\vec{J}_{e_1}) \text{sign}(\vec{J}_{e_2}) \left( \sqrt{J_{e_1}} \hat{e}_1 \times \sqrt{J_{s_2}} \hat{s}_2 \right) \quad (137)
\]

The sign of the linear momentum is given with

\[
\text{sign}(d\vec{p}_2) = - \text{sign}(\vec{J}^{(s)}_{n_2}) \quad (138)
\]

To calculate the energy \( dE_p^{(s)} \) that allows to calculate the linear momentum \( dp \), we start with the energy equation for longitudinal rotational momentum \( J_s \) of a BSP that moves with the velocity \( v \).
\[ dE_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \frac{c}{2v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| w_e \, d\varphi \] (139)

with

\[ w_e = \frac{r_o}{r^2_e} \, dr_e \quad \text{and} \quad E_o = m \, c^2 \] (140)

For \( v = 0 \) we have that \( v_s = v_e \) and that

\[ \lim_{v \to 0} \frac{\sin \alpha}{v} = \frac{1}{c} \sin \varphi \] (141)

We obtain

\[ dE_s = E_o \frac{1}{2} w_e \sin \varphi \, d\varphi = E_o \, d\kappa \] (142)

For \( v = 0 \) we also have, that

\[ r_e = r_r \quad dr_e = dr_r \quad \varphi = \psi \quad d\varphi = d\psi \] (143)

and we can write \( dE_s \) as follows

\[ dE_s = E_o \frac{1}{2} w_r \sin \psi \, d\psi = E_o \, d\kappa \] (144)

Now we write the expression for the variable \( dH_s \)

\[ dH_s = H_s \frac{1}{2} \frac{r_o}{r^2} \, dr_r \sin \psi \, d\psi \quad \text{with} \quad H_s = \sqrt{E_o} \] (145)

Through the area \( dA \) at the distance \( r_r \) defined by the differential angles \( d\psi \) and \( d\gamma \) of the torus with vertex at the BSP

\[ dA = r_r \sin \psi \, r_r \, d\psi \, d\gamma \] (146)

flows at each moment all the fundamental particles that the regenerating ray has stored from \( r_r \) to \( r_r = \infty \).

\[ \int_{r_r}^{\infty} dH_s \quad \text{with } \psi \text{ and } d\psi = \text{constant} \] (147)

The same is valid for the fundamental particles stored by the emitting ray and we can write
\[ \int_{r_1}^{\infty} dH_e \quad \text{with} \quad dH_e = H \, d\kappa = \sqrt{E_o} \, d\kappa \quad (148) \]

If we have two basic subatomic particles whose stored fundamental particles meet at the distances \( r_1 \) and \( r_2 \), we get for the energy contribution responsible for the linear momentum at BSP 2

\[ dE^{(s)}_p = \left| \int_{r_1}^{\infty} dH_{e1} \, \vec{s}_1 \times \int_{r_2}^{\infty} dH_{s2} \, \vec{s}_2 \right| \quad (149) \]

and the linear momentum is given by

\[ dp_2 \, \vec{s}_R = \frac{a}{c} \oint_R \left\{ \frac{\vec{d}l \cdot (\vec{s}_1 \times \vec{s}_2)}{2\pi R} \int_{r_1}^{\infty} H_{e1} \, d\kappa_{r_1} \int_{r_2}^{\infty} H_{s2} \, d\kappa_{r_2} \right\} \, \vec{s}_R \quad (150) \]

**Note:** The dimensionless equalization factor \( a = 8.7743 \cdot 10^{-2} \) is introduced at this point to make in sec. 8.1 the product \( E_o \Delta \Delta t \) exactly equal the Planck constant \( \hbar \).

The magnitudes \( dH_{e1} \) and \( dH_{s2} \) must refer to the same volume \( dV \) in which they meet and in which they generate the transversal rotational momentum. In this special case of symmetry the requirement is fulfilled, because of the coincidence of the two toruses of the BSPs, by the following relation between the two areas.

\[ dr_1 \, r_1 \, d\psi_1 = dr_2 \, r_2 \, d\psi_2 \quad (151) \]

The concept is shown in Fig. 25

---

Figure 25: Geometric relations for the calculation of the linear momentum between two static basic subatomic particles at a distance \( d \)
The contribution to the linear momentum of the BSP 2 due to the ring-shaped volume \( dV \) is

\[
dp_2 = \frac{1}{c} \, dE_p^{(s)}
\]  

(152)

We obtain the total linear momentum for the BSP 2 by integrating over the whole space. For the integration over \( d\psi_1 \) and \( d\psi_2 \) we must consider the minimum and maximum integration limits defined by the radii of the two BSPs and the distance \( d \). The limits are given by

\[
\psi_{\text{min}} = \arcsin \frac{r_o}{d} \quad \psi_{\text{max}} = \pi - \psi_{\text{min}} \quad d \geq \sqrt{r_o^2 + r_o^2} \quad \text{(153)}
\]

\[
\psi_{\text{min}} = \arccos \frac{d}{2r_o} \quad \psi_{\text{max}} = \pi - \psi_{\text{min}} \quad d < \sqrt{r_o^2 + r_o^2} \quad \text{(154)}
\]

\[
p_2 = \int_{\psi_{\text{min}}^{\psi_{\text{max}}}} \int_{\psi_{\text{min}}^{\psi_{\text{max}}}} dp_2
\]

(155)

The concept is shown in Fig. 26 for the angle \( \varphi \) of the emitted ray.

![Figure 26: Integration limits for the calculation of the linear momentum between two static basic subatomic particles at the distance \( d \)](image)

The force is measured by reversing the distance \( \Delta d \) produced by the linear momentum \( \vec{p}_2 \) in the time \( \Delta t \), applying an external force on the BSP. We can therefore write that \( d\vec{p}_2 = \vec{p}_2 \).

\[
d\vec{F}_2 = - \frac{d\vec{p}_2}{dt} = - \frac{\vec{p}_2}{\Delta t}
\]

(156)

To obtain the total resulting force \( \vec{F} \) we have to integrate along all the regenerating rays of BSP 2.
\[ \tilde{F}_2 = \int_{\sigma} d\tilde{F}_2 \]  

(157)

At large distances beyond the maximum linear momentum of Fig. 27, where the force is given by the Coulomb law, the quantized momentum time \( \Delta t \) is calculated by the ratio between the momentum \( p_2 \) and the Coulomb force between two charges.

\[ \Delta t = \frac{p_2}{F} \quad \text{with} \quad F = \frac{1}{4 \pi \epsilon_0} \frac{Q_1 Q_2}{d^2} \]  

(158)

At short distances before the maximum linear momentum of Fig. 27, we define the quantized momentum time \( \Delta t \) as equal to the quantized momentum time \( \Delta t \) beyond the maximum linear momentum which has the same momentum \( p_2 \).

We note that the probability \( w \) is a function of the radius of the BSP and, therefore also the momentum \( p_2 \) and the time \( \Delta t \) are functions of the radius.

For complex particles that consist of more than one BSP, the force is given by

\[ d\tilde{F}_2 = -\left(\Delta n_1, \Delta n_2\right) \frac{\tilde{p}_2}{\Delta t} \]  

(159)

\[ d\tilde{F}_2 = -\left(\Delta n_1, \Delta n_2\right) \frac{a}{c \Delta t} \left| \int_{r_1}^{\infty} dH_{e_1} \, \bar{s}_1 \times \int_{r_2}^{\infty} dH_{s_2} \, \bar{s}_2 \right| \]  

(160)

with \( \Delta n_i = n_i^+ - n_i^- \) the difference between the number of positive and negative BSPs that form the complex particle \( i \).

For the proton we have \( n^+ = 919 \) and \( n^- = 918 \) with a binding Energy of \( E_{B_{\text{prot}}} = -6.9489 \times 10^{-14} \, \text{J} = -0.43371 \, \text{MeV} \). For the neutron we have \( n^+ = 919 \) and \( n^- = 919 \) with a binding Energy of \( E_{B_{\text{neutr}}} = 5.59743 \times 10^{-14} \, \text{J} = 0.34936 \, \text{MeV} \).

We define the field generated by the complex particle 1 as

\[ dF_F = \frac{d\tilde{F}_2}{\Delta n_2} = -\Delta n_1 \frac{a}{c \Delta t} \left| \int_{r_1}^{\infty} dH_{e_1} \, \bar{s}_1 \times \int_{r_2}^{\infty} dH_{s_2} \, \bar{s}_2 \right| \]  

(161)

with \( dF_F \) the force generated by the complex SP \( \Delta n_1 \) on a BSP at point 2.

3.1.1 Calculations

The results are the same for accelerating and decelerating BSPs.

\[ m_e = 9.1093897 \times 10^{-31} \, \text{kg} \]
\[ q_e = 1.60217733 \times 10^{-19} \, \text{A} \, \text{s} \]
\[ \epsilon_o = 8.85418781762 \cdot 10^{-12} \frac{A \cdot s}{V \cdot m} \]
\[ v_e = c \]
\[ v_r = 10^{30} \frac{m}{s} \]
\[ r_o = 10^{-16} m \]
\[ a = 8.7743 \cdot 10^{-2} \]

Note: Because of the axis symmetry of the Coulomb configuration it is possible to describe the problem without the space variable \( \gamma \). The general form of the distribution function \( d\kappa \) is

\[ d\kappa = \frac{1}{2} \frac{r_o}{r_r^2} dr_r \sin \varphi d\varphi \frac{d\gamma}{2\pi} \] (162)
Fig. 27 shows the calculation for the linear momentum $p$.
For $d = 0$ we have $p = 0$. The linear momentum grows up to his maximum at $d = 2 r_o$ and then decreases proportional to $d^{-2}$.

Figure 27: Linear momentum $p$ between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$
Fig. 28 shows the calculation for the time $\Delta t$.
For $d = 2 r_o$ the time has a minimum and grows then up for $d \to \infty$ to the same value it has for $d = 0$.

![Graph showing the quantized momentum time $\Delta t$ between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$](image)

Figure 28: Quantized momentum time $\Delta t$ between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$
Fig. 29 shows the calculation for the force $F$.

For $d = 0$ the force is $F = 0$. The force grows up to his maximum at $d = 2 r_o$ and then decreases proportional to $d^{-2}$.

Figure 29: Force $F$ between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} m$
Fig. 30 shows the calculation for the potential energy $W$.

For $d = 0$ the potential energy is $W = 0$. The potential energy then grows for $d \to \infty$ to $W_{pot} = 1.6 \cdot 10^{-12} \text{ J}$

Figure 30: Potential energy between two static basic subatomic particles with radius $r_o = 1.0 \cdot 10^{-16} \text{ m}$
Summary of calculations.

The time $\Delta t$ is the same for $d = 0$ and for $d \to \infty$.

$$\Delta t(d = 0) = \Delta t(d \to \infty) \quad (163)$$

The time $\Delta t$ is a function of the radii $r_{o1}$ and $r_{o2}$.

$$\Delta t = K r_{o1} r_{o2} \quad with \quad K = 5.42713 \cdot 10^4 \frac{sec}{m^2} = \text{constant for } d \gg r_o \quad (164)$$

That the force disappears for $d = 0$ means that in the nucleus of an atom the BSPs don’t attract nor repel each other.

The energy necessary to separate two BSPs with the proposed radii $r_o$ and with opposed signs from $d = 0$ to $d = \infty$ is

$$W_{pot} = 1.6 \cdot 10^{-12} J \approx 1.0 GeV. \quad (165)$$

Note: The ionization potential required to separate an orbital electron from its atom is approx. 5.0 eV. The energy of $W_{pot} \approx 1.0 GeV$ shows the difficulty to separate one electron from a neutron, which is composed of equal number of electrons and positrons.

Conclusions.

- As the Coulomb law is only an approximation of the force between two BSPs for distances $d \gg r_o$ we conclude, that the time $\Delta t$ is constant for all distances from $d = 0$ to $d \to \infty$ as long as the radii remain constant. This conclusion is based on the result that the time $\Delta t$ is the same for $d = 0$ and $d \to \infty$ (see Fig. 28).

- The new expression for the Coulomb law is proportional to the mass of the electron or positron. The charge of the electron is used to calculate the quantized momentum time $\Delta t$. The conservation law of charge is replaced by the conservation law of positive $n^+$ and negative $n^-$ BSPs that form a complex SP. As the $n$ are integer numbers, the Coulomb force is quantized.

- As the linear momentum is caused by a pair of regenerating fundamental particles with opposed rotational momentums in the time $\Delta t$, the frequency the fundamental particles arrive to the nucleus of the BSP is $\frac{1}{\Delta t}$.
3.1.2 Complex particles.

Complex particles are formed by basic subatomic particles with distances between them oscillating around zero. All electrons and positrons that form a stable atomic nucleus are in the region left to the maximum of the curve of Fig. 27, where the attracting or repulsing force grows with the distance. Because of the dynamic polarization of an atomic nucleus produced by the electrons and positrons of the nucleus, all electrons or positrons that leave the nucleus are immediately attracted and remain in the nucleus.

Positive BSPs don’t mix with negative BSPs at $d = 0$ because their emitted and regenerating fundamental particles have different rotational momentums and velocities. They can be separated by applying the necessary energy to overcome the maximum linear momentum between them.

We have defined $\Delta n_i = n_i^+ - n_i^-$ as the difference between the number of positive and negative BSPs that form the complex particle $i$. As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{\text{prot}}} = -6.9489 \cdot 10^{-14} \text{ J} = -0.43371 \text{ MeV}$, and for the neutron $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{\text{neutr}}} = 5.59743 \cdot 10^{-14} \text{ J} = 0.34936 \text{ MeV}$.

3.2 The Coulomb-law for two BSPs.

For the static force between two basic subatomic particles with $v = 0$ and therefor $\psi = \varphi$ we get from the previous section

$$F_2 = \int_\sigma \frac{a}{c \Delta t} \left| \int_{r_{r_1}}^\infty dH_{e_1} \bar{s}_1 \times \int_{r_{r_2}}^\infty dH_{s_2} \bar{s}_2 \right| \quad (166)$$

with

$$\int_{r_{r_1}}^\infty dH_{e_1} = \frac{1}{2} \sqrt{m_1 c} \frac{r_{o_1}}{r_{r_1}} \sin \varphi_1 \, d\varphi_1 \quad |\bar{s}_1 \times \bar{s}_2| = \sin \beta \quad (167)$$

and

$$\int_{r_{r_2}}^\infty dH_{s_2} = \frac{1}{2} \sqrt{m_2 c} \frac{r_{o_2}}{r_{r_2}} \sin \varphi_2 \, d\varphi_2 \quad (168)$$

If we put the last two expressions in the first equation and concentrate on a $dF_2$ we get, because of the symmetry

$$dF_2 = \frac{a}{4 \Delta t} \sqrt{m_1} \sqrt{m_2} \frac{c}{r_{o_1}} \frac{c}{r_{o_2}} \frac{r_{o_1}}{r_{r_1}} \frac{r_{o_2}}{r_{r_2}} \sin \beta \, d\varphi_1 \, d\varphi_2 \quad (169)$$

or
\[ dF_2 = K_F \frac{\sin \varphi_1 \sin \varphi_2}{r_1 r_2} \sin \beta \, d\varphi_1 \, d\varphi_2 \quad K_F = \frac{a}{4 \Delta t} \sqrt{m_1} \, \sqrt{m_2} \, c \, r_{o_1} \, r_{o_2} \quad (170) \]

With the following geometric conditions

\[ R = r_1 \sin \varphi_1 \quad R = r_2 \sin \varphi_2 \quad -r_1 \cos \varphi_1 + r_2 \cos \varphi_2 = d \quad (171) \]

we get

\[ r_1 \, r_2 = d^2 \frac{\sin \varphi_1 \sin \varphi_2}{\left[ \sin \varphi_1 \cos \varphi_2 - \sin \varphi_2 \cos \varphi_1 \right]^2} \quad (172) \]

As

\[ \sin \varphi_1 \cos \varphi_2 - \sin \varphi_2 \cos \varphi_1 = \sin(\varphi_1 - \varphi_2) = \sin \beta \quad (173) \]

we obtain for the total force \( F_2 \)

\[ F_2 = \frac{K_F}{d^2} \int_{\varphi_{1 \text{min}}}^{\varphi_{1 \text{max}}} \int_{\varphi_{2 \text{min}}}^{\varphi_{2 \text{max}}} \left| \sin^3(\varphi_1 - \varphi_2) \right| \, d\varphi_2 \, d\varphi_1 \quad (174) \]

With \( \Delta t = K \, r_{o_1} \, r_{o_2} \) and \( r_{o_1} = r_{o_2} \) and \( m_1 = m_2 \) and \( a = 8.7743 \cdot 10^{-2} \) we get

\[ K_F = \frac{a}{4K} \, m \, c = 1.104516 \cdot 10^{-28} \left[ \frac{kg \, m^3}{s^2} \right] \quad \text{with} \quad K = 5.4274 \cdot 10^4 \left[ \frac{s}{m^2} \right] \quad (175) \]

\[ \varphi_{\text{min}} = \arcsin \frac{r_o}{d} \quad \varphi_{\text{max}} = \pi - \varphi_{\text{min}} \quad d \geq \sqrt{r_o^2 + r_o^2} \quad (176) \]

\[ \varphi_{\text{min}} = \arccos \frac{d}{2 \, r_o} \quad \varphi_{\text{max}} = \pi - \varphi_{\text{min}} \quad d < \sqrt{r_o^2 + r_o^2} \quad (177) \]

Eq.(174) is the Coulomb-law expressed in the present approach. We see the inverse proportionality to \( d^2 \). The double integral becomes zero for \( d \to 0 \) because the integration limits approximate each other taking the values \( \varphi_{\text{min}} = \frac{\pi}{2} \) and \( \varphi_{\text{max}} = \frac{\pi}{2} \). For \( d \gg r_o \) the double integral becomes a constant because the integration limits tend to \( \varphi_{\text{min}} = 0 \) and \( \varphi_{\text{max}} = \pi \).

The classic Coulomb-law for the electron is

\[ F_s = \frac{1}{4\pi \epsilon_o} \frac{q_e \cdot q_e}{d^2} = K_F' \frac{1}{d^2} \quad (178) \]

with

\[ 58 \]
\[ K_F' = \frac{q_e^2}{4\pi \epsilon_0} = 2.307078 \cdot 10^{-28} \quad [N\ m^2] \quad (179) \]

If we make \( F_2 = F_s \) we get for the double integral the value \( \int \int_{\text{Coulomb}} = 2.0887 \) which is valid for \( d \gg r_o \). The Coulomb equation transforms to

\[ F_2 = 2.088768 \ \frac{a \ c \ r_o^2}{4\ K} \ \frac{\sqrt{m_1} \sqrt{m_2}}{d^2} = 2.78029601 \cdot 10^{32} \ \frac{m_1 m_2}{d^2} \quad (180) \]

The charge of the electron is replaced by the mass of the electron.

For complex particles that are formed by more than one BSP and with \( d \gg r_o \) we have

\[ F_2 = 2.307078 \cdot 10^{-28} \ \frac{\Delta n_1 \cdot \Delta n_2}{d^2} \quad (181) \]

The charge \( Q \) is replaced by the expression \( \Delta n = n^+ - n^- \) which gives the difference between the constituent numbers of positive and negative BSPs that form the complex SP. As the \( n_i \) are integer numbers, the Coulomb force is quantified.

As examples we have for the proton \( n^+ = 919 \) and \( n^- = 918 \) with a binding Energy of \( E_{B_{\text{prot}}} = -6.9489 \cdot 10^{-14} \ J = -0.43371 \ MeV, \) and for the neutron \( n^+ = 919 \) and \( n^- = 919 \) with a binding Energy of \( E_{B_{\text{neut}}} = 5.59743 \cdot 10^{-14} \ J = 0.34936 \ MeV. \)

In the case of an atomic nucleus \( \Delta n = n^+ - n^- \) is equal to the order number \( Z \) of the element.

The following Fig.31 shows a schematic representation of the generation of the Coulomb force.

We now express the Coulomb force as a function of the power stored in the longitudinal angular momentum of the two BSPs. We start with eq. (174) that we write as

\[ F_2 = \frac{a \ m \ c \ r_o^2}{4 \ \Delta t \ d^2} \ \int \int_{\text{Coulomb}} = \frac{a \ c \ r_o^2}{4 \ d^2} \ \sqrt{\frac{E_o}{\Delta t}} \ \sqrt{\frac{m}{\Delta t}} \ \int \int_{\text{Coulomb}} \quad (182) \]

or

\[ F_2 = \frac{a \ r_o^2}{4 \ c \ d^2} \ \sqrt{\frac{E_o}{\Delta t}} \ \sqrt{\frac{E_o}{\Delta t}} \ \int \int_{\text{Coulomb}} \quad \text{and with} \quad P_o = \frac{E_o}{\Delta t} = E_o \nu_o \quad (183) \]

we get for complex particles

\[ F_2 = \frac{a \ r_o^2}{4 \ c} \ \sqrt{P_o \sqrt{P_o}} \ \frac{\Delta n_1 \cdot \Delta n_2}{d^2} \ \int \int_{\text{Coulomb}} \quad (184) \]
3.3 Convention for the representation of positron and electron.

Fig. 32 shows the convention used for the electron and positron. The positron emits FPs with high speed $v_e = \infty$ and positive longitudinal angular momentum $\vec{J}_s^+ (\infty+)$ and is regenerated by FPs with low speed $v_r = c$ and negative longitudinal angular momentum $\vec{J}_s^- (c-)$). The electron emits FPs with low speed $v_e = c$ and negative longitudinal angular momentum $\vec{J}_s^- (c-)$ and is regenerated by FPs with high speed $v_r = \infty$ and positive longitudinal angular momentum $\vec{J}_s^+ (\infty+)$. (see sec. 2.1 postulate 3)

![Diagram of generation of linear momentum between two static BSP](image.png)

**Figure 32:** Convention for electron and positron

**Figure 31:** Generation of linear momentum between two static BSP
3.4 Power flow between charged complex SPs.

The energy $E_p$ exchanged between two BSPs is given by

$$E_p = \int a \left| \int_{r_1}^\infty dH_{r_1} \bar{s}_1 \times \int_{r_2}^\infty dH_{r_2} \bar{s}_2 \right| \quad \text{with} \quad a = 8.7743 \cdot 10^{-2} \quad (185)$$

or

$$E_p = 6.82333 \cdot 10^{-27} \frac{E_o}{d^2} \ J \quad (186)$$

and the power $P$

$$P_1 = \frac{E_p}{\Delta_o t} = c F_1 = c F_2 = P_2 \quad \text{with} \quad \Delta_o t = K i_o^2 \quad (187)$$

resulting

$$P_1 = 6.82333 \cdot 10^{-27} \frac{E_o}{\Delta_o t} \frac{1}{d^2} \ J/s \quad (188)$$

The energy $E_p = P_1 \Delta_o t$ is exchanged with the frequency

$$\nu_o = \frac{1}{\Delta_o t} = 1.2373 \cdot 10^{20} \ s^{-1} \quad (189)$$

The concept is shown at Fig.33
Note: According eq.(186) the exchange energy \( E_p = pc = E_o \) gives the distance 
\[ d = 8.26032 \cdot 10^{-14} \text{ m}, \]
distance that is smaller than \( 2r_o = 7.71806 \cdot 10^{-13} \text{ m} \) where the
curve of Fig.27 has its maximum of \( p_{\text{max}} = 1.3 \cdot 10^{-23} \text{ Ns} \) and \( E_{p_{\text{max}}} = 3.9 \cdot 10^{-15} \text{ J} \).
For all distances \( d \) the exchanged energy \( E_p < E_o \approx 21 E_{p_{\text{max}}}. \)

In the case of charged complex SPs the power exchanged is

\[ P_1 = \Delta n_1 \Delta n_2 \frac{E_p}{\Delta \delta} = c F_1 = c F_2 = P_2 \quad (190) \]

For a given distance \( d \), each BSP of the complex SP "1" emits \( \Delta n_2 \) times the power
of two isolated BSPs at the same distance \( d \), and each BSP of the complex SP "2" emits \( \Delta n_1 \) times the power of two isolated BSPs at the same distance \( d \). The power
interchange is quantized in power units of two isolated BSPs at the same distance \( d \).

Fig. 34 shows a proton with one level electron. The level electron emits FPs with
light speed, what explains the light speed of photons when the level electron changes
to a lower energy level.

![Figure 34: Proton with level electron](image)

### 3.5 Invariance of the Coulomb force.

Two BSPs that move parallel with the speed \( v \) at a distance \( d \) between them, are
exposed to the following Coulomb force.

\[ dF_2 = \frac{a}{c \Delta t} \left| \int_{r_{\text{1}}}^{\infty} dH_{e_1} \bar{s}_1 \times \int_{r_{\text{2}}}^{\infty} dH_{s_2} \bar{s}_2 \right| \quad (191) \]

where we have for the emitting particle 1

\[ dH_{e_1} = H d\kappa_{e_1} \quad \text{where} \quad H^2 = E = \sqrt{E_o^2 + E_p^2} \quad (192) \]

and for the regenerating particle 2
\[ dH_{s2} = H_s \, d\kappa_{s2} \quad \text{where} \quad H_s^2 = E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \quad (193) \]

We now analyze the force for \( v \ll c \) and for relativistic speed.

a) For \( v \ll c \) we have that

\[ H = \sqrt{E_o} \quad \text{and} \quad H_s = \sqrt{E_o} \quad (194) \]

If we introduce these expressions in (191) we get

\[ d\bar{F}_2 = a \frac{m_o \, c^2}{c \, \Delta t} \left| \int_{r_1}^{\infty} d\kappa_{e1} \, \bar{s}_1 \times \int_{r_2}^{\infty} d\kappa_{s2} \, \bar{s}_2 \right| \quad (195) \]

b) For relativistic speed with \( E_o^2 \ll E_p^2 \) we have that

\[ H \approx \sqrt{E_p} \quad \text{and} \quad H_s \approx \frac{E_o}{\sqrt{E_p}} \quad (196) \]

If we introduce these expressions in (191) we get

\[ d\bar{F}_2 = a \frac{m_o \, c^2}{c \, \Delta t} \left| \int_{r_1}^{\infty} d\kappa_{e1} \, \bar{s}_1 \times \int_{r_2}^{\infty} d\kappa_{s2} \, \bar{s}_2 \right| \quad (197) \]

As \( d\kappa \) is independent of the speed \( v \) and proportional to the particle’s radius like \( \Delta t \), we get the same force for the whole range \( 0 \leq v \leq c \) of speed. The Coulomb force is invariant for inertial reference systems.

**Note:** The Lorentz invariance of the charge in today’s theory is equivalent to the invariance of the difference between the constituent numbers of BSPs with positive \( \bar{J}_e^{(+)} \) and negative \( \bar{J}_e^{(-)} \) that integrate the complex SP.

### 3.6 Induced force on a static BSP.

The force between two static basic subatomic particles is basically, if we ignore the proportionality factor \( a \),

\[ F_{sp} = \int_{\sigma} dF_{sp} \quad \text{with} \quad dF_{sp} = \frac{1}{c \, \Delta t} \left| \int_{r_s}^{\infty} dH_e \, \bar{s} \times \int_{r_p}^{\infty} dH_{sp} \, \bar{s}_p \right| \quad (198) \]

where \( \int_{\sigma} \) is the spacial integral around the test particle.

The force on the static test BSP \( dH_{sp} \) has its origin at the pairs of symmetric and opposed transversal angular momentums generated by the longitudinal angular momentum of the fundamental particles of the two static particles, when they cross.
Pairs of symmetric and opposed transversal angular momentums are also generated by a BSP that moves with the speed \(v\).

We now imagine an BSP that is accelerated in the time \(\Delta t\) by the transversal angular momentums \(J_n\) of its regenerating fundamental particles from \(v = 0\) to \(v = k c\) with \(k < 1\), and then returned by an external force to its original position with \(v = 0\) in the time \(\Delta t \rightarrow \infty\).

We then have

\[
\int_{r_r}^{\infty} \bar{d}H_n = \int_{r_r}^{\infty} dH_n(\nu = k c) - \int_{r_r}^{\infty} dH_n(\nu = 0) = \Delta \int_{r_r}^{\infty} \bar{d}H_n \quad (199)
\]

because

\[
\int_{r_r}^{\infty} \bar{d}H_n(\nu = k c) = \int_{r_r}^{\infty} dH_n \text{ and } \int_{r_r}^{\infty} \bar{d}H_n(\nu = 0) = 0 \quad (200)
\]

We now introduce (199), that gives us pairs of symmetrical opposed transversal angular momentums in eq.(198) in considering, that the vector \(\bar{d}H_n\) is constant and tangential along a torus with an axis that goes through the two BSPs. The resulting force is the induced force on the probe BSP by the moving BSP and we call it \(dF_i\).

\[
dF_i = \frac{1}{c} \oint \frac{\bar{d}l}{2\pi R} \cdot \left\{ \Delta \int_{r_r}^{\infty} \bar{d}H_n \int_{r_p}^{\infty} dH_{s_p} \right\} \quad (201)
\]

Now we generalize the expression to dynamic processes where the vector \(\bar{d}H_n\) changes in time and in space and get

\[
dF_i = \frac{1}{c} \oint \frac{\bar{d}l}{2\pi R} \cdot \left\{ \frac{d}{dt} \int_{r_r}^{\infty} \bar{d}H_n \int_{r_p}^{\infty} dH_{s_p} \right\} \quad (202)
\]

This expression of the force as a function of a closed path integral of a timely changing variable is called induced force and is the basis for the description of all dynamic processes that will be analyzed in the section 6 for dynamic laws.

**Note:** It has still to be determined if an equalization factor is required for the equation of the induced linear momentum to match with experimental data.

### 3.7 Field divergence of a static complex SP.

We start with the expression of the field for a complex SP that is defined as

\[
dF_s = \frac{d\bar{F}_2}{\Delta n_2} = \Delta n_1 \frac{a}{c} \frac{1}{\Delta t} \left| \int_{r_{s_1}}^{\infty} dH_{c_1} \bar{s}_1 \times \int_{r_{s_2}}^{\infty} dH_{s_2} \bar{s}_2 \right| \quad (203)
\]
Through calculations in sec. 3.1.1 we arrived to the following results for $d \gg r_o$:

1. The inverse proportionality of the two vectors $\int dH_1$ and $\int dH_2$ to their respective $r_1$ and $r_2$ results in an inverse proportionality to the distance $d^2$ for the force $F_2$.

2. The proportionality $\Delta t = K r_o$, with $K = 5.42713 \cdot 10^4$.

According to eq. (180) the field $F_s$ can be written with $\Delta n_2 = 1$ and $m_1 = m_2$ as

$$F_s = 2.5326 \cdot 10^2 \Delta n \cdot \frac{m}{d^2}$$  \hspace{1cm} (204)

Now we define the divergence of the field $F_s$ as

$$\text{div} F_s = \lim_{V \to 0} \frac{\oint F_s dA}{V}$$  \hspace{1cm} (205)

With $A$ the area of a sphere with centrum in $\Delta n \cdot m$ and $V$ its volume we get

$$\text{div} F_s = 4\pi \cdot 2.5326 \cdot 10^2 \Delta n \cdot \frac{m}{V} = 3.1826 \cdot 10^3 \Delta n \rho_m$$  \hspace{1cm} (206)

where $\rho_m$ is the masse density of a positive or negative basic subatomic particle.

3.8 Balance of energy, rotational momentum and linear momentum between two static BSPs.

3.8.1 Balance of energy.

The energy $\nu J_{e_1}$ stored in an emitted fundamental particle of BSP 1 with $v = 0$ is passed to a regenerating fundamental particle of the same BSP 1 when they meet, so that

$$\nu J_{e_1} = \nu J_{s_1}$$  \hspace{1cm} (207)

The concept is shown in Fig. 35

The energy $\nu J_{s_1}$ is then split in longitudinal and transversal components when it meets with regenerating fundamental particles of the other BSP (2) so that

$$\nu J_{s_1} = \nu J_{s_1}^{(s)} + \nu J_{n_1}^{(s)}$$  \hspace{1cm} (208)

The energy emitted by the BSP (1) is returned to the same BSP (1) and we can write

65
The same process is valid for the other BSP (2).

The energy balance can also be explained through an energy interchange between the two static BSPs in, that the energy \( \nu J_{e_1} \) stored in an emitted fundamental particle of BSP 1 with \( v = 0 \) is splitted and passed to a regenerating fundamental particle of BSP 2 when they meet, so that

\[
\nu J_{e_1} = \nu J_{s_1}^{(s)} + \nu J_{n_1}^{(s)}
\]  

(209)

Because of symmetry, there is an emitted FP of BSP 2 that meets a regenerating FP of BSP 1 with the same angle \( \beta \) that carries the same energy.

3.8.2 Balance of rotational momentum.

The concept is shown in Fig. 35.

On the drawing we see that on ray 2' all the longitudinal rotational momentums
are opposed to ray 1. The same applies for the rays 1′ and 2.

The transversal rotational momentums have opposed rotational momentums on the rays 1 and 2 and the rays 1′ and 2′.

\[
\bar{J}^{(s)}_{n_1} = -\bar{J}^{(s)}_{n_2} \quad \bar{J}^{(s)′}_{n_1} = -\bar{J}^{(s)′}_{n_2} \quad (211)
\]

\[
\bar{J}^{(s)}_{s_1} = -\bar{J}^{(s)}_{s_2} \quad \bar{J}^{(s)′}_{s_1} \neq \bar{J}^{(s)′}_{s_2} \quad (212)
\]

\[
\bar{J}^{e}_{e_1} = -\bar{J}^{e}_{e_2} \quad (213)
\]

Opposed rotational momentums are constantly generated on one place, and at the same time, equal opposed rotational momentums are destroyed on an other place, so that the sum of all rotational momentums is always zero.

3.8.3 Balance of linear momentum.

As already exposed, the linear momentum is a characteristic of BSPs, generated by rotational momentums of fundamental particles that comply with defined symmetry conditions. The concept is shown in Fig. 36.

Because of symmetry we have for two BSPs

\[
dp_1 = \frac{a}{c} \left| \int_{r_1}^{\infty} dH_{s_1} \bar{s}_1 \times \int_{r_2}^{\infty} dH_{s_2} \bar{s}_2 \right| = \frac{a}{c} \left| \int_{r_2}^{\infty} dH_{s_2} \bar{s}_2 \times \int_{r_1}^{\infty} dH_{s_1} \bar{s}_1 \right| = dp_2 \quad (214)
\]

For complex SPs that are formed by more than one BSP we have

\[
dp_1 = a \frac{\Delta n_1 \Delta n_2}{c} \left| \int_{r_1}^{\infty} dH_{s_1} \bar{s}_1 \times \int_{r_2}^{\infty} dH_{s_2} \bar{s}_2 \right| \quad (215)
\]

\[
dp_2 = a \frac{\Delta n_2 \Delta n_1}{c} \left| \int_{r_2}^{\infty} dH_{s_2} \bar{s}_2 \times \int_{r_1}^{\infty} dH_{s_1} \bar{s}_1 \right| \quad (216)
\]

resulting that

\[
dp_1 = dp_2 \quad (217)
\]

with \(\Delta n_i = n^+_i - n^-_i\) the difference between the number of positive and negative BSPs that form the complex particle \(i\).
3.9 Energy of transversal rotational momentums $J_n$ at a torus with an axis that coincides with a current of BSPs with speed $v$.

We start with the energy equation for transversal rotational momentums $J_n$ of a BSPs that moves with $v$.

$$dE_n = \frac{E_p^2}{\sqrt{E_0^2 + E_p^2}} \frac{c}{2\sqrt{v}} \left| \frac{\vec{v}_e}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| w_e \, d\varphi$$

with

$$w_e = r_o \frac{d\varphi}{r_e}$$

and

$$E_p = c \frac{m \, v}{\sqrt{1 - \frac{v^2}{c^2}}}$$

For decelerating BSPs we have

$$v_r \to \infty \quad \text{and} \quad t_r \to 0$$
\[ r_e = r_r \quad dr_e = dr_r \quad \varphi = \psi \quad d\varphi = d\psi \]  

(221)

and for \( dE_n \) we can write

\[ dE_n = \frac{E_p^2}{\sqrt{E_0^2 + E_p^2}} \frac{c}{2v} \left| \frac{\bar{v}_s}{|\bar{v}_r|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2} \, dr_r \, d\psi \]  

(222)

with

\[ v_s = \sqrt{v_e^2 + v^2 - 2v_e v \cos \psi} \]  

(223)

For \( v << c \) we get

\[ dE_n = m \, v^2 \, d\kappa = m \, v^2 \, \frac{1}{2} \, \frac{r_o}{r_r^2} \, dr_r \, \sin \psi \, d\psi \, \frac{d\gamma}{2\pi} \]  

(224)

The cumulate energy is

\[ \int_{r_r}^{\infty} dE_n = m \, v^2 \, \frac{1}{2} \, \frac{r_o}{r_r^2} \, \sin \psi \, d\psi \, \frac{d\gamma}{2\pi} \]  

(225)

The concept is shown in Fig. 37.

Figure 37: Geometric relations of a torus for a straight conductor with a current of basic subatomic particles \( I_m \)
From Fig 37 we have that
\[ r_r \, d\psi = dl \psi \quad dl = \sin \psi \, dl \psi \quad \rightarrow \quad \sin \psi \, d\psi = \frac{dl}{r_r} \tag{226} \]

We get for the cumulated energy
\[ \int_{r_r}^{\infty} dE_n = m \, v^2 \, \frac{1}{4\pi} \, \frac{r_o}{r_r^2} \, dl \, d\gamma = dE_{n(cum)} \tag{227} \]

For \( \rho_x \) the linear density of BSPs in the conductor, where \( \rho_x = \frac{N_x}{\Delta x} \) with \( N_x \) the number of BSPs in \( \Delta x \), we get the cumulated energy for \( N_x \) BSPs
\[ \int_{r_r}^{\infty} dE_n = \rho_x \, \Delta x \, m \, v^2 \, \frac{1}{4\pi} \, \frac{r_o}{r_r^2} \, dl \, d\gamma \tag{228} \]

To get the cumulated energy for all BSPs of a straight conductor with infinite length we write
\[ \int_{-\infty}^{\infty} \int_{r_r}^{\infty} dE_n = \rho_x \, m \, v^2 \, \frac{1}{4\pi} \, \frac{r_o}{r_r^2} \, dl \, d\gamma \int_{-\infty}^{\infty} \frac{\Delta x}{X} \quad X = r_r^2 = h^2 + x^2 \tag{229} \]
resulting
\[ \int_{-\infty}^{\infty} \int_{r_r}^{\infty} dE_n = \rho_x \, m \, v^2 \, \frac{1}{4} \, \frac{r_o}{h} \, dl \, d\gamma = dE_{n(cum,\infty)} \tag{230} \]
if we multiply and divide the expression with \( h \), what leaves the expression unchanged, we see that the equation represents the cumulated energy for the area \( dA = h \, dl \, d\gamma \).

**Note a)**
Transversal rotational momenta \( \bar{J}_n \) from regenerating fundamental particles of positive or negative BSPs, that move in the same direction in the conductor, have the same rotation sense. It is not possible to know from the rotation sense of the transversal rotational momenta \( \bar{J}_n \) if the BSPs that move in the same direction have a positive or negative sign.

If we change the direction of the current of positive or negative BSPs in the conductor, the rotation sense of the transversal rotational momenta \( \bar{J}_n \) changes.

Only the rotation sense of the longitudinal rotational momenta \( \bar{J}_s \) shows, if the BSPs that move in the same direction, have a positive or negative sign.

**Note b)**
The relation between the mass current \( I_m \) and the electric current \( I_e \) is defined by the following equations:
\[ I_c = N_x q v = 1.60217733 \cdot 10^{-19} N_x v \left[ \frac{C}{s} \right] \]  
\[ I_m = N_x m v = 9.1093897 \cdot 10^{-31} N_x v \left[ \frac{kg}{s} \right] \]  

with \( q \) the elementary charge in Coulomb and \( m \) the rest masse of the electron in kilogram.

We get that

\[ I_m = \frac{m}{q} I_c = 5.685631378 \cdot 10^{-12} I_c \left[ \frac{kg}{s} \right] \]  

### 3.10 Current flow of BSPs at an infinite straight conductor.

#### 3.10.1 Current flow through a closed loop enclosing an infinite straight conductor.

We start with eq. (230) switching to the cumulated \( \vec{dH}_n \) field

\[ \int_{-\infty}^{\infty} \int_{r_v}^{r_r} d\vec{H}_n = \rho_x [m v^2]^{1/2} \frac{1}{4} \frac{r_v}{\hbar} dl d\gamma \bar{n} \]  

(234)

With the mass current \( I_m = \rho_x m v \) and with constant \( \Delta l \) and \( \Delta \gamma \) we get

\[ \int_{-\infty}^{\infty} \int_{r_v}^{r_r} d\vec{H}_n = \frac{I_m}{\sqrt{m}} \frac{1}{4} \frac{r_v}{\hbar} \Delta l \Delta \gamma \bar{n} = d\vec{H}_{n(\text{cum,}\infty)} \]  

(235)

We now build the close loop integral

\[ \oint d\vec{H}_{n(\text{cum,}\infty)} \cdot d\bar{l}_\gamma = d\vec{H}_{n(\text{cum,}\infty)} \ h \int_0^{2\pi} d\gamma \ d\bar{l}_\gamma = h \ d\gamma \bar{n} \]  

(236)

We get

\[ \oint d\vec{H}_{n(\text{cum,}\infty)} \cdot d\bar{l}_\gamma = K_H I_m \quad K_H = \frac{\pi}{\sqrt{m}} \frac{1}{2} \frac{r_o}{\hbar} \Delta l \Delta \gamma = \text{constant} \]  

(237)

If we compare with the mainstream expression

\[ \oint \vec{H}_c \cdot d\bar{l}_\gamma = I_c \]  

we conclude that
3.10.2 Current flow through a closed loop outside an infinite straight conductor.

To obtain the current flow outside an infinite straight conductor we place the closed path integral outside the conductor.

The concept is shown in Fig. 38

Figure 38: Geometric relations for the calculation of the closed path integral outside a straight conductor with a current of basic subatomic particles $I_m$

We start with equation (235) which is

$$\int_{-\infty}^{\infty} \int_{r_r}^{\infty} \tilde{d} \tilde{H}_n = \frac{I_m}{\sqrt{m}} \frac{1}{4} \frac{r_o}{h} \Delta l \Delta \gamma \bar{n} = d \bar{H}_{n(cum, \infty)}$$

that we can write as

$$d \bar{H}_{n(cum, \infty)} = \frac{K}{\bar{n}} \quad K = \frac{I_m}{\sqrt{m}} \frac{1}{4} \frac{r_o}{h} \Delta l \Delta \gamma$$

As $d \bar{H}_{n(cum, \infty)} \propto d \bar{H}_n$ we use the nomenclature from Fig. 38 in what follows

$$d \bar{H}_{n_l} = d \bar{H}_n \sin \mu \bar{t} \quad h^2 = h_o^2 + R^2 - 2 h_o R \cos \epsilon \quad \mu = \sigma - \frac{\pi}{2}$$
with

\[ \sigma = \frac{\pi}{2} - \frac{\varepsilon}{2} + \arctan \left[ \frac{h_o - R}{h_o + R} \cot \frac{\varepsilon}{2} \right] \] (243)

For the closed path integral we get

\[ \oint d\vec{H}_n \cdot d\vec{s} = 0 \quad \text{with} \quad d\vec{H}_n(h) = \frac{K}{h} \hat{n} \] (244)

For another relation between \( dH_n \) and \( h \) we have

\[ \oint d\vec{H}_n \cdot d\vec{s} \neq 0 \quad \text{with} \quad d\vec{H}_n(h) \neq \frac{K}{h} \hat{n} \] (245)

The finding that only with a relation of the type \( dH_n(h) = \frac{K}{h} \) the external closed path integral is zero is important for the analysis of the laws that describe processes that are variable in time.

### 3.11 Linear momentum density on two infinite straight parallel conductors that have mass currents \( I_{m1} \) and \( I_{m2} \).

We start with eq. (230) from sec. 3.9 which represents the cumulated energy for the area \( dS = dl \, h \, d\gamma \).

\[ \int_{-\infty}^{\infty} \int_{r_r}^{\infty} dE_n = \rho_x \, m \, v^2 \frac{1}{4} \frac{r_o}{h} \, dl \, d\gamma = dE_n(cum, \infty) \] (246)

Now we switch to the cumulated field of \( d' \, H_n(cum, \infty) \) defining \( H_n' \) as

\[ H_n' = \left[ m \, v^2 \frac{dl}{h} \right]^{1/2} \] (247)

and get

\[ \int_{-\infty}^{\infty} \int_{r_r}^{\infty} d' \, H_n = \rho_x \left[ m \, v^2 \frac{dl}{h} \right]^{1/2} \frac{r_o}{4} \, d\gamma = d' \, H_n(cum, \infty) \] (248)

We now rearrange the equation to get an expression for the current \( I_m = \rho_x \, m \, v \) and get

\[ d' \, H_n(cum, \infty) = \frac{I_m}{4\sqrt{m}} \sqrt{\frac{dl}{h}} \, r_o \, d\gamma \] (249)

We now take two parallel conductors at the distance \( d \) with mass currents \( I_{m1} \) and \( I_{m2} \).
and \( I_{m2} \) that have transversal rotational momentum \( J_{n1} \) and \( J_{n2} \) at the distances \( h_1 \) respective \( h_2 \). Because of the existing symmetry the rotational momenta \( J_2 \) that are generated according to postulate 7 form pairs that comply with the requirements for linear momentum.

\[
\bar{J}_2 = + \text{sign} (\bar{J}_{n1}) \text{sign} (\bar{J}_{n2}) \left( \sqrt{J_{n1}} \bar{n}_1 \times \sqrt{J_{n2}} \bar{n}_2 \right)
\]  

(250)

with \( \bar{n}_1 \) and \( \bar{n}_2 \) unit vectors that are orthogonal respectively to the area formed by \( I_{m1} \) and \( h_1 \), and the area formed by \( I_{m2} \) und \( h_2 \).

The concept is shown in Fig. 39

![Diagram](image)

Figure 39: Angle \( \beta \) between the transversal angular momentum of regenerating fundamental particles of two straight conductors with currents \( I_{m_i} \)

The energy \( dE_{ph} \) associated with \( J_2 \) is

\[
dE_{ph} = \left| \int_{x=-\infty}^{\infty} \int_{r_1}^{r_2} d'H_{n1} \bar{n}_1 \times \int_{x=-\infty}^{\infty} \int_{r_2}^{\infty} d'H_{n2} \bar{n}_2 \right|
\]  

(251)

and the linear momentum

74
\[ dp_h = \frac{1}{c} \, dE_{ph} \]  

(252)

We get with \( m_1 = m_2 = m \) and \( r_{o_1} = r_{o_2} = r_o \) and \( dl_1 = dl_2 = dl \)

\[ dE_{ph} = \frac{I_{m_1} I_{m_2} \, r_o^2 \, I_0}{16 \, m \, \sqrt{h_1 \, h_2}} \, |\vec{n}_1 \times \vec{n}_2| \, dl \]  

(253)

with

\[ |\vec{n}_1 \times \vec{n}_2| = \sin \beta = \sin(\gamma_1 - \gamma_2) \]  

(254)

With the following geometric conditions already defined in sec. 3.2

\[ R = h_1 \, \sin \gamma_1 \quad R = h_2 \, \sin \gamma_2 \quad - h_1 \, \cos \gamma_1 + h_2 \, \cos \gamma_2 = d \]  

(255)

we get

\[ h_1 \, h_2 = d^2 \, \frac{\sin \gamma_1 \, \sin \gamma_2}{[\sin \gamma_1 \, \cos \gamma_2 - \sin \gamma_2 \, \cos \gamma_1]^2} \]  

(256)

As

\[ \sin \gamma_1 \, \cos \gamma_2 - \sin \gamma_2 \, \cos \gamma_1 = \sin(\gamma_1 - \gamma_2) = \sin \beta \]  

(257)

we obtain

\[ dE_{ph} = \frac{I_{m_1} I_{m_2} \, r_o^2}{16 \, m \, d \, \sqrt{\sin \gamma_1 \, \sin \gamma_2}} \, \sin^2(\gamma_1 - \gamma_2) \, d\gamma_1 \, d\gamma_2 \, dl \]  

(258)

The differential force density is given by

\[ \frac{dF}{\Delta l} = \frac{dp_h}{\Delta l \, dt} = \frac{1}{c \, dl \, \Delta t} \, dE_{ph} \]  

(259)

and we get

\[ \frac{dF}{\Delta l} = \frac{1}{c \, \Delta t} \, \frac{I_{m_1} I_{m_2} \, r_o^2}{16 \, m \, d \, \sqrt{\sin \gamma_1 \, \sin \gamma_2}} \, \sin^2(\gamma_1 - \gamma_2) \, d\gamma_1 \, d\gamma_2 \]  

(260)

The total force density we obtain by integrating over the whole space

\[ \frac{F}{\Delta l} = \frac{1}{c \, \Delta t} \, \frac{r_o^2 \, I_{m_1} I_{m_2}}{16 \, m \, d} \int_{\gamma_{1_{\text{min}}}}^{\gamma_{1_{\text{max}}}} \int_{\gamma_{2_{\text{min}}}}^{\gamma_{2_{\text{max}}}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin \gamma_1 \, \sin \gamma_2}} \, d\gamma_1 \, d\gamma_2 \]  

(261)

In eq. (261) we can see the inverse proportionality to the distance \( d \) between the parallel conductors.

The integration limits are similar to the integration limits for two static BSPs shown...
in Fig. 26.

The double integral gives for $d \gg r_o$

$$\int_{\gamma_{2\min}}^{\gamma_{2\max}} \int_{\gamma_{1\min}}^{\gamma_{1\max}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sin \gamma_1 \sin \gamma_2} \, d\gamma_1 \, d\gamma_2 = \int \int_{\text{Ampere}} = 5.8731$$

Finally we get

$$\frac{F}{\Delta l} = b \frac{5.8731}{c \Delta t} \frac{r_o^2}{16 \, m} \frac{I_{m_1} \, I_{m_2}}{d}$$

where $b$ is a tuning factor we introduce who's function is explained later.

The reference force density we calculate with the mainstream equation of the theory of electricity and magnetism

$$\frac{F_c}{\Delta l} = \frac{\mu_o}{2 \pi} \frac{I_{c_1} \, I_{c_2}}{d}$$

with $I_c$ the current in Ampere.

The relation between the mass current $I_m$ and the electric current $I_c$ is given by

$$I_m = \frac{m}{q} I_c = 5,685631378 \cdot 10^{-12} \, \text{Ampere} \left[ \frac{\text{kg}}{\text{s}} \right]$$

with $m$ the electron mass in kilogram and $q$ the elementary charge in Coulomb.

If we make the two total force densities equal for $d \gg r_o$

$$\frac{F}{\Delta l} = \frac{F_c}{\Delta l} \quad \text{for} \quad d \gg r_o$$

we get for $b = 0.25$ the same $K = 5.4274 \cdot 10^4 \, \text{s/m}^2$ we got for two static BSPs.

The advantage to make $K = 5.4274 \cdot 10^4 \, \text{s/m}^2$ we see in sec. 8.1 resulting

$$\frac{4 \, \pi^2 \, m}{K} = \hbar \quad \text{with 'h' the Planck Constant}$$

The Ampere law for the mass currents takes the form

$$\frac{F}{\Delta l} = K_A \, \frac{I_{m_1} \, I_{m_2}}{d} \quad \text{with} \quad K_A = b \frac{5.8731}{c \Delta t} \frac{r_o^2}{16 \, m} = 6.18706 \cdot 10^{15} \, \frac{m}{\text{kg}}$$

The energy density flow from mass-current $I_{m_1}$ to $I_{m_2}$ is equal to the energy density flow from mass-current $I_{m_2}$ to $I_{m_1}$

$$\frac{E_{p_{\text{flow}}}}{\Delta l} = \frac{F_1 \, c}{\Delta l} = \frac{F_2 \, c}{\Delta l} = \frac{E_{p_{\text{flow2}}}}{\Delta l}$$

76
**Note:** There is an important difference when switching from the cumulated energy equation to the $dH$ field to arrive to the Coulomb or the Ampere equations.

- To arrive to the Coulomb law we simply passed from
  \[
  \int_{r}^{\infty} dE = E \int_{r}^{\infty} d\kappa \quad \text{to} \quad \int_{r}^{\infty} dH = \sqrt{E} \int_{r}^{\infty} d\kappa \quad (270)
  \]
to build the cross product and obtain the inverse $d^2$ law from the Coulomb law.

- To arrive to the Ampere law we had to pass from
  \[
  \int_{r}^{\infty} dE = E \int_{r}^{\infty} d\kappa \quad \text{to} \quad \int_{r}^{\infty} d'H = \sqrt{E} \int_{r}^{\infty} d\kappa' \quad (271)
  \]
with
  \[
  \int_{r}^{\infty} d'\kappa = \frac{1}{2} \sqrt{\frac{r_{o}}{r}} \sin \varphi \ d\varphi \frac{d\gamma}{2\pi} \quad (272)
  \]
to build the cross product and obtain the inverse $d$ law from the Ampere law.

**Force density as a function of the power.**

Now we express the force density as a function of the powers stored in the regenerating transversal angular momentum of the BSPs of the two conductors.

We start with eq. (261) that we write with $I_{m} = \rho_{x} \ m \ v$

\[
\frac{F}{\Delta l} = \frac{1}{c \ \Delta t} \ \frac{r_{o}^{2}}{16 \ m} \ \frac{\rho_{x_{1}} \ m \ v_{1} \ \rho_{x_{2}} \ m_{2} \ v}{d} \ \int \int_{\text{Ampere}} \quad (273)
\]
or

\[
\frac{F}{\Delta l} = \frac{1}{16 \ m \ c} \ \frac{\rho_{x_{1}} \ r_{o_{1}} \ \rho_{x_{2}} \ r_{o_{2}}}{d} \ \sqrt{\frac{m \ v_{1}^{2}}{\Delta_{1}^{t}}} \ \sqrt{\frac{m \ v_{2}^{2}}{\Delta_{2}^{t}}} \ \int \int_{\text{Ampere}} \quad (274)
\]
where

\[
\Delta t = K \ r_{o_{1}} \ r_{o_{2}} = \sqrt{K \ r_{o_{1}}^{2}} \ \sqrt{K \ r_{o_{2}}^{2}} = \sqrt{\Delta_{1}^{t}} \ \sqrt{\Delta_{2}^{t}} \quad (275)
\]
and with $E_{n} = m \ v^{2}$ we get

\[
\frac{F}{\Delta l} = \frac{1}{16 \ m \ c} \ \frac{\rho_{x_{1}} \ r_{o_{1}} \ \rho_{x_{2}} \ r_{o_{2}}}{d} \ \sqrt{E_{n_{1}} \ \nu_{1}} \ \sqrt{E_{n_{2}} \ \nu_{2}} \ \int \int_{\text{Ampere}} \quad (276)
\]
where $\nu_{n_{1}} = 1/\Delta_{t}$. Finally we get with $P_{n} = E_{n} \ \nu_{n}$

\[
\frac{F}{\Delta l} = \frac{1}{16 \ m \ c} \ \frac{\rho_{x_{1}} \ r_{o_{1}} \ \rho_{x_{2}} \ r_{o_{2}}}{d} \ \sqrt{P_{n_{1}} \ \nu_{1}} \ \sqrt{P_{n_{2}} \ \nu_{2}} \ \int \int_{\text{Ampere}} \quad (277)
\]
The dimensionless factor \( r_o \rho_x = N_x r_o / \Delta x \) gives the density of the BSPs with radius \( r_o \) at the conductor.

**Sign convention between currents and angular momenta.**

We have seen that the transversal angular momentum \( \vec{J}_n \) is oriented according the right screw rule in the direction of the velocity vector \( \vec{v} \) of the BSPs and is independent of the charge of the BSPs. It is not possible to know the charge of the moving BSPs based on the direction the transversal angular momentum \( \vec{J}_n \) has. The direction of the transversal angular momentum \( \vec{J}_n \) gives the direction of the linear momentum \( d\vec{p} \).

The equation of postulate 7 gives the opposed transversal angular momentum \( \vec{J}_2 \) generated by the BSPs of the current \( I_{m1} \) and the BSPs of current \( I_{m2} \) which generate the linear momentum \( d\vec{p}_2 \) on the BSPs of current \( I_{m2} \).

\[
\vec{J}_2 = \text{sign}(\vec{J}_{e_1}) \text{sign}(\vec{J}_{e_2}) \left( \sqrt{\vec{J}_{n_1}} \vec{n}_1 \times \sqrt{\vec{J}_{n_2}} \vec{n}_2 \right) \quad (278)
\]

The sign of the linear momentum \( d\vec{p}_2 \) is given by

\[
\text{sign}(d\vec{p}_2) = \text{sign}(\vec{J}_2) \quad (279)
\]

The concept is shown in Fig. 40. See also Fig. 39.
Figure 40: Sign convention for the calculation of the linear momentum $dp$
for two straight conductors with currents $I_m$.

3.11.1 Invariance of the Ampere force between two parallel conductors.

In Fig. 41 we have parallel negative BSPs moving at a distance $d$ with the speeds $v_1$ and $v_2$ producing the currents $I_{m_1}$ and $I_{m_2}$ relative to a coordinate system that is fix with the positive BSPs that regenerate the negative moving BSPs. At point $P$ the transversal angular momentum of the regenerating FPs will interact according postulate 7 and generate the opposed forces $dF_1^-$ and $dF_2^-$. After the integration of all regenerating positive BSPs of the whole space we get the forces $F_1^-$ and $F_2^-$. 

If we now assume that $v_1 = v_2 = v$ and that the coordinate system is fix with the moving negative BSPs we have the case of Fig. 42 where the positive BSPs are moving at a distance $d$ producing the currents $I_{m_1}^+$ and $I_{m_2}^+$ relative to a coordinate system that is fix with the negative BSPs that regenerate the positive moving BSPs. At point $P$ the transversal angular momentum of the regenerating FPs will interact according postulate 7 and generate the opposed forces $dF_1^+$ and $dF_2^+$. After the integration of all regenerating negative BSPs of the whole space we get the forces $F_1^+$ and $F_2^+$. Due to the symmetry the forces $F_1^-$ and $F_2^-$ are equal to $F_1^+$ and $F_2^+$ provided that $v_1 = v_2 = v$.

**Note:** The selection of a coordinate system implies the definition of the environment that provides the regenerating BSPs.
Fig. 41 and Fig. 42 show the conservation of the Ampere force for inertial coordinate systems. 

Regenerating environment

\[ \vec{v}_{e_1} = c \]
\[ \vec{v}_{e_1} \approx \infty \]
\[ \vec{v}_{e_2} \approx \infty \]

Figure 41: Moving negative BSPs and positive regenerating BSPs

\[ \vec{v}_{e_1} = c \]
\[ \vec{v}_{e_1} \approx \infty \]

Figure 42: Moving positive BSPs and negative regenerating BSPs
3.11.2 Energy and rotational momentum balance for two parallel conductors.

Because of the constant velocities of the BSPs at the two conductors and the existing symmetry, the balances of energy and rotational momentums are reduced to the two following already analyzed cases:

- One BSP with constant speed at sec. 2.11
- Two static BSPs at sec. 3.8

The rotational momentums $\bar{J}_i^{(n)}$ are generated as opposed pairs so that the total sum of all rotational momentums is zero.

3.11.3 Calculations

The calculations were made assuming two infinite parallel conductors with currents of decelerating BSPs. To calculate the momentum time we consider that $dp_h = p_h$ and the momentum time

$$\Delta t = \frac{p_h}{F_c}$$

was calculated with

$m_e = 9.1093897 \cdot 10^{-31} \text{ kg}$
$q_e = 1.60217733 \cdot 10^{-19} \text{ A s}$
$\mu_0 = 4 \pi \cdot 10^{-7} \frac{\text{V s}}{A \text{ m}}$
$v_e = c$
$v_r = 10^{30} \frac{m}{s}$
$r_o = 10^{-16} \text{ m}$

For the radius $r_o$ the same value as for the calculations for two static BSPs was used.

Results.

The results show that for a given radius $r_o$ and for $d \gg r_o$ the momentum time $\Delta t$ is the same and constant for two static BSPs and for two infinite straight conductors. The curve of $\Delta t$ has the same shape as for two static BSPs induing the conclusion, that here also the time $\Delta t$ is a constant for all distances $d$, even for $d \ll r_o$ (see Fig. 28).
The following Fig. 43 shows a schematic representation of the generation of the linear momentum between two conductors and between a moving BSP and an oriented transversal field.

Figure 43: Generation of the linear momentum between two conductors and between a moving BSP and an oriented transversal field
3.12 Momentum on a BSP that moves with \( v_t \) in a space with oriented transversal rotational momentums.

3.12.1 General considerations

If a BSP moves with the speed \( v_t \) in a space with fundamental particles that all have transversal rotational momentums \( \vec{J}_{nt} \) oriented in the same direction, then the TRMs \( \vec{J}_{nt} \) of the regenerating fundamental particles of the BSP and the oriented TRMs of the space will generate rotational momentums according to postulate 7.

\[
\vec{J}_t = - \text{sign}(\vec{J}_{nt}) \text{sign}(\vec{J}_{nh}) (\sqrt{\vec{J}_{nt}} \vec{n}_t \times \sqrt{\vec{J}_{nh}} \vec{n}_h) \tag{281}
\]

\( \vec{J}_{nt} \) represents the TRMs of the moving BSP.
\( \vec{J}_{nh} \) represents the oriented TRMs in the space.
\( \vec{J}_{nt} \) and \( \vec{J}_{nh} \) are the corresponding longitudinal RMs that define the sign and will be omitted in the following analysis.

The concept is shown in Fig. 44, where the current that generates the field \( \vec{J}_{nh} \) and the corresponding regenerating longitudinal field \( \vec{J}_{nh} \), are not shown. It is important to note, that the direction of the resulting force on the moving BSP is also defined by the sign of the field \( \vec{J}_{nh} \) not shown in the figure, and not only by the direction of the field \( \vec{J}_{nh} \). The field \( \vec{J}_{nh} \) shown in Fig. 44 can be generated by a current of positive or negative BSPs moving in the direction of \( v_t \).

If we decompose the vector \( \vec{n}_h \) in a component \( \vec{n}_h^\parallel \) parallel to the velocity \( v_t \) and a component \( \vec{n}_h^\perp \) orthogonal to \( v_t \) we get

\[
\vec{J}_t = \sqrt{\vec{J}_{nt}} \vec{n}_t \times \sqrt{\vec{J}_{nh}} (\vec{n}_h^\parallel + \vec{n}_h^\perp) \tag{282}
\]

The components \( \sqrt{\vec{J}_{nh}} \vec{n}_h^\parallel \) parallel to \( v_t \) generate components of the rotational momentum \( \vec{J}_t \) that don’t comply with the requirements for generation of linear momentum \( dp \), namely, that they form pairs of opposed rotational momentums.

The components \( \sqrt{\vec{J}_{nh}} \vec{n}_h^\perp \) orthogonal to \( v_t \) on the contrary generate components of the rotational momentums \( \vec{J}_t \) that comply with the requirements for generation of linear momentum \( dp \). The direction of the momentum \( dp \) is orthogonal to \( v_t \) and \( \vec{n}_h^\perp \). The so generated momentum is responsible for a lateral displacement of the BSP during the regeneration.

\[
\vec{J}_t^\perp = \sqrt{\vec{J}_{nt}} \vec{n}_t \times \sqrt{\vec{J}_{nh}} \vec{n}_h^\perp \tag{283}
\]

\( \vec{J}_t^\perp \) represents the opposed rotational momentum that comply with the requirements.
Figure 44: Generation of a pair of opposed $J_i^\perp$ on a basic subatomic particle that moves with $v_t$ in a field of oriented $J_n^\perp$ for generation of linear momentum $\vec{p}_R$ radially to the resulting circular movement.

If we multiply both sides of the equation with $\sqrt{\nu_{n_l}} \, d\kappa_{n_l}$ and $\sqrt{\nu_{n_h}} \, d\kappa_{n_h}$ and build then the sum of $dH_{n_i}$ and $dH_{n_h}$ of the regenerating fundamental particles, we get for the energy $dE_{pR}$ responsible for the radial impulse

$$dE_{pR} = \left| \int_{r_{x_i}}^\infty dH_{n_l} \, \vec{n}_l \times \int_{r_{r_h}}^\infty dH_{n_h} \, \vec{n}_h \right|$$

(284)

with

$$dH_{n_i} = \sqrt{\nu_{n_i} \, J_{n_i} \, d\kappa_{n_i}}$$

(285)

$dH_{n_h}$ can have its origin at a current through a straight conductor that is parallel to the $y$ axis in the $xy$ plane at the distance $h$ from the moving BSP.
The total linear momentum in radial direction we get by the spatial integration of $dE_{pR}$.

$$p_R = \frac{1}{c} E_{pR} = \frac{1}{c} \int_V dE_{pR} \quad (286)$$

The BSP has constant tangential $v_t$ and radial $v_R$ velocities.

$$v_t = \frac{E_{pR}}{m c} \quad \text{and} \quad v_R = \frac{E_{pR}}{m c} \quad (287)$$

The force on a BSP is

$$F_L = \frac{dp_R}{dt} = \frac{p_R}{\Delta t} = \frac{1}{c} \frac{1}{\Delta t} E_{pR} = \frac{1}{c} \frac{1}{\Delta t} \int_V dE_{pR} \quad (288)$$

or

$$F_L = \frac{1}{c} \frac{1}{\Delta t} \int_V \left| \int_{r_t}^{\infty} dH_{n_t} \tilde{n}_t \times \int_{r_{\tilde{n}_h}}^{\infty} dH_{n_h} \tilde{n}_{\perp} \right| \quad (289)$$

The differential $dp_R$ is equal to the momentum $p_R$ because the momentum is constantly reduced to zero.

For complex particles composed of more than one BSP the force is

$$F_L = \Delta n \frac{p_R}{\Delta t} \quad (290)$$

with $\Delta n = n^+ - n^-$ where $n^+$ are the number of positive and $n^-$ the number of negative BSPs that compose the complex SP. As $n^+$ and $n^-$ are integer numbers the force is quantified.

The known Lorentz force is

$$\tilde{F}_c = Q \tilde{v}_t \times \tilde{B} \quad (291)$$

with $\tilde{F}_c$ the Lorentz force, $Q$ the electric charge and $\tilde{B}$ the magnetic flux density.

The general expression for the linear momentum due to the transversal fields of two moving BSPs is

$$dp \tilde{s}_R = \frac{1}{c} \int_R \left\{ \frac{\tilde{d}l \cdot (\tilde{n}_1 \times \tilde{n}_2)}{2\pi R} \int_{r_1}^{\infty} H_{n_1} d\kappa_{r_1} \int_{r_2}^{\infty} H_{n_2} d\kappa_{r_2} \right\} \tilde{s}_R \quad (292)$$

The concept is shown in Fig. 45.
### 3.12.2 Lorentz law.

We start with eq. (235) from sec. 3.10.1 which gives the \(dH_n\) field at the distance \(h\) and the interval \(dl\) generated by a straight infinite current \(I_m\).

\[
\int_{-\infty}^{\infty} \int_{r_r}^{\infty} d\tilde{H}_n = \frac{I_m}{\sqrt{m}} \frac{1}{4} \frac{r_o}{h} dl \, d\gamma \, \tilde{n} = d\tilde{H}_{n(cum,\infty)} \tag{293}
\]

and with eq. (261) from sec. 3.11 which gives us the force density between two straight infinite currents \(I_{m_1}\) and \(I_{m_2}\).

\[
\frac{F}{\Delta l} = \frac{b}{c \Delta t} \frac{r_o^2}{16 \, m} \frac{I_{m_1}}{d} \frac{I_{m_2}}{d} \int \int_{\text{Ampere}} \tag{294}
\]

with \(b\) the tuning factor introduced in eq. (263).

The \(dH_n\) field at \(dl\) generated by \(I_{m_1}\) is with eq. (293)

\[
d\tilde{H}_{n(cum,\infty)} = \frac{I_{m_1}}{\sqrt{m}} \frac{1}{4} \frac{r_o}{h_1} dl \, d\gamma \, \tilde{n} \tag{295}
\]

The concept is shown in Fig. 46.

For \(h_2 = 0\) we have that \(h_1 = d\) and \(dl\) overlaps with \(I_{m_2}\) and the \(dH_n\) field generated by \(I_{m_1}\) at \(dl\) is perpendicular to \(I_{m_2}\). It is

\[
I_{m_1} = \frac{4 \, d \, \sqrt{m}}{r_o \, dl \, d\gamma} d\tilde{H}_{n(cum,\infty)} \tag{296}
\]
The current $I_{m2}$ can be expressed as a function of the velocity $v_t$ of its BSPs as $I_{m2} = \rho_x m v_t$ where $\rho_x = N/\Delta x$. If we now concentrate on one BSP of $I_{m2}$ we have that $N = 1$ and $\Delta x = r_o$ resulting $I_{m2} = m v_t/r_o$. We now introduce $I_{m1}$ and $I_{m2}$ in eq. (294) and get

$$F = \frac{b}{c\Delta t} \sqrt{m v_t} dH_n \frac{1}{4} d\gamma \int \int \text{Ampere} \quad (297)$$

**Note:** For simplicity reasons we used the notation $dH_n$ instead of $dH_n(\text{cum,} \infty)$.

The equation has two variables $d\gamma$ and $dH_n$ that are free and if fixing one we fix the other. We decide to make

$$\frac{1}{4} d\gamma \int \int \text{Ampere} = 1 \quad (298)$$

In Fig. 44 we have defined the angular momentum $\vec{J}_{n_h}^{\perp}$ as the component perpendicular to the speed $\vec{v}_t$. It is $J_{n_h}^{\perp} = J_{n_h} \sin \mu$, with $\mu$ the angle between $\vec{v}_t$ and $\vec{J}_{n_h}$.

For the case of two parallel currents the $dH_n$ field from eq. (297) is perpendicular to the current $I_{m2}$ and we express it now in a more evident form as $dH_n = dH_{n_h}^{\perp}$. It is $dH_{n_h}^{\perp} = dH_{n_h} \sin \mu$, with $\mu$ the angle between $\vec{v}_t$ and $d\vec{H}_{n_h}$.

The relation between the angular momenta $J_{n_h}$ and the $dH_{n_h}$ fields is

$$dH_{n_h} = \sqrt{J_{n_h}^{\perp}} \nu \quad dH_{n_h}^{\perp} = \sqrt{J_{n_h}^{\perp}} \nu \quad (299)$$

We get

$$\vec{F} = \frac{b}{c\Delta t} \sqrt{m v_t} dH_{n_h}^{\perp} (\vec{n}_t \times \vec{n}_h) = \frac{b}{c\Delta t} \sqrt{m v_t} \times d\vec{H}_{n_h} \quad (300)$$

The force $F$ is perpendicular to the speed $\vec{v}_t$ and the $d\vec{H}_{n_h}^{\perp}$ field and describes the Lorentz force.
\[ \vec{F}_c = q \mu_0 \vec{v}_t \times \vec{H}_c = q \mu_0 v_t H_c \sin \mu \vec{n} \]  

(301)

We make \( F = F_c \) for \( \mu = \pi/2 \) and get

\[ \frac{b}{c} \sqrt{m} v_t \Delta t dH_n = q \mu_0 v_t H_c \quad \text{with} \quad H_c = \frac{1}{2\pi} \frac{I_c}{d} \]  

(302)

The following equations for the conversion from mainstream to the present approach result

\[ dH_n = \frac{q \mu_0 c \Delta t}{b \sqrt{m}} H_c = \frac{q \mu_0 c \Delta t}{b \sqrt{m}} \frac{1}{2\pi} \frac{I_c}{d} \]  

(303)

From sec. 2.16.1 we have that

\[ dH_n = \sqrt{\frac{1}{2} \mu_o dV d\kappa} \mathbf{H} \]  

(304)

where \( \mathbf{H} \) is the magnetic field strength from standard theory.

If we make \( H_c = \mathbf{H} \) we get that

\[ dV d\kappa = 2 \frac{q^2 \mu_0 c^2 \Delta^2 t}{b^2 m} = 6.66 \cdot 10^{-36} \ m^3 \]  

(305)

### 3.13 Momentum on a BSP that moves with light speed through a space with oriented transversal rotational momentums.

When a BSP moves with light speed through a space with fundamental particles with oriented transversal rotational momentums \( \bar{J}_{nt} \) as shown in Fig. 44, in the equation

\[ \bar{J}_t = - \text{sign}(\bar{J}_{nt}) \text{sign}(\bar{J}_{nh}) \left( \sqrt{J_{nt}} \vec{n}_t \times \sqrt{J_{nh}} \vec{n}_h \right) \]  

(306)

the sign of the missing LRM \( \bar{J}_{nt} \) is not defined.

The direction of the pairs of opposed TRMs \( \bar{J}_t \) that comply with the requirements for linear momentum is not defined and therefore also the direction of the linear momentum generated is undefined.

**Note:** Each angular momentum \( \bar{J}_1 \) from a \( FP_1 \) of \( BSP_1 \) has its opposed \(-\bar{J}_1\) on an other \( FP'_1 \) of \( BSP_1 \), they are entangled. If the angular momentum of \( FP_1 \) interacts with an angular momentum of a \( FP_2 \) of \( BSP_2 \), then necessarily the angular momentum of \( FP'_1 \) must interact with the angular momentum of another \( FP'_2 \) of \( BSP_2 \) so that opposed angular momentum are generated.
3.14 Momentum on complex particles that move with the speed \( v \) in a space with oriented transversal rotational momentums.

Complex particles are formed by more than one BSP that are forced in opposed directions orthogonal to the moving direction, according to their signs, when they move through a space with oriented TRMs. Thus a polarization of the positive and negative BSPs inside the complex particle occur. There are two basic cases:

- If the complex particle has the same number of positive and negative BSPs (neutron) the sum of momentum orthogonal to the moving direction compensate and the complex particle maintain its straight direction.

- If the complex particle has different numbers of positive and negative BSPs (proton) the sum of momentum orthogonal to the moving direction does not compensate and the complex particle deviate from its straight direction.

3.15 \( \Delta t \) as a function of the radius \( r_o \) of the BSP.

In the equations for the momentum responsible for the force between two static BSPs and the force on a BSP that moves in a field of oriented transversal rotational momentums, the radius \( r_o \) of the BSPs appears. The momentum time \( \Delta t \) as a function of the radius \( r_o \) is given by

\[
\Delta t = K r_o^2 \quad \text{with} \quad K = 5.42713 \cdot 10^4 \left[ \frac{s}{m^2} \right] \quad (307)
\]

From the calculations for two static BSPs and for two straight parallel conductors we have that

\[
\Delta t = 5.4274 \cdot 10^{-28} \text{ sec} \quad \text{for} \quad r_o = 10^{-16} \quad \text{and} \quad 0 \leq d \leq \infty \quad (308)
\]

**Note:** Calculations and plots originally were made for an energy distribution (see sec. 2.3)

\[
d\kappa = \frac{c}{2} v \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| W \sin \varphi \, d\varphi \quad (309)
\]

and changed to

\[
d\kappa = \frac{c}{2} v \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| W \, d\varphi \quad (310)
\]
which allows to express the Coulomb force as an rotor of the $dH_n$ field (see sec. 3.6). This explains, why there is a difference of approx. a factor 2 between the values of the plots of sec. 3.1 and values calculated with the new energy distribution.

We now analyze the two following expressions for the calculation of the force

1. Force between two static BSPs.

\[
dF = \frac{a}{c} \frac{dE_p^{(s)}}{\Delta t} \quad \text{with} \quad dE_p^{(s)} = \left| \int_{r_{r_1}}^{\infty} dH_{e_1} \bar{s}_1 \times \int_{r_{r_2}}^{\infty} dH_{e_2} \bar{s}_2 \right| \quad (311)
\]

and

\[
dH_s = H_s \, d\kappa \quad \text{with} \quad d\kappa = \frac{2}{\pi v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2} d\varphi \quad (312)
\]

We see that $dE_p^{(s)}$ is proportional to $r_o^2$. With $\Delta t = K \, r_o^2$ also proportional to $v_o^2$, the equation for the force $dF$ is independent of the radius $r_o$ of the BSPs. As complex particles like protons, atomic nucleus, etc. are formed by the sum of BSPs, the attraction force between them is also independent of their radii.

2. Force between two straight parallel currents of BSPs.

\[
dF = \frac{1}{c} \frac{dE_{p_h}}{\Delta t} \quad (313)
\]

with

\[
dE_{p_h} = \left| \int_{x=-\infty}^{\infty} \int_{r_{r_1}}^{\infty} dH_{n_1} \bar{n}_1 \times \int_{x=-\infty}^{\infty} \int_{r_{r_2}}^{\infty} dH_{n_2} \bar{n}_2 \right| \quad (314)
\]

and

\[
dH_n = H_n \, d\kappa \quad \text{with} \quad d\kappa = \frac{2}{\pi v} \left| \frac{\bar{v}_s}{|\bar{v}_e|} \times \frac{\bar{v}_r}{|\bar{v}_r|} \right| \frac{r_o}{r_r^2} d\varphi \quad (315)
\]

We see that the same considerations as for the two static BSPs are valid with the same result, that the force $dF$ is independent of the radii $r_o$ of the BSPs.

These results are conform with the two basic equations of classic physics for the force between two static BSPs and the force density between two parallel straight conductors of BSPs, that are also independent of their radii.
If we now observe the following derived equations for the Coulomb-force

\[ F_2 = \frac{4}{\pi^2} \frac{c}{K} \Delta n_1 \sqrt{m} \Delta n_2 \sqrt{m} \int_{\varphi_{1\min}}^{\varphi_{1\max}} \int_{\varphi_{2\min}}^{\varphi_{2\max}} \sin \varphi_1 \sin \varphi_2 \sin^3(\varphi_1 - \varphi_2) \, d\varphi_2 \, d\varphi_1 \]

(317)

and the force density between two parallel straight conductors of BSPs

\[ F = \frac{1}{64 \, m \, c \, K} \int_{\gamma_{1\min}}^{\gamma_{1\max}} \int_{\gamma_{2\min}}^{\gamma_{2\max}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin \gamma_1 \sin \gamma_2}} \, d\gamma_2 \, d\gamma_1 \]

(318)

and compare them with the basic equations of classic physics we see, that the permittivity \( \epsilon_o \) and the permeability \( \mu_o \) are replaced by the constant \( K \).

### 3.16 Considerations on the quantized momentum time \( \Delta t \).

The momentum time \( \Delta t \) during which reactions between two BSPs occur is

\[ \Delta t = K \, r_{o1} \, r_{o2} \]

(319)

The displacement \( \Delta d \) of a BSP in the time \( \Delta t \) due to the presence of an other BSP occurs with the speed \( k \, c \) with \( k \neq c \), and takes place each time a pair of regenerating fundamental particles that comply with the requirements for linear momentum arrive at the nucleus of the BSP.

The displacement is given by

\[ \Delta d = k \, c \, \Delta t = k \, c \, K \, r_o^2 \quad \text{for} \quad r_{o1} = r_{o2} \]

(320)

The linear momentum is

\[ p = F \, \Delta t = F \, K \, r_o^2 \]

(321)

If one of the particles is a complex particle with \( n^+ \) positive and \( n^- \) negative BSPs, the momentum is

\[ p = (n^+ - n^-) \, F \, \Delta t = (n^+ - n^-) \, F \, K \, r_o^2 \]

(322)

with \( F \) the force between the two particles at the distance \( d \).
3.17 Momentum between BSPs that move with light speed.

At BSPs that move with light speed the longitudinal rotational momentum \( \vec{J}_e = 0 \) and \( \vec{J}_s = 0 \) and therefore \( dH_e = 0 \) and \( dH_s = 0 \).

The direction of the vector products of the transversal rotational momentums \( \vec{J}_n \) of two BSPs that move with light speed, according postulate 7, are not defined because the longitudinal rotational momentums \( \vec{J}_s = 0 \)

\[
\bar{J}_1^{(n)} = \pm \left( \sqrt{J_{n1}} \bar{n}_1 \times \sqrt{J_{n2}} \bar{n}_2 \right)
\]

(323)

We get that

\[
dE^{(n)}_p = | dH_{n1} \bar{n}_1 \times dH_{n2} \bar{n}_2 | \quad \text{ and } \quad dp = \frac{1}{c} dE^{(n)}_p
\]

(324)

As photons are composed of a sequence of BSPs that move with light speed, the interaction of photons is a result of the interactions of the individual components.

BSPs with light speed have fundamental particles with only transversal rotational momentums that comply with the requirements for linear momentum. As the difference between negative and positive BSPs is given by the rotation sense of their longitudinal rotational momentums, which are zero for BSPs with light speed, BSPs with light speed have no charge.

BSPs with light speed are formed of pairs of fundamental particles with opposed transversal rotational momentums. They don’t disintegrate by emitting fundamental particles in all directions and therefore don’t need to be regenerated. The pairs of fundamental particles with opposed transversal rotational momentums are placed in planes orthogonal to the moving direction or in planes containing the moving direction.

If placed in the orthogonal plane, the potential linear momentum is in the direction or opposed to the moving direction and, if placed in the plane containing the moving direction the potential linear momentum is transversal to the moving direction.

The closed path integral along the transversal rotational momentum is

\[
\oint \vec{d}l \cdot \vec{J}_n \quad \text{ with } \quad \sum \vec{J}_n = 0
\]

(325)

3.18 Classification overview of stable particles and fields.

Stable particles that emit fundamental particles have to be regenerated to not disintegrate. They require an environment that is capable to regenerate them, an environment where fundamental particles of the other velocity than the emitted one exist in sufficient quantity. As they are regenerated, they have longitudinal rotational momentums on their regenerating fundamental particles, and therefore, a positive or negative charge
according to the sign of the longitudinal rotational momentums. Complex particles without charge are formed by equal number of positive and negative charged particles.

Stable particles that don’t emit fundamental particles don’t require to be regenerated. As they don’t emit fundamental particles they don’t disintegrate and can move through space without fundamental particles to regenerate them. As they are not regenerated, they have no regenerating fundamental particles with longitudinal rotational momentums and have therefor no charge.

There are two fundamental particles (sec.2.1) defined by their speeds (see Fig. 3).

- Fundamental particle with light speed \( c \).
- Fundamental particle with infinity speed \( \infty \).

The fundamental particles are subdivided according the angular momentums they have in:

- velocity equal \( c \) and negative longitudinal angular momentum.
- velocity equal \( c \) and positive longitudinal angular momentum.
- velocity equal \( \infty \) and negative longitudinal angular momentum.
- velocity equal \( \infty \) and positive longitudinal angular momentum.

The basic subatomic particles are classified in \( v \neq c \) and \( v = c \).

Basic subatomic particles with \( v \neq c \) are:

- accelerating electron
- decelerating electron
- accelerating positron
- decelerating positron

Basic subatomic particles with \( v = c \) (see Fig. 57 and Fig. 67) are Neutrinos which can have the following configurations:

- pair of opposed transversal angular momentum with positive linear momentum
- pair of opposed transversal angular momentum with negative linear momentum
- pair of opposed transversal angular momentum with transversal linear momentum
• pair of opposed longitudinal angular momentum with transversal linear momentum

Stable complex subatomic particles are:

• neutron (composed of electrons and positrons and binding energy)
• proton (composed of electrons and positrons and binding energy)
• nuclei of atoms
• photon (composed of neutrinos)
A classification of stable particles and fields is shown in Fig. 47.

**Fundamental particles defined by their speeds and by their longitudinal and transversal angular momentum.**

![Diagram of particle classification]

Figure 47: Classification of stable particles and fields

There are three interaction laws between fundamental particles of different BSPs, namely,

- Vector product between longitudinal angular momentums of fundamental particles (Postulate 6).

- Vector product between transversal angular momentums of fundamental particles (Postulate 7).

- Transfer of angular momentum between two fundamental particles (Postulate 8).
4 Quarks.

The existence of Quarks were first inferred from the study of hadron spectroscopy. Inferred means that they were reconstructed from the final measured products obtained after collisions of particles. The final products are neutrons, protons, pions, muons, electrons, positrons, photons, and neutrinos. As neutrons, protons, pions and muons are composed of electrons and positrons according the $E\&R$ model, the real final products are electrons, positrons photons and neutrinos. And as also according to the $E\&R$ model the photon is a sequence of neutrinos, the final products are reduced to electrons, positrons and neutrinos.

![Diagram of quarks in nucleus and meson]

Figure 48: Nucleus composed of quarks.

The concept is shown in Fig: 48

To explain the interpretation given with the model $E\&R$ UFT we calculate an
example with the proton.

**Example:** The proton has a mass of 938.2723 MeV/c². With the mass of an electron or positron of 0.511 MeV/c² we get \(\approx 1837.00\) electrons and positrons from which \(n^+ = 919\) are positrons and \(n^- = 918\) electrons. The mass of the proton \(m_p\) is equal 1837 times the mass of an electron plus the binding energy.

\[
1837 m_e + m_{\text{binding}} = m_p \tag{326}
\]

The total number of electrons and positrons at the proton are

\[
T = N_A + N_B + N_C = n^+ + n^- = 1837 \tag{327}
\]

where \(N_i\) is the total number of electrons and positrons at Quark \(i\).

As the proton is a baryon it has three quarks with the electric charge \(uud\). With the SM we get the charge of the proton adding the fractional charges

\[
u + u - d = \frac{2}{3} + \frac{2}{3} - \frac{1}{3} = 1 \tag{328}
\]

Charges that are fractions of the charge of an electron or positron were never experimentally measured.

The finding of the “E&\(R\)’ model that electrons and positrons neither attract nor repel each other when the distance between them tend to zero, allows to interprete the charge numbers \(Q\) of quarks as the relative charge

\[
u = \left| \frac{N_i^+ - N_i^-}{N_i} \right| \quad \text{and} \quad d = - \left| \frac{N_i^+ - N_i^-}{N_i} \right| \tag{329}
\]

where \(N_i^+\) and \(N_i^-\) are the number of positrons and electrons at the quark \(i\) and \(N_i = N_i^+ + N_i^-\) and \(\Delta N_i = N_i^+ - N_i^-\).

As the sum of the differences between electrons and positrons at each quark must give the charge of the proton we write

\[
u N_A + u N_B + d N_C = \frac{2}{3} N_A + \frac{2}{3} N_B - \frac{1}{3} N_C = 1 \tag{330}
\]

With equations (327) and (330) we can calculate \(N_A, N_B\) and \(N_C\) if we know one of them. If we fix for the moment arbitrarilly \(N_A = 499\) we get

\[
N_A = 499 \quad N_B = 114.33 \quad N_C = 1223.66 \tag{331}
\]

We should get integer numbers, but this is irrelevant for the moment to understand the new interpretation and continue with the obtained results and get
\[ \Delta N_A = \frac{2}{3} N_A = 332.66 \quad \Delta N_B = \frac{2}{3} N_B = 76.22 \quad \Delta N_C = -\frac{1}{3} N_C = -407.886 \] 

or

\[ \Delta N_A + \Delta N_B + \Delta N_C = 332.66 + 76.22 - 407.886 = 0.994 \] (333)

The rest masses of the quarks are, with \( m_e \) the mass of the electron

\[ m_A = N_A \, m_e = 4.54558 \cdot 10^{-28} \text{ kg} \quad m_B = N_B \, m_e = 1.03847 \cdot 10^{-28} \text{ kg} \] (334)

\[ m_C = N_C \, m_e = 1.11498 \cdot 10^{-27} \text{ kg} \] (335)

**Note:** The rest masses \( m_A \) and \( m_B \) which belong to the same type \( u \) of quarks of the proton are not equal.

As chemical elements are composed of protons and neutrons, the atomic number \( Z \) of an element can be expressed as the sum of the \( \Delta N \) of its quark constituents.

\[ Z = \sum_i \Delta N_i \] (336)

**Note:** All hadrons have a total charge equal \(-1, 0 \) or \( 1 \) while chemical elements have charges \( Z \geq 1 \). Quarks play a similar function at hadrons as protons and neutrons play at chemical elements.

Now we come back to the fractional numbers of \( N \) and \( \Delta N \). If we round the fractional numbers slightly to get integer numbers as follows

\[ N_A = 499 \quad N_B = 114 \quad N_C = 1224 \quad \text{to get} \quad T = 1837 \] (337)

\[ \Delta N_A = 333 \quad \Delta N_B = 76 \quad \Delta N_C = 408 \quad \text{to get} \quad \sum \Delta N = 1 \] (338)

we get for the relative charge of the quarks

\[ u_A = \frac{\Delta N_A}{N_A} = 0.6673 \quad u_B = \frac{\Delta N_B}{N_B} = 0.6666 = \quad d_C = \frac{\Delta N_C}{N_C} = 0.33333 = \] (339)
and if we compare with $\frac{2}{3} = 0.6666666$ and $\frac{1}{3} = 0.333333$ we see that they are in the error range of measurements.

**More examples:**

For the $\pi^+$ particle we have that $n^+ = 137$ and $n^- = 136$ and that it is an $u\bar{d}$ particle.

$$T = N_A + N_B = n^+ + n^- = 273 \quad (340)$$

$$u - \bar{d} = \frac{2}{3} + \frac{1}{3} = 1 \quad (341)$$

With the equations

$$\frac{2}{3} N_A - \frac{1}{3} N_B = 1 \quad \text{and} \quad N_A + N_B = 273 \quad (342)$$

we get

$$N_A = 92 \quad \Delta N_A = u N_A = 61.333 \quad (343)$$

$$N_B = 181 \quad \Delta N_B = d N_B = -60.333 \quad (344)$$

$$\Delta N_A + \Delta N_B = 61.333 - 60.333 = 1 \quad (345)$$

The rest masses of the quarks are

$$m_A = N_A m_e = 8.3806 \cdot 10^{-29} \text{ kg} \quad m_B = N_B m_e = 1.6488 \cdot 10^{-28} \text{ kg} \quad (346)$$

For the neutron we have that $n^+ = 919$ and $n^- = 919$ and that it is a $udd$ particle.

We get

$$T = N_A + N_B + N_C = n^+ + n^- = 1838 \quad (347)$$

$$u - d - d = \frac{2}{3} - \frac{1}{3} - \frac{1}{3} = 0 \quad (348)$$

For the $\Sigma^+$ particle we have that $n^+ = 1164$ and $n^- = 1163$ and that it is an $uuu$ particle.
\[ T = N_A + N_B + N_C = n^+ + n^- = 2327 \]  

\[ u + u + s = \frac{2}{3} + \frac{2}{3} - \frac{1}{3} = 1 \]

The distribution of electrons and positrons on the different quarks must not be necessarily static.

**Conclusion:** The \( Q \) values for the electric charge at quarks refer to the relative charge of the quarks. There is no need to introduce fractional charges which were never directly measured. All charges are integer multiples of the charge of an electron, which constitutes the unit of the charge.

**Note:** No strong forces or gluons are necessary to hold quarks together, because for the distance tending to zero electrons and positrons neither attract nor repel each other. The distribution of electrons and positrons on the quarks is not a constant. The number \( N_i \) of the \( u \) quarks of one hadron may be different because \( u \) gives only the relative charge of a quark.

## 5 Spin of level electrons and the formation of elements

In sec. 2.1 two types of electrons and positrons were identified according the velocities of their regenerating and emitting fundamental particles; they were named accelerating and decelerating BSPs.

We know, that electrons in individual energy orbits must have different states which the SM explains with two states of angular and magnetic momenta (spins). In the present approach the two states are explained with the two types of electrons, namely accelerating and decelerating electrons.

For each type of level electron, a corresponding opposed type of positron must exist in the atomic nucleus, to allow that the emitted fundamental particles of one can regenerate the other. This leads to the conclusion, that protons and neutrons are also composed of BSPs of different types.

**Neutron:** Composed of 919 electrons and 919 positrons. The 919 electrons are composed of 459 accelerating, 459 decelerating and 1 acc/dec electrons. The 919 positrons are composed of 459 accelerating, 459 decelerating and 1 dec/acc positrons.

**Proton:** Composed of 918 electrons and 919 positrons. The 918 electrons are composed of 459 accelerating and 459 decelerating electrons. The 919 positrons are
composed of 459 accelerating, 459 decelerating and 1 acc/dec positrons.

The concept is shown in Fig. 49.

![Diagram of Neutron and Proton](image)

Figure 49: Neutron and proton

The definition of two types of electrons and positrons has let to protons that are formed of BSPs that complement each other and which are of two types:

- Protons formed of accelerating positrons and decelerating electrons and
- Protons formed of decelerating positrons and accelerating electrons

The level electron associated to a proton is of the same type as the electrons of the proton. Elements in the Periodic Table are classified according to the growing number of protons in their nuclei and with level electrons that alternate their spin. In the present approach the elements of the periodic table are built with alternating types of protons and the two types of electrons with opposed spin from our standard theory are replaced by the accelerating and decelerating electrons.

The formation of elements is shown in Fig. 50.
Atoms

a)

Hydrogen Atom

b)

Helium Atom

Figure 50: Level electrons of Hydrogen and Helium Atoms
6 Laws that describe dynamic interactions between BSPs.

In this section the forces induced on static BSPs, caused by longitudinal and transversal angular momenta of BSPs that move with constant speed, are derived.

The possibility to explain static laws through dynamic laws is presented.

The generation of gravitation forces is deduced and a proposal for gravitational momenta between galaxies and black holes is made.

The force field of an oscillating dipole is derived and the irradiated energy is decomposed in its longitudinal and transversal components.

A relation between the radius of the oscillating BSP and its energy is deduced.

The 1. Maxwell equations for the static and the far induced fields are derived.

The 2. Maxwell equation is derived and the equivalence between the vector \( dH_n \) and the magnetic Hertz field vector \( \Pi_m \) is shown.

The divergence of static and induced fields are presented.

The Lorenz invariance of the deduced Maxwell-equations is presented.

6.1 Field at a point \( P \) of the space due to a BSP that moves with an instant speed \( v \).

The time variation of the longitudinal and transversal rotational momentums fields \( d\bar{H}_s \) and \( d\bar{H}_n \) at a point \( P \), produced by a BSP that moves with an instant speed \( \bar{v} \) at the \( x \) coordinate, is now analyzed.

Starting with

\[
\frac{dH_s}{dt} = H_s \frac{d\kappa}{dt} \tilde{s} \quad \text{and} \quad \frac{dH_n}{dt} = H_n \frac{d\kappa}{dt} \tilde{n}
\]  

and

\[
H_s = H_s(v) \quad H_n = H_n(v) \quad d\kappa = d\kappa(r, \varphi) \quad r = r(t) \quad \varphi = \varphi(t)
\]  

we get for the time differentiation of the longitudinal field

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_s = - \frac{d}{dt} [H_s] \int_{r_r}^{\infty} d\kappa \tilde{s}_r - H_s \frac{d}{dt} \int_{r_r}^{\infty} d\kappa \tilde{s}_r + H_s \int_{r_r}^{\infty} d\kappa \frac{d\varphi}{dt} \tilde{s}_\varphi
\]  

(354)
with
\[ d\kappa = \frac{1}{2} \frac{r_o}{r_r^2} dr_r \sin \varphi \, d\varphi \quad \text{and} \quad \int_{r_r}^{\infty} d\kappa = \frac{1}{2} \frac{r_o}{r_r} \sin \varphi \, d\varphi \] (355)

resulting
\[ \frac{d}{dt} \int_{r_r}^{\infty} d\kappa = \frac{d}{dt} \int_{r_r}^{\infty} \kappa(r_r) + \frac{d}{dt} \int_{r_r}^{\infty} \kappa(\varphi) + \frac{d}{dt} \int_{r_r}^{\infty} \kappa(r_o) \] (356)

With the last term of eq. 356 we have anticipated the results of sec.6.5.4 that show that the radius \( r_o \) of a BSP is a function of its energy that can vary with time.

\[ r_o = \frac{\hbar c}{E} \] (357)

with
\[ E = \sqrt{E_o^2 + E_p^2} \quad \text{for BSP with } v \neq c \] (358)

and
\[ E = \hbar \omega \quad \text{for BSP with } v = c \] (359)

The variations in the directions \( r_r \) and \( \varphi \) are defined by the unit vectors \( \bar{s}_r \) and \( \bar{s}_\varphi \). For sign conventions see Fig. 51.

The vectors \( \bar{s}_r = -\bar{s}, \bar{s}_\varphi \) and \( \bar{s}_\delta = \bar{n} \) are orthogonal unit vectors.

It is important to note that for the time differentiation of the transversal field, the vector \( \int_{r_r}^{\infty} dH_n \) is normal to the surface formed by \( v \) and \( r_r \), and doesn’t change its direction with the variations of \( r_r \) and \( \varphi \) because of \( dy = -v \, dt \). This means, that the variations in time of \( \int_{r_r}^{\infty} d\kappa \) in the direction \( \bar{s}_\gamma \) add algebraic.

\[ \frac{d}{dt} \int_{r_r}^{\infty} dH_n = \frac{d}{dt}[H_n] \int_{r_r}^{\infty} d\kappa \bar{s}_\gamma + H_n \frac{d}{dt} \int_{r_r}^{\infty} d\kappa \bar{s}_\gamma \] (360)

The concept is shown in Fig. 51.

6.1.1 Deduction of \( \frac{d}{dt} \int_{r_r}^{\infty} d\kappa \) at a point \( P \) for a BSP that moves with the speed \( v \).

It is
\[ d\kappa = \frac{1}{2} \frac{r_o}{r_r^2} dr_r \sin \varphi \, d\varphi \quad \text{and} \quad \int_{r_r}^{\infty} d\kappa = \frac{1}{2} \frac{r_o}{r_r} \sin \varphi \, d\varphi \] (361)
The time differentiation presents three terms depending if the differentiation is made towards $r_r$ or $\varphi$ or $r_o$.

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\kappa(r_r) = \frac{\delta}{\delta r_r} \int_{r_r}^{\infty} d\kappa(r_r) \frac{dr_r}{dt} \tag{362}
\]

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\kappa(\varphi) = \frac{\delta}{\delta \varphi} \int_{r_r}^{\infty} d\kappa(\varphi) \frac{d\varphi}{dt} \tag{363}
\]

and

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\kappa(r_o) = \frac{\delta}{\delta r_o} \int_{r_r}^{\infty} d\kappa(r_o) \frac{dr_o}{dt} \tag{364}
\]

With the instant speed $v(t)$ of a BSP on the $y$ coordinate and without signal time delay considerations, we have

\[
\frac{\delta}{\delta r_r} \int_{r_r}^{\infty} d\kappa(r_r) = -\frac{1}{2} \frac{r_o}{r_r^2} \sin \varphi \, d\varphi \quad \frac{dr_r}{dt} \approx v(t) \cos \varphi \tag{365}
\]

\[
\frac{\delta}{\delta \varphi} \int_{r_r}^{\infty} d\kappa(\varphi) = \frac{1}{2} \frac{r_o}{r_r} \cos \varphi \, d\varphi \quad \frac{d\varphi}{dt} \approx -\frac{v(t)}{r_r} \sin \varphi \tag{366}
\]

and
\[
\frac{\delta}{\delta r_o} \int_{r_r}^{\infty} d\kappa(r_o) = \frac{1}{2} \frac{1}{r_r} \sin \varphi \, d\varphi \quad \frac{dr_o}{dt} = \frac{dr_o}{dt}
\] (367)

We get for the time differentiation of \( \int_{r_r}^{\infty} d\kappa \) in the direction of \( r_r \)

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\kappa(r_r) = -\frac{1}{2} v(t) \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi
\] (368)

and in the direction of \( \varphi \)

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\kappa(\varphi) = -\frac{1}{2} v(t) \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi
\] (369)

and in the direction of \( r_o \)

\[
\frac{d}{dt} \int_{r_r}^{\infty} d\kappa(r_o) = \frac{1}{2} \frac{1}{r_r} \sin \varphi \, d\varphi \frac{dr_o}{dt}
\] (370)

6.1.2 Deduction of the time differentiations at a point \( P \) of the longitudinal and transversal fields for a BSP that moves with \( v \).

The time differentiation for the longitudinal field was

\[
\frac{d}{dt} \int_{r_r}^{\infty} dH_s = -\frac{1}{2} \frac{d}{dt} [H_s] \int_{r_r}^{\infty} \kappa \, s_r - 2 \frac{d}{dt} \kappa \, s_r + r_o \frac{d}{dt} \frac{d\varphi}{dt} \sin \varphi \gamma - H_s \frac{d}{dt} \frac{d\varphi}{dt} \sin \varphi \gamma (371)
\]

and for the time differentiation of the \textbf{longitudinal field} we get

\[
\frac{d}{dt} \int_{r_r}^{\infty} dH_s = -\frac{1}{2} \frac{d}{dt} [H_s] \frac{r_o}{r_r} \sin \varphi \, d\varphi \, s_r + H_s v(t) \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi \, s_r
\] (372)

\[
\frac{1}{2} H_s \frac{1}{r_r} \sin \varphi \, d\varphi \frac{dr_o}{dt} \, s_r - \frac{1}{2} H_s v(t) \frac{r_o}{r_r^2} \sin^2 \varphi \, d\varphi \, s_r
\]

The time differentiation for the transversal field was

\[
\frac{d}{dt} \int_{r_r}^{\infty} dH_n = \frac{d}{dt} [H_n] \int_{r_r}^{\infty} \kappa \, s_\gamma + H_n \frac{d}{dt} \frac{d\varphi}{dt} \sin \varphi \gamma
\] (373)

and for the time differentiation of the \textbf{transversal field} we get

\[
\frac{d}{dt} \int_{r_r}^{\infty} dH_n = \frac{1}{2} \frac{d}{dt} [H_n] \frac{r_o}{r_r} \sin \varphi \, d\varphi \, s_\gamma - H_n v \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi \, s_\gamma
\] (374)
\[ + \frac{1}{2} H_n \frac{1}{r_\gamma} \sin \varphi \, d\varphi \, \frac{dr_o}{dt} \, s_\gamma \]

We now analyze three cases: First for speeds \( v \ll c \), second for speeds where \( \Delta v = c - v \ll c \) and third for \( v = c \).

a) case with \( v \ll c \).

For \( v \ll c \) we get for \( H_s \)

\[ H_s = c \sqrt{m} \quad \text{and} \quad \frac{d}{dt} [H_s] = 0 \quad (375) \]

and for \( H_n \)

\[ H_n = v \sqrt{m} \quad \text{and} \quad \frac{d}{dt} [H_n] = \frac{dv}{dt} \sqrt{m} \quad (376) \]

and for \( r_o \)

\[ r_o = \frac{\hbar c}{E_o} \quad \text{and} \quad \frac{dr_o}{dt} = 0 \quad (377) \]

b) case with \( \Delta v \ll c \).

We have that

\[ E_p^2 \gg E_o^2 \quad \text{with} \quad E_p = m \, c \, \frac{v}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (378) \]

and

\[ \frac{d}{dt} [E_p] = m \, c \left\{ \left[ 1 - \frac{v^2}{c^2} \right]^{-\frac{3}{2}} + \frac{v^2}{c^2} \left[ 1 - \frac{v^2}{c^2} \right]^{-\frac{3}{2}} \right\} \frac{dv}{dt} \quad (379) \]

For the longitudinal field \( H_s \) we get

\[ H_s \approx \frac{E_o}{\sqrt{E_p}} \quad \text{and} \quad \frac{d}{dt} [H_s] \approx - \frac{1}{2} E_o \, E_p^{-\frac{3}{2}} \frac{d}{dt} [E_p] \quad (380) \]

and for the transversal field \( H_n \) we get

\[ H_n \approx \sqrt{E_p} \quad \text{and} \quad \frac{d}{dt} [H_n] = \frac{1}{2} E_p^{-\frac{3}{2}} \frac{d}{dt} [E_p] \quad (381) \]

and for \( r_o \) we get

\[ r_o = \frac{\hbar c}{E_p} \quad \text{and} \quad \frac{dr_o}{dt} = - \frac{\hbar c}{E_p} \frac{d}{dt} [E_p] \quad (382) \]

c) case with \( v = c \).
If simultaneously $v \to c$ and the rest mass $m \to 0$ we define that

$$\lim_{v \to c \atop m \to 0} \frac{m}{\sqrt{1 - \frac{v^2}{c^2}}} = m_c$$

where $m_c$ is the mass of the BSP with light speed. We also define that

$$m_c = \frac{E_c}{c^2} \quad \text{with} \quad E_c = \hbar \omega$$

With $v \to c$ and $m \to 0$ we also have

$$E_o \to 0 \quad H_s = 0 \quad H_n = \sqrt{E_c} = \sqrt{m_c} c$$

For $v = c$ we have

$$\frac{dv}{dt} = 0 \quad \frac{d}{dt} [H_n] = \frac{c}{2\sqrt{m_c}} \frac{d}{dt} [m_c]$$

$$r_o = r_{oc} = \frac{\hbar}{E_c} \quad \frac{d}{dt} [r_{oc}] = -\frac{\hbar}{m_c^2 c} \frac{d}{dt} [m_c]$$

### 6.2 Induced force on a static BSP placed in a field $d\vec{H}$ that changes with time.

We form the closed path integral according eq.(202) from sec. 3.6

$$\oint d\vec{l} \cdot \frac{d}{dt} \int_{r_o}^{\infty} dH_n$$

The concept is shown in Fig. 52.
Even though the tangential values \( \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \) of the fundamental particles are not distributed in opposed pairs symmetric to the probe BSP, so that the rotational momentums \( \bar{J}_n \) form regular opposed pairs, they can be replaced by an equivalent configuration of rotational momentums of equal dimension resulting in the same closed path integral.

This equivalent configuration of opposed rotational momentums generate linear momentum \( dp \) on the probe BSP placed in the variable field.

The linear momentum generates a force \( dF_{in} \) given by

\[
dF_{in} = \frac{1}{c} \oint \frac{d\bar{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d\bar{H}_n \int_{r_p}^{\infty} dH_{sp} \quad (389)
\]

with \( dH_{sp} \) from the static BSP.

To obtain the total force \( F_{in} \) on the static BSP we have to integrate over the whole space around the static BSP.

**Note:** The field \( dH_n \) generated by the moving BSP is the same for negative and positive moving BSPs. The induced force on the probe BSP results from pairs of opposed \( dH_n \) that pass from the moving to the probe BSP. The induced force is therefore independent of the signs of the interacting BSP’s.
6.2.1 Force induced on a static BSP by the transversal field $dH_n$ of a BSP that moves with $v$.

To calculate the momentum or the force on the probe BSP, all closed path integrals in the space around the probe or test BSP must be added, what is mathematically nearly impossible. To work with a more practicable instrument we take as a representant of the integral over the whole space a well defined closed path integral, divide it by its area and take the limit when the area tends to zero. The substitution of the whole space integral by the rotor at the point of the test BSP implies the existence of a proportionality between these variables.

We start with the equation for the force $dF_{in}$ generated by a no specifically defined closed path integral contained in a plane orthogonal to the plane formed by $\vec{v}$ and $r_r$.

$$dF_{in} = \frac{1}{c} \oint \frac{d\vec{l}}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} dH_n \int_{r_p}^{\infty} dH_{sp} \quad [N]$$

(390)

and define a special closed path integral that is positioned relatively to the test BSP so that $r_p = R$ and $\varphi_p \rightarrow \frac{\pi}{2}$.

We get for

$$\int_{R}^{\infty} dH_{sp} = \frac{1}{2} H_{sp} \frac{r_{op}}{R} \sin \varphi_{p} d\varphi_{p} \frac{d\gamma_{p}}{2\pi} \approx \frac{1}{2} \sqrt{m_p c} \frac{r_{op}}{R} d\varphi_{p} \frac{d\gamma_{p}}{2\pi}$$

(391)

We put the obtained expression in the equation for $dF_{in}$ and change terms resulting

$$dF_{in} = \frac{1}{4} \sqrt{m_p} r_{op} d\varphi_{p} \frac{d\gamma_{p}}{2\pi} \oint \frac{d\vec{l}}{\pi R^2} \cdot \frac{d}{dt} \int_{r_r}^{\infty} dH_n$$

(392)

Now we take the limit for $R \rightarrow 0$ and obtain

$$d\bar{F}_{in} = \frac{1}{4} \sqrt{m_p} r_{op} d\varphi_{p} \frac{d\gamma_{p}}{2\pi} \int \frac{d\vec{l}}{\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} dH_n$$

(393)

or

$$d\bar{F}_{in} = K_{ip} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} dH_n \quad [N]$$

(394)

with

$$K_{ip} = \frac{1}{4} \sqrt{m_p} r_{op} d\varphi_{p} \frac{d\gamma_{p}}{2\pi}$$

(395)

Now we introduce a transformation to overcome the undefined variables $d\varphi$ and $d\gamma$ and define

$$d'\kappa = \frac{d\kappa}{\Delta \varphi \Delta \gamma} = \frac{1}{4\pi} \frac{r_{o}}{r_{r}^2} dr_{r} \sin \varphi$$

(396)
and get as general expressions

\[ d'H_n = H_n \frac{r_o}{r^2} dr r \sin \varphi \]  

(397)

and

\[ d'H_s = H_s \frac{r_o}{r^2} dr r \sin \varphi \]  

(398)

We get as general expression for the force

\[ d'F_{in} = \frac{1}{c} \oint \frac{dl}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} \frac{d'H_n}{H_n} \int_{p_r}^{\infty} \frac{d'H_{sp}}{H_{sp}} \]  

[N]  

(399)

with

\[ d'F_{in} \]  

(400)

and for the specially defined closed path integral

\[ d'F_{in} = \frac{1}{8\pi} \sqrt{m_p} \frac{r_o}{r_{p}} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d'H_n \]  

(401)

with

\[ d'H_n = \frac{1}{4\pi} H_n \frac{r_o}{r^2} dr r \sin \varphi \]  

(402)

### 6.2.2 Force induced on a static BSP by the longitudinal field \(dH_s\) of a BSP that moves with \(v\).

We start with the equation for the force \(dF_s\) generated by a no specifically defined closed path integral contained in the plane formed by \(\vec{v}\) and \(r_r\).

\[ dF_s = \frac{1}{c} \oint \frac{dl}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} d'H_s \int_{p_r}^{\infty} d'H_{sp} \]  

[N]  

(403)

with

\[ \int_{p_r}^{\infty} d'H_{sp} = \frac{1}{2} H_{sp} \frac{r_o}{r_p} \sin \varphi_p \frac{d\gamma_p}{2\pi} \]  

(404)

and

\[ H_s = \sqrt{E_s} \quad E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \quad H_{sp} = c \sqrt{m_p} \]  

(405)
If we put these expressions in the first equation and change terms we get with

\[ R = r_p \sin \varphi_p \]

\[
dF_{i_s} = \frac{1}{4} c \sqrt{m_p r_{op}} \sin^2 \varphi_p d\varphi \frac{d\gamma_p}{2\pi} \frac{1}{c} \int \frac{d\bar{l}}{\pi R^2} \cdot \frac{d}{dt} \int_{r_r}^{\infty} dH_s \tag{406} \]

If we chose the closed path integral so that \( \varphi_p = \frac{\pi}{2} \) we get

\[
d\bar{F}_{i_s} = \frac{1}{8\pi} \sqrt{m_p r_{op}} d\varphi_p d\gamma_p \frac{d}{dt} \int_{r_r}^{\infty} dH_s \tag{407} \]

We define that

\[
d'F_{i_s} = \frac{dF_{i_s}}{\Delta \varphi \Delta \gamma \Delta \varphi_p \Delta \gamma_p} \tag{408} \]

and get

\[
d'\bar{F}_{i_s} = \frac{1}{8\pi} \sqrt{m_p r_{op}} \frac{d}{dt} \int_{r_r}^{\infty} d'H_s \tag{409} \]

with

\[
d'\bar{H}_s = \frac{1}{4\pi} H_s \frac{r_o}{r_0^2} dr_r \sin \varphi \bar{s} \tag{410} \]

**Note:** If we compare eq.(401) and eq.(409) with the corresponding equations from standard theoretical physics

\[
\bar{B} = \text{rot} \bar{A} \quad \bar{E} = -\frac{\partial}{\partial t} \bar{A} \quad \bar{F} = q\bar{E} = -q\frac{\partial}{\partial t} \bar{A} \tag{411} \]

with

\[
\bar{A} = \frac{\mu_o}{4\pi} \int \frac{\bar{J}(\bar{r}')}{|\bar{r} - \bar{r}'|} dV' \tag{412} \]

we conclude that the vector potential field \( \bar{A} \) is related to the field \( d'\bar{H} \) through

\[
\bar{A} = -\frac{1}{8\pi q} \sqrt{m_p r_{op}} \int V \text{rot} \int_{r_r}^{\infty} d'H \tag{413} \]

### 6.3 Induced linear momentum balance between static and moving BSPs.

For practical purpose we introduced in sec. 6.2.1 the rotor as representative of the space integral assuming proportionality between them. In what follows we differentiate between aligned and not aligned particles.

112
6.3.1 Induced linear momentum balance between not aligned static and moving BSPs.

The forces induced on the static probe BSP are defined by the equations (409) and (401).

\[
d'\bar{F}_{is} = \frac{1}{8 \pi} \sqrt{m_p r_{op}} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d'H_s
\]

and

\[
d'\bar{F}_{in} = \frac{1}{8 \pi} \sqrt{m_p r_{op}} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d'H_n
\]

where

\[
d'H_s = H_s d'\kappa \bar{s} \quad \text{and} \quad d'H_n = H_n d'\kappa \bar{n}
\]

with

\[
H_s = H_s(v) \quad H_n = H_n(v) \quad v = v(t)
\]

The function \(d'\kappa\) has a rotational symmetry around the velocity vector \(\bar{v}\), and complies with

\[
d'\kappa(r_r, \varphi) = d'\kappa(r_r, \pi - \varphi) \quad \text{for arbitrary } \gamma
\]

where

\[
d'\kappa = \frac{1}{4\pi} \frac{r_o}{r_r^2} dr_r \sin \varphi \quad \text{with} \quad r_r = r_r(t) \quad \varphi = \varphi(t)
\]

The rotor can be interchanged with the time differentiation resulting

\[
d'F_{is} = \frac{d'\bar{p}_{is}}{dt} = \frac{1}{8 \pi} \sqrt{m_p r_{op}} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d'H_s \bar{s}
\]

and

\[
d'F_{in} = \frac{d'\bar{p}_{in}}{dt} = \frac{1}{8 \pi} \sqrt{m_p r_{op}} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d'H_n \bar{n}
\]

The corresponding linear momentums are shown on Fig. 53.
Figure 53: Linear momentum balance between not aligned static and moving BSPs

We get for a constant velocity $v$

$$d' \bar{p}_s = 0 \bar{s}_r + 0 \bar{s}_\theta + \frac{1}{32\pi^2} \sqrt{m_p r_{op}} \frac{r_o}{r_r^2} H_s \cos \theta \bar{s}_\gamma$$ \hspace{1cm} (422)

and

$$d' \bar{p}_n = - \frac{1}{16\pi^2} \sqrt{m_p r_{op}} \frac{r_o}{r_r^2} H_n \cos \theta \bar{s}_r + 0 \bar{s}_\theta + 0 \bar{s}_\gamma$$ \hspace{1cm} (423)

with

$$\bar{s} = - \bar{s}_r \hspace{1cm} \bar{n} = \bar{s}_\gamma$$ \hspace{1cm} (424)

$$\varphi = \pi - \theta \hspace{1cm} \sin \varphi = \sin \theta \hspace{1cm} \cos \varphi = - \cos \theta \hspace{1cm} d\varphi = -d\theta$$ \hspace{1cm} (425)

and
\[
\frac{dr_r}{dt} = -v \cos \theta \\
\frac{d\theta}{dt} = \frac{v}{r_r} \sin \theta
\]  

(426)

Because of the symmetry of the function \(d' \kappa\) the potential linear momentums \(d' \tilde{p}_i\) at the symmetric points \(P\) and \(P'\) are opposed as shown on Fig. 53. That means, that if a probe BSP at the point \(P\) absorbs the angular momentums of the regenerating fundamental particles that produce the linear momentum \(d' \tilde{p}_i\) at the moving BSP, the corresponding angular momentums at point \(P'\) are not more compensated when they arrive at the nucleus of the moving BSP producing there the opposed linear momentum \(-d' \tilde{p}_i\).

**Note:** The direction of the induced force is independent of the sign of the longitudinal angular momentum of the regenerating fundamental particles of the probe particle.

### 6.3.2 Induced linear momentum balance between aligned static and moving BSPs.

We describe now the mechanism how the linear momentum is exchanged between aligned moving and static BSPs.

The concept is shown in Fig. 54.

We start with the moving BSP 1' with the speed \(v_1\) and momentum \(p_1\), which is regenerated as BSP 1 through its longitudinal \(dH_{s1}\) and transversal \(dH_{n1}\) rotational momentums. When BSP 1 approximates to the static BSP 2, the regenerating rotational momentums \(dH_{s2}\) from BSP 2 will take over the rotational momentums \(dH_{n1}\) from BSP 1. When BSP 1 looses its transversal rotational momentums it stops to \(v = 0\), and BSP 2 now moves with the speed \(v_2\) and the momentum \(p_2\) that is equal to the momentum that BSP 1 had before stopping (conservation law).
6.4 Resume of origin of linear momentum.

The energy of a particle is stored in the longitudinal and transversal angular momenta of its regenerating fundamental particles.

Linear momenta are generated by opposed transversal angular momenta that comply with the requirements for generation of linear momenta (sec. 2.10).

Opposed transversal angular momenta that comply with the requirements for generation of linear momenta are generated by

- a moving particle
- the crossing of longitudinal angular momenta of two particles
- the crossing of transversal angular momenta of two moving particles

Opposed transversal angular momenta of a moving particle, that comply with the requirements for generation of linear momenta, can be absorbed by the regenerating longitudinal angular momenta of an other particle, generating on it the corresponding linear momenta (Induced linear momentum).
The following Fig. 55 shows a schematic representation of the generation of the induced force by a moving BSP on a static BSP.

Figure 55: Generation of the induced forces.
6.5 The induced far force field of an oscillating BSP.

We start with eq. (401)

\[ d' F_i = \frac{1}{8\pi} \sqrt{m_p} r_{op} \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d' H_n \]  

(427)

The equation (374) of the transversal field of a BSP that moves with \( v \ll c \) is with \( d' H_n = (2\pi)^{-1} d\tilde{H}_n \) and \( dr_o / dt = 0 \) and \( \tilde{s}_\gamma = \tilde{n} \)

\[ d' \tilde{H}_n = \frac{1}{4\pi} \sqrt{m} \frac{dv}{dt} \frac{r_o}{r_r} \sin \varphi \tilde{n} - \frac{1}{2\pi} \sqrt{m} v^2 \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \tilde{n} \]  

(428)

We now calculate the far field of an oscillating BSP in neglecting the second term that is invers proportional to \( r_r^2 \).

**Note:** The longitudinal field eq. (372) can also be neglected for the far field because it is also inverse proportional to \( r_r^2 \).

We introduce now a change of coordinates.

\[ \theta = \pi - \varphi \quad \sin \varphi = \sin \theta \quad \cos \varphi = -\cos \theta \quad d\varphi = -d\theta \]  

(429)

The concept is shown in Fig. 56

Figure 56: Coordinate transformation for the calculation of the rotor
\[
\frac{d}{dt} \int_{r_r}^{\infty} d' \hat{H}_n = \hat{C}_n = C_r \, \hat{e}_r + C_\gamma \, \hat{e}_\gamma + C_\theta \, \hat{e}_\theta
\]  

(430)

To consider the time delay we define an oscillation with a time delay \( t_r = \frac{r_c}{c} \) as a function of \( r_r \).

\[
y = -y_m \, \sin \left[ \omega \left( t - \frac{r_c}{c} \right) \right] \quad \text{and with} \quad v_m = y_m \, \omega
\]  

(431)

\[
v = -v_m \, \cos \left[ \omega \left( t - \frac{r_c}{c} \right) \right] \quad \frac{dv}{dt} = v_m \, \omega \, \sin \left[ \omega \left( t - \frac{r_c}{c} \right) \right]
\]  

(432)

and

\[
\frac{dv}{dr_r} = -v_m \, \frac{\omega}{c} \, \sin \left[ \omega \left( t - \frac{r_c}{c} \right) \right]
\]  

(433)

So we have that

\[
C_r = 0 \quad C_\gamma = \frac{1}{4\pi} \sqrt{m} \, v_m \, \omega \, \frac{r_o}{r_r} \sin \theta \sin \eta \quad C_\theta = 0
\]  

(434)

with

\[
\eta = \left[ \omega \left( t - \frac{r_c}{c} \right) \right]
\]  

(435)

The components of \( \text{rot} \, \hat{C}_n \) are given by

\[
(\text{rot} \, \hat{C}_n)_{r_r} = \frac{1}{2\pi} \sqrt{m} \, v_m \, \omega \, \frac{r_o}{r_r^2} \cos \theta \sin \eta \quad (\text{rot} \, \hat{C}_n)_\gamma = 0
\]  

(436)

\[
(\text{rot} \, \hat{C}_n)_\theta = \frac{1}{4\pi} \sqrt{m} \, v_m \, \frac{\omega^2}{c} \, \frac{r_o}{r_r} \sin \theta \cos \eta
\]  

(437)

For the far field we neglect all terms that have an inverse proportionality greater than \( r_r \). We get

\[
(\text{rot} \, \hat{C}_n)_{r_r} \approx 0 \quad (\text{rot} \, \hat{C}_n)_\gamma = 0
\]  

(438)

\[
(\text{rot} \, \hat{C}_n)_\theta = \frac{1}{4\pi} \sqrt{m} \, v_m \, \frac{\omega^2}{c} \, \frac{r_o}{r_r} \sin \theta \cos \eta
\]  

(439)

The far force field of the oscillating BSP in relation to the mass is

\[
\frac{d' \hat{F}_i}{\sqrt{m_p} \sqrt{m}} = \frac{1}{32\pi^2} \rho_o \, r_o \, v_m \, \frac{\omega^2}{c} \, \frac{r_o}{r_r} \sin \theta \cos \eta \, \hat{e}_\theta \quad \left[ \frac{N}{kg} \right]
\]  

(440)

with \( r_o \) the radius of the static test BSP and \( r_o \) the radius of the particle that
moves with $v$.

The far force field is proportional to $\omega^2$ and inverse proportional to $r_r$ and coincides with the form of the far oscillating force of an electric dipole that is equal to

$$E = \frac{\mathcal{F}_e}{Q} = \frac{1}{4 \pi} \frac{p_o}{r} \frac{\omega^2}{c^2} \sin \theta \cos \eta \bar{e}_\theta$$

\[ 441 \]

with $p_o = y_m Q$ the electric dipole moment.

### 6.5.1 Induced power on a static BSP that is in the far field of an oscillating BSP.

The energy of the far field is stored in the transversal rotational momentum $J_n$ of the regenerating fundamental particles of the oscillating BSP.

If we introduce a static test BSP in the oscillating far field, a force $d'F_i = m_p \frac{dF}{dt}$ will actuate on the particle and give a kinetic energy $\Delta E = \frac{1}{2} m_p \Delta^2 v_p$ in the time $\Delta t = K r_o^2$. The imparted kinetic energy is absorbed by an external force and reduced to zero.

So we have that

$$\Delta E = \frac{1}{2} \frac{\Delta^2 p}{m_p} \quad \Delta E = \frac{1}{2} \frac{(\Delta t \ d'F_i)^2}{m_p} \quad \Delta E = \frac{1}{2} \frac{K^2 r_o^4}{m_p} d'F_i^2$$

\[ 442 \]

The above energy is produced in the time $\Delta t$ what gives a power of

$$P = \frac{\Delta E}{\Delta t} = \frac{1}{2} \frac{\Delta t}{m_p} d'F_i^2 \quad P = \frac{1}{2} \frac{K r_o^2}{m_p} d'F_i^2$$

\[ 443 \]

If we consider that the test BSP oscillates with the same frequency as the main BSP and therefore both have the same radius $r_o$ and mass $m$, we get for the power density

$$S = \frac{1}{2} \left[ \frac{1}{32\pi^2} \right]^2 \frac{K m}{c^2} \frac{r_o^4}{c^2} \frac{\omega^4}{r_r^2} \sin^2 \theta \cos^2 \left( \omega (t - \frac{r_r}{c}) \right)$$

\[ 444 \]

The power density is proportional to $\omega^4$ and inverse proportional to $r_r^2$ and coincides with the equation of an electric oscillating dipole.

We note that the energy emitted by a BSP through their emitted fundamental particles, returns with the regenerating fundamental particles, except it is absorbed by the regenerating fundamental particles of an other BSP.
6.5.2 Quantification of the irradiated energy of an oscillating BSP.

The energy irradiated by an oscillating BSP is given by the change of velocity with the time, thus by terms with \(\frac{dv}{dt}\). For \(v \ll c\) we must consider only the time variation of \(d'E_n\) because the time variation of \(d'E_s\) has no terms with \(\frac{dv}{dt}\).

In general we have for a particle moving with speed \(v\)

\[
d'E_n = E_n \, d'\kappa \quad \int_{r_r}^{\infty} \, d'E_n = E_n \int_{r_r}^{\infty} \, d'\kappa \quad d'\kappa = \frac{d\kappa}{d\varphi} \frac{d\gamma}{d\varphi} \tag{445}
\]

\[
\frac{d}{dt} \int_{r_r}^{\infty} \, d'E_n = \frac{d}{dt} [E_n] \int_{r_r}^{\infty} \, d'\kappa + E_n \frac{d}{dt} \int_{r_r}^{\infty} \, d'\kappa(r_r) + E_n \frac{d}{dt} \int_{r_r}^{\infty} \, d'\kappa(\varphi) \tag{446}
\]

With the equations from sec. 6.1.1 and with \(v \ll c\) we get

\[
E_n = m \, v^2 \quad \frac{d}{dt} [E_n] = 2 \, m \, v \, \frac{dv}{dt} \tag{447}
\]

\[
\frac{d}{dt} \int_{r_r}^{\infty} \, d'E_n = -\frac{1}{2\pi} \, m \, v^3 \, \frac{r_o}{r^2} \sin \varphi \cos \varphi + \frac{1}{2\pi} \, m \, v \, \frac{dv}{dt} \, \frac{r_o}{r} \sin \varphi \tag{448}
\]

For an oscillating BSP with

\[
y = -y_m \, \sin \eta \quad v = -v_m \, \cos \eta \quad \frac{dv}{dt} = v_m \, \omega \, \sin \eta \quad v_m = y_m \, \omega \tag{449}
\]

we get for the time differentiation of the irradiated energy, that is defined by the second term with \(\frac{dv}{dt}\)

\[
\frac{d}{dt} \int_{r_r}^{\infty} \, d'E_{n,rr} = -\frac{1}{2\pi} \, m \, y_m^2 \, \omega^3 \, \frac{r_o}{r^2} \sin \varphi \sin \eta \cos \eta \tag{450}
\]

**Note:** We define now the following nomenclature:

- \(r_o\) for the radius of the oscillating BSP
- \(r_o\) for the static test or probe BSP
- \(r_o\) for a BSP that moves with speed \(v\)
- \(r_o\) for a BSP that moves with light speed.

We are interested in the irradiated energy during a certain time period and in the space defined by the space angle \(d\varphi \, \sin \varphi \, d\gamma\). The mentioned amount of irradiated
energy is the same for all distances \( r \), so that we can choose a convenient \( r = r_{oc} \) and integrate over time. For \( \omega r_{oc} \ll \frac{\pi}{100} \) it is \( \eta \approx \omega t \) and we get

\[
d' E_{nab} = \frac{1}{\omega} \int_0^{\omega t} \left[ \frac{d}{dt} \int_{r_{oc}}^\infty d' E_{n_{irr}} \right] d\omega t = -\frac{1}{4\pi} m y_m^2 \omega^2 \sin \varphi \sin^2 \omega t \tag{451}
\]

where

\[
d' E_{nab} = \int_{r_{oc}}^\infty d' E_{n_{irr}} \tag{452}
\]

The mean irradiated energy during a period from \( \omega t = 0 \) to \( \omega t = \pi \) is

\[
d' \bar{E}_{nab} = \frac{1}{8\pi} m y_m^2 \omega^2 \sin \varphi \tag{453}
\]

We consider that \( dE_{nab} = d' E_{nab} \ d\varphi \ d\gamma \)

\[
d \bar{E}_{nab} = \frac{1}{8\pi} m y_m^2 \omega^2 \sin \varphi \ d\varphi \ d\gamma \tag{454}
\]

and calculate the irradiated energy from \( \varphi = 0 \) to \( \varphi = \frac{\pi}{2} \)

\[
\int_{\varphi=0}^{\pi/2} d \bar{E}_{nab} = \frac{1}{8\pi} m y_m^2 \omega^2 \ d\gamma = d \bar{E}_{nc} \tag{455}
\]

The deduced energy \( d \bar{E}_{nc} \) is the energy of an irradiated BSP that moves with light speed \( c \) as shown in Fig. 22.

We define an equivalent angular momentum \( \hbar_n \) so that \( d \bar{E}_{nc} = \hbar_n \omega \).

\[
d \bar{E}_{nc} = \frac{1}{8\pi} (m_\gamma y_m^2 \omega) \omega = \hbar_n \omega \tag{456}
\]

with

\[
\hbar_n = \frac{1}{8\pi} m_\gamma y_m^2 \omega \quad \text{and} \quad m_\gamma = m \ d\gamma \tag{457}
\]

The irradiated energy was quantified for a half period of \( \omega t \). For \( n \) half periods we have

\[
d \bar{E}_{nc} = n \frac{1}{8\pi} (m_\gamma y_m^2 \omega) \omega = n \hbar_n \omega \tag{458}
\]

6.5.3 Quantification of the transversal component of the irradiated energy of an oscillating BSP.

We start with the induced force on a probe particle by an oscillating BSP given by eq. (401)
\[ d'F_n = \frac{1}{8\pi} \sqrt{m_p r_{op}} \, \text{rot} \, \tilde{C}_n \]  \hspace{1cm} (459)

with

\[ \tilde{C}_n = \frac{d}{dt} \int_{r_r}^\infty d'\tilde{H}_n \]  \hspace{1cm} (460)

As we are interested in the irradiated part we consider only terms with \( \frac{dv}{dt} \).

The longitudinal component is given by the rotor of \( \tilde{C}_n \) in the direction of \( r_r \) with eq. (436) already deduced.

\[ (\text{rot} \, \tilde{C}_n)_{r_r} = \frac{1}{2\pi} \sqrt{m} \, v_m \, \omega \, \frac{r_{o\sim}}{r^2_r} \cos \theta \sin \eta \]  \hspace{1cm} (461)

and the transversal component by the rotor in the direction of \( \theta \) with eq. (437) already deduced.

\[ (\text{rot} \, \tilde{C}_n)_{\theta} = \frac{1}{4\pi} \sqrt{m} \, v_m \, \omega^2 \, \frac{r_{o\sim}}{c} \frac{r_{op}}{r^2_r} \sin \theta \cos \eta \]  \hspace{1cm} (462)

We get for the induced force in the direction \( r_r \)

\[ d'F_r = \frac{1}{16\pi^2} \sqrt{m} \, \sqrt{m_p} \, v_m \, \omega \, \frac{r_{o\sim}}{r^2_r} \cos \theta \sin \omega t \]  \hspace{1cm} (463)

and in the direction of \( \theta \)

\[ d'F_{\theta} = \frac{1}{32\pi^2} \sqrt{m} \, \sqrt{m_p} \, v_m \, \omega^2 \, \frac{r_{o\sim}}{c} \frac{r_{op}}{r^2_r} \sin \theta \cos \omega t \]  \hspace{1cm} (464)

The longitudinal and transversal forces are displaced in time and in space by an angle of \( \frac{\pi}{2} \) degrees. The concept is shown in Fig. 57.

For the far field we neglect the induced force in the direction \( r_r \) and concentrate on \( d'F_{\theta} \).

We assume now that the oscillating BSP and the probe BSP are electrons and that for \( v_m \ll c \) the radius \( r_{o\sim} \approx r_{op} \). As we are interested in the average irradiated energy during a half time period in the space defined by the space angle \( d\phi \sin \varphi \, d\gamma \), we chose again conveniently \( r_r = r_{o\sim} \) and with \( \eta = \omega t \) we get for the induced force between the oscillating BSP and the probe BSP

\[ d'F_{\theta} = \frac{1}{32\pi^2} \sqrt{m} \, \sqrt{m_p} \, v_m \, \omega^2 \, \frac{r_{op}}{r^2_r} \sin \theta \cos \omega t \] \hspace{1cm} \text{with} \hspace{1cm} v_m = y_m \, \omega \]  \hspace{1cm} (465)

We calculate the average value from \( \omega t = -\frac{\pi}{2} \) to \( \omega t = +\frac{\pi}{2} \), make \( m_p = m \) and get with \( v_m = y_m \, \omega \)
Figure 57: Longitudinal and transversal potential momentums of irradiated energy

\[ d'\vec{F}_\theta = \frac{1}{16\pi^3} m y m \frac{\omega^3}{c} r_{op} \sin \theta \]  

(466)

The force \( d'\vec{F}_\theta \) is transmitted from the irradiated BSP with light speed to the probe BSP in the time \( \Delta t \).

The irradiated transversal linear momentum defined by the space angle \( d\theta \sin \theta \ d\gamma \) is, considering that \( d\vec{p}_\theta = d'\vec{p}_\theta \ d\theta \ d\gamma \)

\[ d\vec{p}_\theta = \frac{1}{16\pi^3} \Delta t m y m \frac{\omega^3}{c} r_{op} \sin \theta \ d\theta \ d\gamma \]  

(467)

We now integrate over \( \theta \) from \( \theta = 0 \) to \( \theta = \frac{\pi}{2} \)

\[ \int_{\theta=0}^{\frac{\pi}{2}} d\vec{p}_\theta = \frac{1}{16\pi^3} \Delta t m y m \frac{\omega^3}{c} r_{op} \ d\gamma \]  

(468)

The transversal linear momentum, defining \( m_\gamma = m \ d\gamma \) is

\[ d\vec{p}_{\theta_e} = \frac{1}{16\pi^3} \Delta t m_\gamma y m \frac{\omega^3}{c} r_{op} \]  

(469)

and the energy of the transversal linear momentum is

\[ d\vec{E}_{\theta_e} = \frac{1}{16\pi^3} \Delta t r_{op} m_\gamma y m \omega^3 \]  

(470)
The irradiated energy was quantified for a half period of $\omega t$. For $n$ half periods we have

$$d \bar{E}_{\theta_c} = n \frac{1}{16\pi^3} \Delta t r_{op} m_\gamma y_m \omega^3 = n \hbar \theta_c \omega$$  \hspace{1cm} (471)

### 6.5.4 Analysis of the quantified components of the irradiated energy of an oscillating BSP.

For the far field the irradiated energy $d \bar{E}_{nc}$ must be equal to the transversal irradiated energy $d \bar{E}_{\theta_c}$.

If we now take into consideration that the energy $\hbar \omega$ is the minimum irradiated energy of a BSP that oscillates with the frequency $\omega$ we have that

$$d \bar{E}_{nc} = \frac{1}{8\pi} (m_\gamma y_m^2 \omega) \omega = \hbar \omega = m_c c^2$$ \hspace{1cm} (472)

and with $m_\gamma = m_c$ we have

$$y_m = \sqrt{8\pi} \frac{c}{\omega}$$ \hspace{1cm} (473)

Also we have that

$$\frac{1}{8\pi} m_\gamma y_m^2 \omega^2 = \frac{1}{16\pi^3} \Delta t r_{op} m_\gamma y_m \omega^3$$ \hspace{1cm} (474)

From the last two expressions and with $\Delta t = K r_{o1} r_{o2}$ we get

$$r_{op} r_{o1} r_{o2} = \frac{2 \pi^2 \sqrt{8\pi} c}{K \omega^2} = \frac{2 \pi^2 \sqrt{8\pi} c}{K c^2} \frac{\hbar c}{\hbar \omega} \frac{\hbar c}{\hbar \omega} \hbar c = 5.42713 \cdot 10^4 \text{ s/m}^2$$ \hspace{1cm} (475)

and with

$$\frac{2 \pi^2 \sqrt{8\pi} m c}{K} = 4.9828 \cdot 10^{-25} [Jm] \quad \text{and} \quad \hbar c = 3.16152929 \cdot 10^{-26} [Jm]$$ \hspace{1cm} (476)

we can write that

$$\frac{2 \pi^2 \sqrt{8\pi} m c}{K} = 15.76056 \cdot \hbar c$$ \hspace{1cm} (477)

We get that

$$r_{op} r_{o1} r_{o2} = 15.76056 \frac{\hbar c}{m c^2} \frac{\hbar c}{\hbar \omega} \frac{\hbar c}{\hbar \omega} = 15.76056 \frac{\hbar c}{E_o} \frac{\hbar c}{E_c} \frac{\hbar c}{E_c}$$ \hspace{1cm} (478)
We conclude that

\[ r_{op} = 2.507 \frac{\hbar c}{E_o} \quad r_{o1} = 2.507 \frac{\hbar c}{E_c} \quad r_{o2} = 2.507 \frac{\hbar c}{E_c} \] \tag{479}

We have deduced the forgoing equations under the assumption that \( v \ll c \) what means that \( E_o \gg E_p \).

**Note:** The irradiated energies \( d \dot{E}_{nc} \) and \( d \dot{E}_{\theta c} \) were deduced on different differential bases what explains that the factor \( 2.507 \neq 1 \). The first differential energy \( d \dot{E}_{nc} \) was deduced based on \( d\kappa \) while the second \( d \dot{E}_{\theta c} \) on the rotor of \( d\kappa \).

**We now define that in general the radius of a BSP is given by**

\[ r_o = \frac{\hbar c}{E} \] \tag{480}

where for the energy \( E \) we have

\[ E = \sqrt{E_o^2 + E_p^2} \quad \text{for \ BSP \ with \ } v \neq c \] \tag{481}

and

\[ E = \hbar \omega \quad \text{for \ BSP \ with \ } v = c \] \tag{482}

### 6.5.5 Distance between one pair of BSPs with \( v = c \) and its relation with the stored energy.

The energy of one pair of BSPs with \( v = c \) is

\[ E = \hbar \omega = h \nu \quad \text{for \ BSP \ with \ } v = c \] \tag{483}

The energy of one BSP we designate with \( E_{(BSP)} \) and have that \( E = 2 \ E_{(BSP)} \). Also we define the distance between the two BSPs as \( d = c \tau \), where \( \tau \) is the time to move from one BSP of the pair to the other with light speed.

Because of

\[ r_{oc} = \frac{\hbar c}{E_c} = \frac{\hbar c}{\hbar \omega} = \frac{\lambda}{2\pi} \] \tag{484}

we have

\[ d = c \tau = \pi r_{oc} = \lambda/2 \] \tag{485}

We now write
\[ E = h \nu = 2 E_{(BSP)} \tau \nu \quad \text{with} \quad h = 2 E_{(BSP)} \tau = \text{constant} \quad (486) \]

or

\[ h = 2 E_{(BSP)} \frac{d}{c} = \text{constant} \quad \text{with} \quad d = \frac{\lambda}{2} \quad (487) \]

resulting that

\[ hc = 2 E_{(BSP)} d = 2 E_{(BSP)} \pi r_o = E_{(BSP)} \lambda = \text{constant} \quad (488) \]

We see that if we concentrate the energy of a photon on one pair of BSPs at the distance \( d = \lambda/2 \), the product of the energy of the BSP and the distance is a constant. It is like a spring with a force \( f \propto 1/d^2 \), where the product of the stored energy with the distance is also a constant. We also see, that for BSPs with light speed, the radius \( r_o \) decreases with the energy.

From

\[ r_o = \frac{hc}{E} \quad E = h \omega \quad c = \nu \lambda \quad (489) \]

we conclude that

\[ r_o = \frac{\lambda}{2\pi} \quad (490) \]

### 6.6 The Maxwell equations.

#### 6.6.1 The 1. Maxwell equation for the far induced force field.

We start with eq. (440) of the far induced force field of an oscillating BSP with \( m = m_p \) and \( r_o = r_{op} \)

\[ d' \vec{F}_i = \frac{1}{32\pi^2} m r_o^2 \frac{v_m}{r_c} \frac{\omega^2}{c} \sin \theta \cos \left[ \omega \left( t - \frac{r_r}{c} \right) \right] \bar{e}_\theta \quad [N] \quad (491) \]

To arrive to an expression that is equivalent to the 1.Maxwell equation

\[ \frac{d}{dt} [\vec{E}] = \frac{1}{\epsilon} \text{rot}\vec{H} \quad (492) \]

we calculate the time differentiation of \( d' \vec{F}_i \), take three times the rotor of the cumulated value of \( d' H_n \) and show that the results obtained are proportional.
\[
\frac{d}{dt}[d' F_i] = - \frac{1}{32\pi^2} m r_o^2 \frac{v_m}{r_r} \frac{\omega^3}{c^2} \sin \theta \sin \left[ \omega \left( t - \frac{r_r}{c} \right) \right] \bar{e}_\theta \quad \left[ \frac{N}{s} \right] \quad (493)
\]

The cumulated value from \( d' H_n \) for \( v \ll c \) is

\[
\int_{r_r}^\infty d' H_n = \frac{1}{4\pi} \sqrt{m} v \frac{r_o}{r_r} \sin \theta \bar{n} \quad (494)
\]

and with

\[
v = -v_m \cos \left[ \omega \left( t - \frac{r_r}{c} \right) \right] \quad \eta = \left[ \omega \left( t - \frac{r_r}{c} \right) \right] \quad (495)
\]

we get after the three rotors, neglecting for the far field all terms with an inverse proportionality greater than \( r_r \), the components

\[
(\text{rot rot rot } \int_{r_r}^\infty d' H_n)_{r_r} = 0 \quad \quad (\text{rot rot rot } \int_{r_r}^\infty d' H_n)_{\gamma} = 0 \quad (496)
\]

\[
(\text{rot rot rot } \int_{r_r}^\infty d' H_n)_{\theta} = \frac{1}{4\pi} v_m \frac{\omega^3}{c^2} \frac{r_o}{c} \sqrt{m} \sin \theta \sin \eta \bar{e}_\theta \quad (497)
\]

If we now compare the time differentiation from \( d' F_i \) with the \( \theta \)-component of the three rotors we see that they are proportional and that we can write

\[
\frac{d}{dt}[d' F_i] = - \frac{1}{8\pi} c^2 r_o \sqrt{m} \text{ rot } \left[ \text{rot rot } \int_{r_r}^\infty d' H_n \right] \quad (498)
\]

This is the flow-law for regions free of BSPs.

Defining the flow density as

\[
\bar{\Theta} = - \text{rot rot } \int_{r_r}^\infty d' H_n \quad (499)
\]

we get

\[
\frac{d}{dt}[d' F_i] = \frac{1}{8\pi} c^2 r_o \sqrt{m} \text{ rot } \bar{\Theta} \quad (500)
\]

This equation has the form of the 1.Maxwell equation

\[
\frac{d}{dt}[\bar{E}] = \frac{1}{\epsilon} \text{ rot } \bar{H} \quad (501)
\]

Written in integral form we get
\[
\int_A \frac{d}{dt}[d' \vec{F}_i] \cdot d\vec{A} = -\frac{1}{8\pi} c^2 r_o \sqrt{m} \oint [\text{rot rot} \int_{r_r}^\infty d' \vec{H}_n] \cdot d\vec{l} \tag{502}
\]

6.6.2 The 2. Maxwell equation.

To get the induction in a closed circuit we must build the rotor of \(d' \vec{F}_i\) from eq.(401)

\[
\text{rot} d' \vec{F}_i = \frac{1}{8\pi} \sqrt{m} r_o \text{rot rot} \frac{d}{dt} \int_{r_r}^\infty d' \vec{H}_n \tag{503}
\]

The time differentiation we can exchange with the rotors and we get

\[
\text{rot} d' \vec{F}_i = \frac{1}{8\pi} \sqrt{m} r_o \frac{d}{dt} \left[\text{rot rot} \int_{r_r}^\infty d' \vec{H}_n\right] \tag{504}
\]

Introducing the previously defined flow density

\[
\vec{\Theta} = -\text{rot rot} \int_{r_r}^\infty d' \vec{H}_n \tag{505}
\]

we obtain the 2. Maxwell equation

\[
\text{rot} d' \vec{F}_i = -\frac{1}{8\pi} \sqrt{m} r_o \frac{d\vec{\Theta}}{dt} \tag{506}
\]

This equation has the form of the 2. Maxwell equation

\[
\text{rot} \vec{E} = -\mu \frac{d}{dt} \left[\vec{H}\right] \tag{507}
\]

In the two Maxwell equations we recognize the equivalence between

\[
\vec{E} \equiv d' \vec{F}_i \quad \text{and} \quad \vec{H} \equiv \vec{\Theta} \tag{508}
\]

If we define a vector potential \(\vec{A}_\Theta\) as follows,

\[
\vec{\Theta} = \text{rot} \vec{A}_\Theta \quad \text{with} \quad \text{div} \vec{\Theta} = 0 \tag{509}
\]

we get the wave equation

\[
\Delta \vec{A}_\Theta - \frac{1}{c^2} \frac{d^2}{dt^2} \vec{A}_\Theta = 0 \quad \text{with} \quad \vec{A}_\Theta = -\text{rot} \int_{r_r}^\infty d' \vec{H}_n \tag{510}
\]

6.6.3 Equivalence between traditional fields based on Coulomb charge and fields based on mass charge.

From the 1. Maxwell equation (500) we have:
\[
\frac{d}{dt}[d'\vec{F}_i] = \frac{1}{8\pi} c^2 r_o \sqrt{m} \ rot \bar{\Theta} \quad \text{with} \quad \bar{\Theta} = - \ rot \ rot \int_r^\infty d'\vec{H}_n \quad (511)
\]

The present work defines the charge as the difference between the mass of the constituent BSPs of opposed signs of a particle \((Q_m = \text{mass - charge})\).

\[
Q_m = N m \ [kg] \quad Q = N q \ [C] \quad Q_m = \frac{m}{q} Q \quad (512)
\]

with \(q\) and \(m\) respectively the charge in Coulomb and the mass in kilogram of an electron. \(N\) represents the difference between the constituent number of electrons and positrons of a particle.

The electric field is then defined as the force per mass-charge as

\[
\bar{E}_m = \frac{d'\vec{F}_i}{Q_m} \ [N/kg] \quad E_m = \frac{q}{m} E \quad (513)
\]

with \(E\) representing the electric field in Newton per Coulomb. We get

\[
\frac{d\bar{E}}{dt} = \frac{m}{q} \frac{d}{dt}\bar{E}_m = \frac{1}{8\pi} c^2 r_o \sqrt{m} \ rot \bar{\Theta} \quad (514)
\]

With

\[
\frac{d\bar{E}}{dt} = \frac{1}{\epsilon_o} \ rot \bar{H} \quad \text{and} \quad \bar{H}_m = \bar{\Theta} = - \ rot \ rot \int_r^\infty d'\vec{H}_n \quad (515)
\]

we conclude that

\[
\bar{H} = \frac{\epsilon_o}{8\pi} \frac{c^2 r_o}{Q} \sqrt{m} \bar{H}_m \quad \text{and} \quad \bar{E} = \frac{m}{q} \bar{E}_m \quad (516)
\]

and define that

\[
B_m = \mu_o \ H_m \quad \text{and} \quad D_m = \epsilon_o \ E_m \quad (517)
\]

6.7 Divergence.

6.7.1 Divergence of the transversal field \(dH_n\).

The components of the transversal field from a not polarized BSP are

\[
\int_r^\infty d\vec{H}_n = C_r \ \vec{e}_r + C_\gamma \ \vec{e}_\gamma + C_\theta \ \vec{e}_\theta \quad (518)
\]

with
\[ C_{r_r} = 0 \quad C_{r} = \left| \int_{r_r}^{\infty} dH_n \right| \quad C_{\theta} = 0 \quad (519) \]

If we use the already defined coordinate transformations we get

\[ \text{div} \int_{r_r}^{\infty} dH_n = 0 \quad (520) \]

which is equivalent to the Maxwell law

\[ \text{div} \vec{H} = 0 \quad (521) \]

**Note:** The defined forms of polarizations for BSPs with light speed allow that \( \text{div} \int_{r_r}^{\infty} dH_n \neq 0 \). The source of the field \( dH_n \) is then a surface.

### 6.7.2 Divergence of the force field \( dF \).

The total force on a probe BSP results from the static (Coulomb) and the dynamic forces.

\[ \vec{F} = \vec{F}_s + \vec{F}_i \quad \text{or} \quad \int_{\sigma} d\vec{F} = \int_{\sigma} d\vec{F}_s + \int_{\sigma} d\vec{F}_i \quad (522) \]

Now we analyze the two components of the total force.

- In sec.3.2 eq.(181) we have seen that the static force \( F_2 \) on a probe BSP(2) produced by a BSP(1) is radial to BSP(1). The divergence outside the radius of the BSP(1) is therefore zero. The divergence at the point of the BSP(1) is proportional to the mass density \( \rho_m \) of the BSP(1). In sec. 3.7 we have calculated the divergence of \( F_2 = F_s \) with \( \Delta n_1 = \Delta n_2 = 1 \) and \( K = 5.42713 \cdot 10^4 \) we got

\[ \nabla \cdot \vec{F}_s = 3.1826 \cdot 10^3 \rho_m \quad (523) \]

For a complex particle formed by more than two BSPs we have

\[ \nabla \cdot \vec{F}_s = 3.1826 \cdot 10^3 \Delta n \rho_m \quad (524) \]

with \( \Delta n \) the difference between positive and negative BSPs.

- We have defined that the total induced force on a probe BSP, produced by the field of a moving BSP, is proportional to a special closed path integral when the area enclosed tends to zero. That definition has lead us to the following expression.
\[ d\vec{F}_i = K_i \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d\vec{H}_n \]  

(525)

with \( K_i \) a proportional constant.

As the divergence of a rotor is always zero we have

\[ \text{div} d\vec{F}_i = K_i \text{div} \left\{ \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d\vec{H}_n \right\} = 0 \]  

(526)

### 6.8 Lorentz transformation.

The present theory is based on fundamental particles with longitudinal and transversal rotational momentums. Based on this new approach we have deduced the four Maxwell equations.

- 1. Maxwell equation for the induced force field \( d'\vec{F}_i \)

\[
\frac{d}{dt}[d'\vec{F}_i] = \frac{1}{8\pi} c^2 r_o \sqrt{m} \text{ rot } \Theta \quad \text{with} \quad \Theta = - \text{rot rot} \int_{r_r}^{\infty} d'\vec{H}_n
\]  

(527)

- 2. Maxwell equation for the induced force field \( d'\vec{F}_i \)

\[
\text{rot} d'\vec{F}_i = - \frac{1}{8\pi} \sqrt{m} r_o \frac{d\bar{\Theta}}{dt} \quad \text{with} \quad \bar{\Theta} = - \text{rot rot} \int_{r_r}^{\infty} d'\vec{H}_n
\]  

(528)

- Divergence of the static force field of a complex particle

\[
\vec{\nabla} \cdot \vec{F}_s = 3.1826 \cdot 10^3 \Delta n \rho_m
\]  

(529)

and the divergence of the induced force field of an BSP

\[
d\text{iv} d'\vec{F}_i = \text{div} \left( \frac{1}{8\pi} \sqrt{m} r_o \text{ rot} \frac{d}{dt} \int_{r_r}^{\infty} d'\vec{H}_n \right) = 0
\]  

(530)

- Divergence of the cummulated transversal rotational momentum field of a BSP

\[
d\text{iv} \int_{r_r}^{\infty} d'\vec{H}_n = 0
\]  

(531)
The four Maxwell equations deduced with the present approach have the same form as the four Maxwell equations of the standard theory, and are therefore also invariant to the Lorentz transformation.

6.9 Basic field equations.

The fields of the present theory are:

\[ d'\vec{H}_s = -H_s \, d' \kappa \, \vec{e}_r \quad \text{and} \quad d'\vec{H}_n = H_n \, d' \kappa \, \vec{e}_\gamma \quad (532) \]

with

\[ d' H^2 = d' H_{s}^2 + d' H_{n}^2 = [d' E_s + d' E_n] \, d' \kappa \quad (533) \]

where \( d' \kappa \) in the coordinates of Fig. 56 is

\[ d' \kappa = \frac{c}{2 \, v} \left| \frac{\vec{v}_s}{|\vec{v}_e|} \times \frac{\vec{v}_r}{|\vec{v}_r|} \right| \frac{r_o}{r^2} \, dr_r \quad (534) \]

which is for \( 0 \leq v \leq c \)

\[ d' \kappa = \frac{1}{2} \frac{r_o}{r^2} \, dr_r \, \sin \theta \quad (535) \]

The divergences of the two fields for \( v \ll c \) are

\[ \nabla \cdot d'\vec{H}_s = \frac{3\pi}{8} \frac{c\sqrt{m}}{r_o} = \frac{3\pi^{3/2}}{4} \frac{c^2}{4\pi r_o^2} = \frac{3\pi^{3/2}}{4} \frac{E_o}{S_o} \quad \text{and} \quad \nabla \cdot d'\vec{H}_n = 0 \quad (536) \]

with \( S_o = 4\pi r_o^2 \) the area of the particle and \( \frac{E_o}{S_o} \) the energy density.

For massless points we get

\[ \nabla \cdot d'\vec{H}_s = 0 \quad \text{and} \quad \nabla \cdot d'\vec{H}_n = 0 \quad (537) \]

and we can define vector fields

\[ d'\vec{H}_s = \nabla \times d'\vec{M}_s \quad \text{and} \quad d'\vec{H}_n = \nabla \times d'\vec{M}_n \quad (538) \]

For the cumulated fields we have

\[ \int_{r_r}^{\infty} d'\vec{H}_s = -H_s \int_{r_r}^{\infty} d' \kappa \, \vec{e}_r \quad \text{and} \quad \int_{r_r}^{\infty} d'\vec{H}_n = H_n \int_{r_r}^{\infty} d' \kappa \, \vec{e}_\gamma \quad (539) \]
with
\[ \int_{r_r}^{\infty} d' \kappa = \frac{1}{2} \frac{r_o}{r_r} \sin \theta \] (540)

The divergences for \( v \ll c \) are
\[ \bar{\nabla} \cdot \int_{r_r}^{\infty} d' \bar{H}_s = \frac{3}{8} \frac{c \sqrt{m}}{r_o} \text{ and } \bar{\nabla} \cdot \int_{r_r}^{\infty} d' H_n = 0 \] (541)

From
\[ d' \bar{F}_i = \frac{d' \bar{p}_n}{dt} = \frac{1}{8 \pi} \sqrt{m} r_o \text{rot} \int_{r_r}^{\infty} d' \bar{H}_n \] (542)
we get
\[ d' \bar{p}_n = \frac{1}{8 \pi} \sqrt{m} r_o \text{rot} \int_{r_r}^{\infty} d' \bar{H}_n \] (543)

and
\[ \bar{\nabla} \cdot d' \bar{p}_n = 0 \] (544)

which is the conservation law for the linear momentum due to the \( d' \bar{H}_n \) field. The same result we get for the linear momentum due to the \( d' \bar{H}_s \) field from eq.(409) for \( d' \bar{F}_s \).

We define vector fields
\[ d' \bar{p}_n = \bar{\nabla} \times \bar{N}_n \quad \text{with} \quad \bar{N}_n = \frac{1}{8 \pi} \sqrt{m} r_o \int_{r_r}^{\infty} d' \bar{H}_n \] (545)
and
\[ d' \bar{p}_s = \bar{\nabla} \times \bar{N}_s \quad \text{with} \quad \bar{N}_s = \frac{1}{8 \pi} \sqrt{m} r_o \int_{r_r}^{\infty} d' \bar{H}_s \] (546)

and the corresponding divergences are
\[ \bar{\nabla} \cdot \bar{N}_n = 0 \quad \text{because} \quad \bar{\nabla} \cdot \int_{r_r}^{\infty} d' \bar{H}_n = 0 \] (547)

and
\[ \bar{\nabla} \cdot \bar{N}_s = \frac{1}{8 \pi} \sqrt{m} r_o \bar{\nabla} \cdot \int_{r_r}^{\infty} d' \bar{H}_s = \frac{3}{64 \pi} m c \] (548)

With the 1. Maxwell equation (498) where \( d' \bar{F}_i = d' \bar{F}_i \)
\[
\frac{d}{dt}[d' \bar{F}_n] = -\frac{1}{8\pi} c^2 r_o \sqrt{m \text{ rot}} \left[ \text{ rot rot } \int_{r_v}^\infty d' \bar{H}_n \right]
\]

and the equation (542) for the force \(d' \bar{F}_n\) we get

\[
\bar{\nabla} \times \bar{\nabla} \times \int_{r_v}^\infty d' \bar{H}_n + \frac{1}{c^2} \frac{d^2}{dt^2} \int_{r_v}^\infty d' \bar{H}_n = 0 \tag{549}
\]

Because of

\[
\bar{\nabla} \times \bar{\nabla} \times = \bar{\nabla} \bar{\nabla} - \Delta \tag{550}
\]

we get

\[
\Delta \int_{r_v}^\infty d' \bar{H}_n - \frac{1}{c^2} \frac{d^2}{dt^2} \int_{r_v}^\infty d' \bar{H}_n = 0 \tag{551}
\]

A similar expression we have in standard theory for the vector field \(\bar{A}\) after introducing the Lorenz gauge condition. We conclude, that the present theory is Lorentz invariant without the need of any gauge.

### 6.10 Synopsis of the fundamental equations for the generation of linear momentum between BSPs.

The Fundamental equations for the generation of linear momentum can be classified in

1. between two static BSPs
2. between two moving BSPs
3. between a moving and a static BSP

1) The equation for the generation of linear momentum between two static BSPs (static) is (See Fig. 24) based on the postulate 6 for the interaction between longitudinal angular momentums \(\bar{J}_s\) of FPs.

\[
d' p_{\text{stat}} \bar{s}_R = \frac{a}{c} \oint_R \left\{ \frac{d\bar{l} \cdot (\bar{s}_{e_1} \times \bar{s}_{e_2})}{2\pi R} \int_{r_1}^\infty H_{e_1} d\kappa_{r_1} \int_{r_2}^\infty H_{e_2} d\kappa_{r_2} \right\} \bar{s}_R \tag{552}
\]

where \(\bar{s}_R\) is a unit vector perpendicular to the plane that contains the closed path with radius \(R\).

After integration over the whole space we get
The linear momentum generated between two static BSPs is the motor of all movement of particles.

Equation (552) gives the curve from Fig. 27 that describes the Coulomb law for \( d \gg r_o \).

2) The equation for the generation of linear momentum between two moving BSPs (dynamic) is based on the postulate 7 for the interaction between transversal angular momentums \( \tilde{J}_n \) of FPs.

\[
d'p_{\text{dyn}} \bar{s}_R = \frac{1}{c} \oint_R \left\{ \frac{d\bar{l} \cdot (\bar{n}_1 \times \bar{n}_2)}{2\pi R} \int_{r_1}^{\infty} H_{n_1} d\kappa_{r_1} \int_{r_2}^{\infty} H_{n_2} d\kappa_{r_2} \right\} \bar{s}_R \tag{554}
\]

(See Fig. 45). Equation (554) contains the Lorentz, Ampere, Bragg and one component of the gravitation laws.

3) The equation for the generation of linear momentum between a moving and a static BSP (induced) is based on the postulate 8 for the interaction between the angular momentum \( \tilde{J}_o \) of one BSP and the longitudinal angular momentum \( \tilde{J}_s \) of another BSP.

\[
d'p_{\text{ind}}^{(o)} \bar{s}_R = \frac{1}{c} \oint_R \left\{ \frac{d\bar{l} \cdot \bar{s}}{2\pi R} \int_{r}^{\infty} H_s d\kappa_r \int_{r_p}^{\infty} H_{s_p} d\kappa_{r_p} \right\} \bar{s}_R \tag{555}
\]

\[
d'p_{\text{ind}}^{(n)} \bar{s}_R = \frac{1}{c} \oint_R \left\{ \frac{d\bar{l} \cdot \bar{n}}{2\pi R} \int_{r}^{\infty} H_n d\kappa_r \int_{r_p}^{\infty} H_{s_p} d\kappa_{r_p} \right\} \bar{s}_R \tag{556}
\]

(See Fig. 51 and Fig. 52). The upper indexes \((o)\) or \((n)\) denote that the linear momentum \( d'p_{\text{ind}} \) on the static BSP is induced by the longitudinal \((o)\) or transversal \((n)\) field of the moving BSP.

Equation (556) contains the first and the second Maxwell laws and one component of the gravitation law.

The force for all the fundamental equations is given by

\[
d'F \bar{s}_R = \frac{d'p}{\Delta t} \bar{s}_R \quad \text{with} \quad \Delta t = K r_o r_o \quad \bar{F} = \int_{\sigma} d'\bar{F} \tag{557}
\]

136
Note: The coordinate system selected to decide if a BSP under observation is moving or not is the coordinate system of the measuring equipment of the laboratory with its BSPs in rest in that coordinate system, BSPs that provide the regenerating fundamental particles for the BSP under observation.

The force on a BSP that moves with the speed \( v \) and which is exposed to the above listed momenta is

\[
\vec{F}_{tot} = \vec{F}_{stat} + \vec{F}_{dyn} + \vec{F}^{(s)}_{ind} + \vec{F}^{(n)}_{ind}
\]  

(558)

If there is no isolated moving BSP inducing on the BSP under observation we have that

\[
\vec{F}_{tot} = \vec{F}_{stat} + \vec{F}_{dyn}
\]  

(559)

Note: With the adequate definitions all above listed forces are derived as rotors from the vector field generated by the longitudinal and transversal angular momenta of the two types of fundamental particle defined at the beginning of this work.

\[
d'\vec{F} = \frac{d'p}{dt} = \frac{1}{8\pi} \sqrt{m} r_0 \text{ rot } \int_{r_0}^{\infty} d'\vec{H}
\]

(560)

6.10.1 Relativistic expressions of the fundamental equations.

In sec. 6.10 the general form of the fundamental equations for the generation of linear momentum between BSPs was presented. This section shows the relativistic influence of each differential part of the equations. We start first with the repetition of some definitions and conveniently formulation of equations for our objective:

\[
d'\kappa = \int_{r_0}^{\infty} dr_0 = r_o \int_{r_0}^{\infty} d\xi = r_o d'\xi \quad \text{with} \quad d'\xi = \int_{r_0}^{\infty} d\xi
\]

(561)

\[
\Delta t = Kr_{o_1}r_{o_2} \quad \text{with} \quad r_o = \frac{hc}{E} = \frac{h c}{\sqrt{E_o^2 + E_p^2}} = \frac{h c}{mc^2 \beta}
\]

(562)

\[
\Delta t = K \frac{h^2 c^2}{m^2 c^4} \beta_1 \beta_2 \quad \text{with} \quad \beta_i = \sqrt{1 - \frac{v_i^2}{c^2}}
\]

(563)

\[
H_s = \sqrt{E_s} = \frac{E_o}{\sqrt{E}} \quad H_n = \sqrt{E_n} = \frac{E_p}{\sqrt{E}} \quad H_e = \sqrt{E}
\]

(564)

\[
E = \sqrt{E_o^2 + E_p^2} = mc^2 \beta^{-1} \quad E_p = mcv\beta^{-1}
\]

(565)
1) Equation (552) for the Coulomb force can be written in a different differential form as:

\[
d'' F_{\text{stat}} = \frac{d'' p_{\text{stat}}}{c \Delta t} = \frac{\Delta'' p_{\text{stat}}}{c \Delta t} = \frac{a}{c \Delta t} H_{c_1} H_{c_2} d' \kappa_{r_1} d' \kappa_{r_2}
\]

(566)

For Coulomb the BSPs don’t move and it is \( H_{c_1} = H_{c_2} = \sqrt{mc} \) and we get

\[
d'' F_{\text{stat}} = \frac{a}{c K} mc^2 d' \kappa_{r_1} d' \kappa_{r_2}
\]

(567)

and finally with \( \Delta t = Kr_{o_1} r_{o_2} \)

\[
d'' F_{\text{stat}} = \frac{a}{c K} mc^2 d' \xi_{r_1} d' \xi_{r_2}
\]

(568)

It is clear that for the Coulomb force the relativistic factors are \( \beta = 1 \) because the speeds of the BSPs are zero and therefore \( \beta \) doesn’t appear in the equations.

2) Now we make the same procedure for equation (554) which is the basic equation for the Lorentz, Ampere and Bragg forces. The currents that generate the forces are continuous currents and \( H_{n_1} \) and \( H_{n_2} \) are not functions of the time.

\[
d'' F_{\text{dyn}} = \frac{1}{c \Delta t} d'' E_{p_{\text{dyn}}} = \frac{1}{c \Delta t} H_{n_1} H_{n_2} r_{o_1} r_{o_2} d' \xi_{r_1} d' \xi_{r_2}
\]

(569)

With \( H_n = \sqrt{mv \beta^{-1/2}} \) we get

\[
d'' F_{\text{dyn}} = \frac{m v_1 v_2}{c K} \beta_1^{-1/2} \beta_2^{-1/2} d' \xi_{r_1} d' \xi_{r_2}
\]

(570)

The \( \beta \) factors in eq. (570) show the relativistic behaviour of the equation.

3) Now we make the procedure for eq. (556) which is the basic equation for the Maxwell and gravitation forces. In this case \( H_n \) is function of the time and we have to start with eq. (374) and eq. (401) that follow:

\[
\frac{d}{dt} \int_{r_r}^{\infty} dH_n = \frac{1}{2} \frac{d}{dt} [H_n] r_o \sin \varphi \, d\varphi \, \hat{s}_\gamma - H_n v \, \frac{r_o}{r_r^2} \sin \varphi \, \cos \varphi \, d\varphi \, \hat{s}_\gamma
\]

(571)

\[
\frac{d}{dt} \vec{F}_{in} = \frac{1}{8 \pi} \sqrt{m_p r_{op}} \, \text{rot} \frac{d}{dt} \int_{r_r}^{\infty} d' \vec{H}_n
\]

(572)

We modify eq. (571) including the variable \( d\gamma \) that was omitted before because of symmetry reasons.
\[ \frac{d}{dt} \int_{r_r}^{\infty} d'' \tilde{H}_n = \frac{1}{2} \frac{d}{dt} [H_n] \frac{r_o}{r_r} \sin \varphi \, d\varphi \frac{d\gamma}{2\pi} \bar{s}_\gamma - H_n \, v \, \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi \frac{d\gamma}{2\pi} \bar{s}_\gamma \quad (573) \]

Correspondingly eq. (572) is modified.

\[ d'' \tilde{F}_i = \frac{1}{8} \pi \sqrt{m_p} r_{prop} \, \text{rot} \, \frac{d}{dt} \int_{r_r}^{\infty} d'' \tilde{H}_n \quad (574) \]

The terms in eq. (573) can be separated in factors that are exclusively functions of \( v(t) \) and factors that are exclusively functions of the space coordinates. We can write eq. (574) as

\[ d'' \tilde{F}_i = \frac{1}{8} \pi \sqrt{m_p} r_{prop} \left\{ \frac{d}{dt} [H_n] \, \text{rot} \bar{K}_{1_{ind}} - v \, H_n \, \text{rot} \bar{K}_{2_{ind}} \right\} \quad (575) \]

where

\[ \bar{K}_{1_{ind}} = \frac{1}{2} \frac{r_o}{r_r} \sin \varphi \, d\varphi \frac{d\gamma}{2\pi} \bar{s}_\gamma \quad \text{and} \quad \bar{K}_{2_{ind}} = \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi \frac{d\gamma}{2\pi} \bar{s}_\gamma \quad (576) \]

For \( \Delta v = c - v \ll c \) it is

\[ H_n \approx \sqrt{E_p} = \sqrt{m \, c \, v} \, \beta^{-1/2} \quad \text{and} \quad \frac{d}{dt} [H_n] \approx \frac{d}{dt} [(m \, c \, v)^{1/2} \, \beta^{-1/2}] \quad (577) \]

and eq. (575) writes

\[ d'' \tilde{F}_i = \frac{1}{8} \pi \sqrt{m_p} r_{prop} \left\{ \frac{d}{dt} [(m \, c \, v)^{1/2} \beta^{-1/2}] \, \text{rot} \bar{K}_{1_{ind}} - v \sqrt{m \, c \, v} \beta^{-1/2} \, \text{rot} \bar{K}_{2_{ind}} \right\} \quad (578) \]

The \( \beta \) factors in eq. (578) show the relativistic behaviour of the equation.

7 Corner-pillars of the “E & R” UFT model

The corner-pillars of the proposed model are:

1. Nucleons are composed of electrons and positrons
2. A space with Fundamental Particle (FPs) with angular momenta is postulated.
3. Electrons and positrons are represented as focal points of rays of FPs where the energy of the electrons and positrons is stored as rotation.
4. FPs are emitted with $c$ or $\infty$ from the focus. The focus is regenerated by FPs that move with $c$ or $\infty$ relative to the focus.

5. Regenerating FPs are those that are emitted by other focuses. A focus is stable when emission and regeneration is energetically balanced.

6. Pairs of FPs with opposed angular momenta generate linear momenta on focuses.

7. Interactions between subatomic particles are the product of the interactions of their FPs when they cross in space. The probability that they cross follows the radiation law.

8. The interactions between FPs are so defined, that the fundamental equations (Coulomb, Ampere, Lorentz, Newton, Maxwell, etc.) can be mathematically derived.

9. Neutrinos are parallel moving pairs of FPs with opposed angular momenta.

10. Photons are a sequence of neutrinos with their potential linear momenta oriented alternately opposed.

11. Photons that move with $c \pm v$ are reflected and refracted by optical lenses and electric antennas with $c$.

All experiments that can be explained with the SM must also be at least explained with the E & R model. The explanations must not be equal to those of the SM.

**Note:** The fundamental laws (Coulomb, Ampere, Lorentz, Newton, Maxwell, etc.) were deduced with measurements that took place under conditions where the nucleons involved were adequately regenerated to be stable. At relativistic speeds and at heavy atomic nuclei the regeneration can become deficient and produce instability. They decay in configurations that can be adequately regenerated by the environment, in other words, in stable configurations.

The interactions between subatomic particles take place at the regenerating FPs that move along the rays with the speed $c$ or $\infty$. The laws that were deduced for stable configurations (Coulomb, Ampere, Lorentz, Newton, Maxwell, etc.) not necessarily must work for unstable particles where emission and regeneration are not in balance.

The model “E & R” only takes into consideration stable particles, in other words, electrons, neutrons, protons, neutrinos, photons and their antiparticles. Positrons are only stable in configurations like the nucleons. The many short-lived configurations are not taken into account because they not necessarily follow the known fundamental laws.
8 Quantification of irradiated energy and movement.

8.1 Quantification of irradiated energy.

To express the energy irradiated by a BSP as quantified in angular momenta over time we start with

\[ E = E_c = E_s + E_n = \sqrt{E_o^2 + E_p^2} \]

\[ \Delta t = K r_o r_{op} \]

\[ r_o = \frac{h c}{E_c} \]

\[ r_{op} = \frac{h c}{E_o} \] (579)

with \( r_o \) the radius of the moving particle and \( r_{op} \) the radius of the resting probe particle. It is

\[ \Delta t = K r_o r_{op} \frac{r_o}{r_{op}} = K r_o^2 \frac{r_o}{r_{op}} = \Delta_o t \frac{r_o}{r_{op}} \] (580)

with

\[ \Delta_o t = \Delta t_{(v=0)} = K \frac{h^2 c^2}{E_o^2} = 8.082097 \cdot 10^{-21} \text{ s} \quad \text{with} \quad K = 5.4274 \cdot 10^4 \text{ s/m}^2 \] (581)

We now define \( E_e \Delta t \) and get

\[ E_e \Delta t = K \frac{h^2 c^2}{E_o^2} = K \frac{h^2}{4 \pi^2 m} = h \] (582)

equation that is valid for every speed \( 0 \leq v \leq c \) of the BSP giving

\[ E_e \Delta t = E_o \Delta_o t = h \] (583)

where \( h \) is the Planck constant.

**Note:** In the equation \( E_e \Delta t = h \) the energy \( E_e \) is the total energy of the moving particle and the differential time \( \Delta t \) is the time the differential momentum \( \Delta p \) is active to give the force \( F = \Delta p/\Delta t \) between the moving and the probe particle.

In connection with the quantification of the energy \( E = J \nu \) the following cases are possible:

- A common frequency \( \nu_g \) exists and the angular momentum \( J \) is variable. This assumption was made in Sec. 2.8.1, for FPs of BSPs with \( v \neq c \) that define an electron or a positron.

- A common angular momentum \( J_g \) exists and the frequency \( \nu \) is variable. This assumption was made in sec. 2.8.2 for FPs of BSPs with \( v \neq c \) that define an
electron or a positron.

The concept is shown in Fig. 58.

We define for a common angular momentum $J_g = \hbar$ the equivalent angular frequencies $\nu$, $\nu_o$ and $\nu_p$ with the following equations

$$E = E_e = h \nu \quad \nu = \frac{1}{\Delta t} \quad \text{and} \quad E_p = p c = h \nu_p \quad (584)$$

and

$$E_o = mc^2 = h \nu_o \quad \nu_o = \frac{1}{\Delta_o t} = 1.2373 \cdot 10^{20} \text{ s}^{-1} \quad (585)$$

We have already defined the angular frequencies $\nu_e$, $\nu_s$ and $\nu_n$ for the FPs with the following equations

$$E_e = E_s + E_n \quad \text{and} \quad dE_e = dE_s + dE_n \quad (586)$$

With a common angular momentum $J_g = \hbar$ it is
The relation between the angular frequencies of FPs and the equivalent angular frequencies is

\[ \nu = \sum_i \nu_{e_i} = \sum_i \nu_{s_i} + \sum_i \nu_{n_i} = \sqrt{\nu_o^2 + \nu_p^2} \]  
(588)

If all FPs have the same angular frequency \( \nu_{e_i} = \nu_{s_i} = \nu_{n_i} = \nu_{FP} \) we get

\[ \nu = N_e \nu_{FP} = N_s \nu_{FP} + N_n \nu_{FP} = \sqrt{\nu_o^2 + \nu_p^2} \]  
(589)

with \( N \) the corresponding total number of FPs of the BSP. If we multiply the equation with \( h \) we get

\[ h \nu = N_e h \nu_{FP} = N_s h \nu_{FP} + N_n h \nu_{FP} = h \sqrt{\nu_o^2 + \nu_p^2} \]  
(590)

or

\[ E = E_e = E_s + E_n = \sqrt{E_o^2 + E_p^2} \]  
(591)

with \( E_{FP} = h \nu_{FP} \) the energy of one FP.

We define the quantized emission of energy for a BSP with \( v \neq c \) defining the power as

\[ P_e = \frac{E_e}{\Delta t} = E_e \nu \quad \nu = \frac{1}{\Delta t} \]  
(592)

\[ P_e = \frac{E_e}{\Delta t} = \frac{1}{\Delta t} \sqrt{E_o^2 + E_p^2} = \sqrt{P_o^2 + P_p^2} = E_s \nu + E_n \nu = P_s + P_n \]  
(593)

where

\[ P_o = E_o \nu \quad P_p = E_p \nu \quad P_s = E_s \nu \quad P_n = E_n \nu \]  
(594)

For the differential powers we get

\[ dP_e = \nu E_e d\kappa \quad dP_s = \nu E_s d\kappa \quad dP_n = \nu E_n d\kappa \]  
(595)

Fundamental equations expressed with the powers exchanged by the
Now we show that the fundamental equations of sec 6.10 for the generation of linear momentum can be expressed as functions of the powers of their interacting BSPs.

With

\[ dE = E \, d\kappa \quad dH = \sqrt{E} \, d\kappa = H \, d\kappa \quad \text{and} \quad \frac{H}{\sqrt{\Delta t}} = \sqrt{E} \, \nu = \sqrt{P} \]  

(596)

the equations for the Coulomb, Ampere and induction forces of sec. 6.10 can be transformed to

\[ \dot{d}' F \, \bar{s}_R = \frac{\dot{d}' p}{\Delta t} \, \bar{s}_R \propto \frac{1}{c} \oint_R \left\{ \int_{r_1}^{\infty} \frac{H_1}{\sqrt{\Delta t}} \, d\kappa_{r_1} \int_{r_2}^{\infty} \frac{H_2}{\sqrt{\Delta t}} \, d\kappa_{r_2} \right\} \, \bar{s}_R \]  

(597)

and expressed as a function of the powers of the interacting BSPs

\[ \dot{d}' F \, \bar{s}_R = \frac{\dot{d}' p}{\Delta t} \, \bar{s}_R \propto \frac{1}{c} \oint_R \left\{ \int_{r_1}^{\infty} \sqrt{P_1} \, d\kappa_{r_1} \int_{r_2}^{\infty} \sqrt{P_2} \, d\kappa_{r_2} \right\} \, \bar{s}_R \]  

(598)

It is also possible to define differential energy fluxes for BSPs. We start with

\[ dP_e = \nu \, E_e \, d\kappa \quad dP_s = \nu \, E_s \, d\kappa \quad dP_n = \nu \, E_n \, d\kappa \]  

(599)

and with

\[ d\kappa = \frac{1}{2} \frac{r_o}{r^2} \, dr \, \sin \varphi \, d\varphi \, d\gamma \quad \text{and} \quad dA = r^2 \, \sin \varphi \, d\varphi \, d\gamma \]  

(600)

The concept is shown in Fig. 59.

![Figure 59: Emmitted Energy flux density dS of a moving electron](image)

The cumulated differential energy flux is
\[
\int_r^\infty dP_e = \nu E \int_r^\infty d\kappa = \nu E \frac{r_o}{2} \frac{r_o}{r} \sin \varphi \, d\varphi \frac{d\gamma}{2\pi} \quad J \, s^{-1} \quad (601)
\]

The cumulated differential energy flux density is

\[
\int_r^\infty dS_e = \frac{1}{dA} \int_r^\infty dP_e = \nu E \frac{1}{4\pi} \frac{r_o}{r^3} \frac{J}{m^2 \, s} \quad (602)
\]

To get the total cumulated energy flux through a sphere with a radius \( r \) we make \( r_o = r \) and integrate over the whole surface \( A = 4\pi \, r^2 \) of the sphere and get

\[
4\pi \, r^2 \int_r^\infty dS_e = \nu E \frac{J}{m^2 \, s} \quad (603)
\]

**Note:** The differential energy flux density is independent of \( \varphi \) and \( \gamma \) and therefore independent of the direction of the speed \( v \). This is because of the relativity of the speed \( v \) that does not define who is moving relative to whom.

**Physical interpretation of an electron and positron as radiating and absorbing FPs:**

The emitted differential energy is

\[
dE_e = E_e \, d\kappa = \frac{h}{\Delta t} \frac{1}{2} \frac{r_o}{r^2} \, dr \, \sin \varphi \, d\varphi \frac{d\gamma}{2\pi} \quad (604)
\]

With the help of Fig. 59 we see that the area of the sphere is \( A = 4\pi r^2 \), and we get

\[
dE_e = \frac{h}{\Delta t \, A} \, r_o \, dr \, \sin \varphi \, d\varphi \, d\gamma \quad (605)
\]

We now define

\[
dE_e = \sigma_h \, r_o \, dr \, \sin \varphi \, d\varphi \, d\gamma \quad \text{with} \quad \sigma_h = \frac{h}{\Delta t \, A} \quad (606)
\]

where \( \sigma_h \) is the current density of fundamental angular momentum \( h \).

We can also write

\[
dE_e = \sigma_h \, dA \quad \text{with} \quad dA = r_o \, dr \, \sin \varphi \, d\varphi \, d\gamma \quad (607)
\]

### 8.2 Energy and density of Fundamental Particles.

#### 8.2.1 Energy of Fundamental Particles.

The emission time of photons from isolated atoms is approximately \( \tau = 10^{-8} \, s \) what gives a length for the train of waves of \( L = c \, \tau = 3 \, m \). The total energy of the emitted photon is \( E_t = h \, \nu_t \) and the wavelength is \( \lambda_t = c/\nu_t \). We have defined (see Fig. 58,
Fig 66 and Fig. 67), that the photon is composed of a train of FPs with alternated opposed angular momenta where the distance between two consecutive FPs is equal $\lambda_t/2$. The number of FPs that build the photon is therefore $N_{FP} = L/(\lambda_t/2)$ and we get for the energy of one FP

The concept is shown in Fig. 60

$$
E_{FP} = \frac{E_t}{N_{FP}} = \frac{E_t \lambda_t}{2L} = \frac{h}{2\tau} = 3.313 \cdot 10^{-26} J = 2.068 \cdot 10^{-7} \text{ eV} \quad (608)
$$

and for the angular frequency of the angular momentum $\hbar$

$$
\nu_{FP} = \frac{E_{FP}}{\hbar} = \frac{1}{2\tau} = 5 \cdot 10^7 \text{ s}^{-1} \quad (609)
$$

Finally we get
\[ \nu_t = N_{FP} \nu_{FP} = 5 \cdot 10^7 \text{ s}^{-1} \quad \text{with} \quad N_{FP} = \frac{c \tau}{\lambda_t/2} \] (610)

**Note:** The frequency \( \nu_t \) represents a linear frequency where the relation with the velocity \( v \) and the wavelength \( \lambda_t \) is given by \( v = \lambda_t \nu_t \). The frequency \( \nu_{FP} \) represents the angular frequency of the angular momentum \( h \).

The momentum generated by a pair of FPs with opposed angular momenta is

\[ p_{FP} = \frac{2 E_{FP}}{c} = 2.20866 \cdot 10^{-34} \text{ kg m s}^{-1} \] (611)

**Note:** Isolated FPs have only angular momenta, they have no linear momenta and therefore cannot generate a force through the change of linear momenta. Linear momentum is generated only out of pairs of FPs with opposed angular momentum as defined in sec. 2.10. It makes no sense to define a dynamic mass for FPs because they have no linear inertia, which is a product of the energy stored in FPs with opposed angular momenta. FPs that meet in space interact changing the orientation of their angular momenta but conserving each its energy \( E_{FP} = 3.313 \cdot 10^{-26} \text{ J} \).

The number \( N_{FP_o} \) of FPs of an resting BSP (electron or positron) is

\[ N_{FP_o} = \frac{E_o}{E_{FP}} = 2.4746 \cdot 10^{12} \] (612)

### 8.2.2 Density of Fundamental Particles.

From sec. 2.15 we have that

\[ dE = E \, dk = E \frac{1}{2} \frac{r_o}{r^2} \, dr \sin \varphi \, d\varphi \frac{d\gamma}{2\pi} \quad \text{and} \quad dV = r^2 \, dr \sin \varphi \, d\varphi \, d\gamma \] (613)

resulting for the energy density

\[ \omega = \frac{dE}{dV} = \frac{E}{4\pi} \frac{r_o}{r^4} \quad J \text{ m}^{-3} \] (614)

The density of FPs we define as

\[ \omega_{FP} = \frac{\omega}{E_{FP}} = \frac{1}{4\pi} \frac{E}{E_{FP}} \frac{r_o}{r^4} \quad m^{-3} \] (615)

with \( E_{FP} = h \nu_{FP} = 3.313 \cdot 10^{-26} \text{ J} \).

The concept is shown in Fig. 61

The energy emitted by a BSP is equal to the sum of the energies of the regenerating FPs with longitudinal (s) and transversal (n) angular momenta. The corresponding
densities are

\[ \omega_{FP}^{(s)} = \frac{1}{4\pi} \frac{E_s}{E_{FP}} \frac{r_o}{r^4} \quad \omega_{FP}^{(n)} = \frac{1}{4\pi} \frac{E_n}{E_{FP}} \frac{r_o}{r^4} \quad \text{m}^{-3} \]  \hspace{1cm} (616)

As \( E_e = E_s + E_n \) we get

\[ \omega_{FP}^{(e)} = \omega_{FP}^{(s)} + \omega_{FP}^{(n)} \quad \text{m}^{-3} \]  \hspace{1cm} (617)

The number \( dN_{FP} \) of FPs in a volume \( dV \) is given with

\[ dN_{FP} = \omega_{FP} \, dV \quad \text{and with} \quad dV = r^2 \, dr \, \sin \varphi \, d\varphi \, d\gamma \]  \hspace{1cm} (618)

we get

\[ dN_{FP} = \frac{1}{2\pi} \frac{E}{E_{FP}} \, d\kappa \]  \hspace{1cm} (619)

With the definition of \( \mu_{FP} = E_{FP}/c^2 \), where \( \mu_{FP} \) is the dynamic mass of a FP, we get for the density of the mass

\[ \omega_\mu = \frac{\mu_{FP} \, dN_{FP}}{dV} = \mu_{FP} \, \omega_{FP} \quad \text{kg m}^{-3} \]  \hspace{1cm} (620)

The rest mass \( m \) of a BSP expressed as a function of the dynamic mass \( \mu_{FP} \) of its FPs is
\[ m = N_{FP} \mu_{FP} = \frac{\nu_o}{\nu_{FP}} \mu_{FP} \]  

**Note:** In the present theory all BSPs are expressed through FPs with the Energy \( E_{FP} \), the angular frequency \( \nu_{FP} \) and the dynamic mass \( \mu_{FP} \).

### 8.3 Quantification of movement.

An isolated moving BSP has a potential energy

\[ E = E_s + E_n \]  

which is a function of the relative speed \( v \) to the selected reference coordinate. The potential energy will manifest when the isolated moving BSP interacts with a BSP which is static in the selected coordinate system.

The time variation \( \Delta t \) derived for the variation \( dp \) of the momentum for the Coulomb, Ampere and Induction forces between two BSPs, we use also as time variation to describe the movement of a BSP that moves with constant speed \( v = \Delta x/\Delta t \) where \( dp = 0 \).

The energy \( E_n \) is responsible for the movement of the BSP and the number of FPs that generate the movement during the time \( \Delta t \) is

\[ N_{FP}^{(n)} = \frac{E_n}{E_{FP}} \]  

The total momentum of a BSP moving with constant speed \( v \) is therefore

\[ p = m v = N_{FP}^{(n)} p_{FP} = m \frac{\Delta x}{\Delta t} \]  

with \( p_{FP} \) defined in eq. (611). For \( \Delta x \) we get

\[ \Delta x = N_{FP}^{(n)} p_{FP} \frac{\Delta t}{m} \]  

For \( v = 0 \) we get

\[ v = 0 \quad E_n = 0 \quad N_{FP}^{(n)} = 0 \quad \Delta x = 0 \]  

For \( v \to c \) we get with \( \Delta t = K r_o^2 \) with \( r_o \) the radius of the moving BSP

\[ v \to c \quad E_p \to \infty \quad E_n \to \infty \quad N_{FP}^{(n)} \to \infty \quad \Delta t \to 0 \]  

\[ \lim_{v \to c} \Delta x = \lim_{v \to c} \frac{2 K h^2 c}{m E_p} = 0 \quad \text{for} \quad v \to c \]
\[ \lim_{v \to c} \frac{\Delta x}{\Delta t} = v \] \hspace{1cm} (629)

**Note:** For the isolated BSP moving with constant speed \( v \) we have no static probe BSP with radius \( r_{op} \) that measures the force between them, force that is zero because \( dp = 0 \). There is no difference between the two BSPs and the equation \( \Delta t = K r_o r_{op} \) becomes \( \Delta t = K r_o^2 \) with \( r_o \) the radius of the moving BSP.

### 9 Analysis of linear momentum between two static BSPs.

In this section the static eq.(552) is analyzed in order to explain

- why BSPs of equal sign don’t repel in atomic nuclei
- how gravitation forces are generated
- why atomic nuclei radiate

Although the analysis is based only on the static eq.(552) for two BSPs, neglecting the influence of the important dynamic eq.(554) that explains for instance the magnetic moment of nuclei, it shows already the origin of the above phenomena.

With the integration limits shown in Fig. 62

![Integration limits for the calculation of the linear momentum between two static basic subatomic particles at the distance \( d \)](image_url)

and considering that for static BSPs it is \( r_{o1} = r_{o2} = r_o \) and \( m_1 = m_2 = m \), the integration limits are

\[ \varphi_{min} = \arcsin \frac{r_o}{d} \quad \varphi_{max} = \pi - \varphi_{min} \quad \text{for} \quad d \geq \sqrt{r_o^2 + r_o^2} \] \hspace{1cm} (630)

\[ \varphi_{min} = \arccos \frac{d}{2r_o} \quad \varphi_{max} = \pi - \varphi_{min} \quad \text{for} \quad d < \sqrt{r_o^2 + r_o^2} \] \hspace{1cm} (631)
and eq.(552) transforms to

\[ p_{\text{stat}} = \frac{m c r_o^2}{4 d^2} \int_{\varphi_{1\text{min}}}^{\varphi_{1\text{max}}} \int_{\varphi_{2\text{min}}}^{\varphi_{2\text{max}}} |\sin^3(\varphi_1 - \varphi_2)| \ d\varphi_2 \ d\varphi_1 \]  

(632)

The double integral becomes zero for \( d \to 0 \) because the integration limits approximate each other taking the values \( \varphi_{\text{min}} = \frac{\pi}{2} \) and \( \varphi_{\text{max}} = \frac{\pi}{2} \). For \( d \gg r_o \) the double integral becomes a constant because the integration limits tend to \( \varphi_{\text{min}} = 0 \) and \( \varphi_{\text{max}} = \pi \).

Fig.63 shows the curve of eq.(174) where five regions can be identified with the help of \( d/r_o = \gamma \) from the integration limits:

1. From \( 0 \ll \gamma \ll 0.1 \) where \( p_{\text{stat}} = 0 \)
2. From \( 0.1 \ll \gamma \ll 1.8 \) where \( p_{\text{stat}} \propto d^2 \)
3. From \( 1.8 \ll \gamma \ll 2.1 \) where \( p_{\text{stat}} \approx \text{constant} \)
4. From \( 2.1 \ll \gamma \ll 518 \) where \( p_{\text{stat}} \propto \frac{1}{d} \)
5. From \( 518 \ll \gamma \ll \infty \) where \( p_{\text{stat}} \propto \frac{1}{d^2} \) (Coulomb)

Figure 63: Linear momentum \( p_{\text{stat}} \) as function of \( \gamma = d/r_o \) between two static BSPs with equal radii \( r_{o1} = r_{o2} \)
The first and second regions are where the BSPs that form the atomic nucleus are confined and in a dynamic equilibrium. BSPs of different charges don’t mix in the nucleus because of the different signs their longitudinal angular momentum of the emitted FPs have.

For BSPs that are in the first region, the attracting or repelling forces are zero because the angle between their longitudinal rotational momentum is \( \beta = \pi \). BSPs that migrate outside the first region are reintegrated or expelled with high speed when their FPs cross with FPs of the remaining BSPs of the atomic nucleus because the angle \( \beta < \pi \). At stable nuclei all BSPs that migrate outside the first region are reintegrated, while at unstable nuclei some are expelled in all possible combinations (electrons, positrons, hadrons) together with neutrinos and photons maintaining the energy balance.

As the force induced on other particles during reintegration described by eq. (556) has always the direction and sense of the reintegrating particle (right screw of \( \bar{J}_n \)) independent of its charge, BSPs that are reintegrated induce on other atomic nuclei the gravitation force. The inverse square distance law for the gravitation force results from the inverse square distance law of the radial density of FPs that transfer their angular momentum from the moving to the static BSPs according postulate 8). See sec. 16.4 for induced gravitation force.

The third region gives the width of the tunnel barrier through which the expelled particles of atomic nuclei are emitted. As the reintegration process of BSPs that migrate outside the first region depend on the special dynamic polarization of the remaining BSPs of the atomic nucleus, particles are not always reintegrated but expelled when the special dynamic polarization is not fulfilled. The emission is quantized and follows the exponential radioactive decay law.

The fourth region is a transition region to the Coulomb law.

The transition value \( \gamma_{\text{trans}} = 518 \) to the Coulomb law was determined by comparing the tangents of the Coulomb equation and the curve from Fig.63. At \( \gamma_{\text{trans}} = 518 \) the ratio of their tangents begin to deviate from 1.

At the transition distance \( d_{\text{trans}} \), where \( \gamma_{\text{trans}} = 518 \), the inverse proportionality to the distance \( d_{\text{trans}} \) from the neighbor regions must give the same force \( F_{\text{trans}} \)

\[
F_{\text{trans}} = \frac{1}{\Delta t} \frac{K'}{d_{\text{trans}}} = \frac{1}{\Delta t} \frac{K_F'}{d_{\text{trans}}^2}
\]  

(633)

with \( K' \) and \( K_F' \) the proportionality factors of the fourth and fifth regions.
The transition distance for BSPs (electron and positron) is:

\[ d_{\text{trans}} = \gamma_{\text{trans}} r_o = \gamma_{\text{trans}} \frac{\hbar c}{E_o} = 518 \cdot 3.859 \cdot 10^{-13} = 2.0 \cdot 10^{-10} \text{ m} \quad (634) \]

which is of the order of the radii of neutral isolated atoms.

The **fifth region** is where the Coulomb law is valid. The concept is shown in Fig. 64

![Potential well of an atom](image)

**Figure 64:** Potential well of an atom.

Fig. 65 shows potential energies corresponding to different theoretical models. All potential energies from existing models are not defined for the distance between charged particles tending to zero, what forces to define the potential energy as negative and to place the zero at infinite.

The potential energy of the present approach is defined for the distance between charged particles tending to zero allowing to place the origin of the potential energy at \( d = 0 \).

The potential is given by

\[ V(d) = \int_0^d F_{\text{stat}} \delta d = \frac{1}{\Delta t} \int_0^d p_{\text{stat}} \delta d \quad \text{for} \quad d \to \infty \quad \text{we get} \approx 1.0 \text{ GeV} \quad (635) \]

The energy of 1.0 GeV is the energy necessary to separate an electron from a positron from the distance between them \( d = 0 \) to \( d = \infty \).
10 Classification of BSPs with $v = c$.

BSPs with $v = c$ have no nucleus where fundamental particles are emitted and absorbed and therefore have no charge characteristics and pass through each other without collision. They are constituted of fundamental particles with the energy stored in pairs of opposed angular momentums $\bar{J}$.

BSPs with $v = c$ are classified in two types according if they were generated on emitted or regenerating FPs.

BSPs with $v = c$ generated on regenerating FPs can be classified according to the linear momentum they may generate on a static probe BSP, in

- BSP with potential linear momentum $p_y = p_c^\parallel$ in propagation direction Fig. 66 a).

Figure 65: Comparison of potential energies between charged particles
- BSP with potential linear momentum $p_y = p^\parallel_c$ opposed to propagation direction. Same as Fig. 66 a) but with inverted directions of angular momentum $J'_{xy}$ and linear momentum $p_y = p^\parallel_c$.

- BSP with potential linear momentum $p_z = p^\perp_c$ perpendicular to the propagation direction Fig. 66 b).

- Complex SP with potential linear momentum perpendicular and in propagation direction. Fig. 66 c).

Figure 66: BSPs with light speed generated on regenerating FPs
Fig. 67 d) shows BSPs with $v = c$ generated on emitted FPs which are the neutrinos.

Note: Photons are complex particles formed by more than one BSP separated by the distance $\lambda/2$ in the direction of movement Fig. 66 c). BSPs with transversal linear momentum $p_z$ of a complex particle form pairs with opposed transversal directions and give the complex SP the character of a wave. The energy associated independently with the longitudinal or transversal linear momentum is $\hbar \omega$. The resulting linear momentum at each BSP is shown in Fig. 68. Considering the possibility of BSPs with potential linear momentum $p_y = p_y^\parallel$ opposed to the propagation direction, the wave character may also be generated in longitudinal direction.
Figure 68: Linear momentum $p$ on a probe BSP generated by a basic subatomic particle with $v = c$ ($GP=FP$)
11 Induction between a moving and a probe BSP.

In the present approach the energy of a BSP is distributed in space around the radius of the BSP. The carriers of the energy are the angular momentums of FPs that are continuously emitted, and regenerate the BSP. At a free moving BSP each angular momentum of a FP is balanced by an other angular momentum of a FP of the same BSP. Opposed transversal angular momentums \((d\vec{H}_n \text{ and } -d\vec{H}_n \text{ in Fig. 69})\) from two FPs that regenerate the BSP produce the linear momentum \(\vec{p}\) of the BSP. If a second static probe BSP\(_p\) appropriates with its regenerating angular momentums \((d\vec{H}_s\)\) angular momentums \((d\vec{H}_n)\) from FPs of the first BSP according postulate 3, angular momentums that built a rotor different from zero in the direction of the second BSP\(_p\) generating \(d\vec{p}_n\), the first BSP loses energy and its linear momentum changes to \(\vec{p} - d\vec{p}_n\). The angular momentums appropriated at point \(P\) by the probe BSP\(_p\) generating the linear momentum \(d\vec{p}_p\) are missing now at the first BSP to compensate the angular momentums at the symmetric point \(P'\). The linear momentums at the two symmetric points are therefore equal and opposed \(d'\vec{p}_i = -d\vec{p}_p\) because of the symmetry of the energy distribution function \(d\kappa(\pi - \theta) = d\kappa(\theta)\).

As the closed linear integral \(\oint d\vec{H}_n \, d\vec{l}\) generates the linear momentum \(\vec{p}\) of a BSP, the orientation of the field \(d\vec{H}_n\) (right screw in the direction of the velocity) is independent of the sign of the BSP, sign that is defined by \(\vec{J}_c(\pm)\).

![Figure 69: Linear momentum balance between static and moving BSPs](image-url)
12 Conventions introduced for BSPs.

Fig. 70 shows the convention used for the two types of electrons and positrons introduced.

The accelerating positron emits FPs with high speed $v_e = v_h \approx \infty$ and positive longitudinal angular momentum $\tilde{J}_s^+ (\infty +)$ and is regenerated by FPs with low speed $v_r = v_l = c$ and negative longitudinal angular momentum $\tilde{J}_s^- (c -)$.

The decelerating electron emits FPs with low speed $v_e = v_l = c$ and negative longitudinal angular momentum $\tilde{J}_s^- (c -)$ and is regenerated by FPs with high speed $v_r = v_h \approx \infty$ and positive longitudinal angular momentum $\tilde{J}_s^+ (\infty +)$.

FPs emitted by BSPs are the regenerating FPs for other BSPs as follows:

- emitted FPs of the acc\textsuperscript{+} regenerate the dec\textsuperscript{−}
- emitted FPs of the acc\textsuperscript{−} regenerate the dec\textsuperscript{+}
- emitted FPs of the dec\textsuperscript{+} regenerate the acc\textsuperscript{−}
- emitted FPs of the dec\textsuperscript{−} regenerate the acc\textsuperscript{+}
FPs of the same speed, direction and opposed angular momentum compensate each other so that the following compensation of BSPs results:

- \( acc^+ \) compensates \( acc^- \)
- \( dec^+ \) compensates \( dec^- \)

Protons and neutrons can be seen as composed of electrons and positrons except for the binding energy.

We have the following possible types of protons, anti-protons and neutrons:

- \( dec^+/acc^- \) proton with \( n^+ = 919 \) and \( n^- = 918 \)
- \( acc^+/dec^- \) proton with \( n^+ = 919 \) and \( n^- = 918 \)
- \( dec^-/acc^+ \) anti-proton with \( n^- = 919 \) and \( n^+ = 918 \)
- \( acc^-/dec^+ \) anti-proton with \( n^- = 919 \) and \( n^+ = 918 \)
- \( dec^+/acc^- \) neutron with \( n^+ = 919 \) and \( n^- = 919 \)
- \( acc^+/dec^- \) neutron with \( n^+ = 919 \) and \( n^- = 919 \)

The two possible types of protons are shown in Fig. 71
The two possible types of anti-protons are shown in Fig. 72
The two possible types of neutrons are shown in Fig. 73

If we overlap the two types of protons the internal FPs compensate because of the \( acc^+ / acc^- \) and the \( dec^+ / dec^- \) compensations, remaining only the external FPs which have same speed, opposed angular momentum but different directions. The same we have for the two types of anti-protons. This is important to explain nuclear magnetic resonance.
Protons

\[ \text{Protons} \]

\[ e^+ \rightarrow \infty^- \]

\[ \text{dec}^+ / \text{acc}^- - \text{proton} \]
\[ n^+ = 919 \quad n^- = 918 \]

Legend:
\[ \text{acc} = \text{accelerating, dec} = \text{decelerating} \]
\[ c^+ = \text{light speed with positive torque} \]
\[ \infty^- = \text{high speed with negative torque} \]

Figure 71: Protons
Antiproton

Legend:
- $acc = accelerating$,
- $dec = decelerating$
- $c^+ = light speed with positive torque$
- $\infty^- = high speed with negative torque$

Figure 72: Anti-Protons

$dec^-/acc^+ - \text{antiproton}$

$n^- = 919 \quad n^+ = 918$

$acc^-/dec^+ - \text{antiproton}$

$n^- = 919 \quad n^+ = 918$
Figure 73: Neutrons

Legend:

acc = accelerating, dec = decelerating

\( c^+ = \text{light speed with positive torque} \)

\( \infty^- = \text{high speed with negative torque} \)
Atoms are composed of protons, neutrons and electrons. The energy levels of atoms are filled by electrons with alternated spins, what corresponds in the present approach to the two types of electrons, namely $acc^-$ and $dec^-$. 

Fig. 74 shows the Hydrogen and the Helium atoms. Each type of level electron interacts only with that type of proton in the nucleus that can deliver the right FPs for its regeneration, what requires that nuclei of atoms are filled with alternate types of protons in the Mendelejew periodic table, namely $acc^+dec^-$ and $dec^+/acc^-$. 

Fig. 75 shows neutrinos and photons. Neutrinos are pairs of FPs with opposed angular momenta which carry a potential linear momentum. The linear momentum can be oriented in all directions relative to the direction of movement of the neutrino. On Fig. 75 longitudinal and transversal oriented neutrinos are shown. 

A photon is a sequence of transversal or longitudinal oriented neutrinos at a distance equal to the semi wavelength $\lambda/2$. On Fig. 75 longitudinal and transversal oriented photons are shown.
Atoms

a) Hydrogen Atom

b) Helium Atom

Figure 74: Hydrogen and Helium atoms
**Neutrinos**

\[ \vec{J} \cdot \vec{p} \]

\[-\vec{J} \times \]

**Photons**

\[ \dot{p} \]

Legend:

- \( \bullet \) \( \times \) Fps with transversal angular momenta \( \vec{J} \)

Figure 75: Neutrinos and Photons
Fig. 76 shows the difference between Fermions and Bosons at the “E&R” UFT and the Standard Model.

<table>
<thead>
<tr>
<th></th>
<th>SM</th>
<th>E&amp;R</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fermions</strong></td>
<td>Rest mass</td>
<td>Focal Point</td>
<td>Basic: electron, positron</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Composed: Proton, Neutron</td>
</tr>
<tr>
<td><strong>Bosons</strong></td>
<td>No Rest mass</td>
<td>No Focal Point</td>
<td>Basic: Neutrino</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Composed: Photon</td>
</tr>
</tbody>
</table>

Figure 76: Difference between Fermions and Bosons

Fig. 77 shows the difference between the two states of a Fermion at the “E&R” UFT and the Standard Model.

<table>
<thead>
<tr>
<th></th>
<th>SM</th>
<th>E&amp;R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two states</td>
<td>Spin + $\frac{1}{2}$</td>
<td>acc/dec electrons or positrons</td>
</tr>
</tbody>
</table>

acc=accelerated Fundamental Particles
dec=decelerated Fundamental Particles

Figure 77: Difference between Fermions and Bosons
13 Flux density of FPs and scattering of particles.

13.1 Flux density of FPs.

At each BSP the flux density of emitted FPs is equal to the flux density of regenerating FPs although the different speeds of the FPs.

In a complex SP formed by more than one BSP (Fig. 71), a mutual internal regeneration between the BSPs of the complex SP exists. Part of the emitted positive rays of FPs with $J_e^+(+)$ of the positive BSPs of the complex SP regenerate the negative BSPs of the complex SP, and part of the emitted negative rays of FPs with $J_e^-(−)$ of the negative BSPs regenerate the positive BSPs. The other part of the emitted and regenerating rays of FPs respectively radiate into space and regenerate from space.

At a complex SP with equal number of positive and negative BSPs Fig. 73 the flux density of FPs radiated into space with positive angular momenta is equal to the flux density of FPs radiated into space with negative angular momenta. The same is valid for the flux density of regenerating FPs.

At a complex SP with different number of positive and negative BSPs Fig. 71 the flux density of FPs radiated into space with positive angular momenta is not equal to the flux density of FPs radiated into space with negative angular momenta. If the complex SP has more positive BSPs in the nucleous, the flux density of FPs radiated into space with positive angular momenta is bigger than the flux density of FPs radiated into space with negative angular momenta and vice versa.

13.2 Scattering of particles.

Elastic scattering.

Elastic scattering we have when the scattering partners conserve their identity. No photons, neutrinos, electrons, positrons, protons, neutrons are emitted.

There are two types of elastic scatterings according the smallest scattering distance $d_s$ that is reached between the scattering partners.

"Electromagnetic" scattering we have when the smallest scattering distance $d_s$ is in the fifth region of the linear momentum curve $p_{stat}$ of Fig.63 where the Coulomb force is valid. Electromagnetic scattering is characterized by the inverse square distance force between particles.

"Mechanical" scattering we have when the smallest scattering distance $d_s$ is in the fourth region of Fig.63. Mechanical scattering is characterized by the combination of inverse square distance and inverse distance forces between particles.

Plastic or destructive scattering.

Plastic scattering we have when the identity of the scattering partners is modified
and photons, neutrinos, electrons, positrons, protons or neutrons are emitted.

In plastic or destructive scattering the smallest scattering distance $d_s$ enters the third and second region of the linear momentum curve $p_{stat}$ of Fig. 63.

The internal distribution of the BSPs is modified and the acceleration disturbs the internal mutual regeneration between the BSPs. The angular momenta of each BSP of the scattering partners interact heavily, and new basic configurations of angular momenta are generated, configurations that are balanced or unbalanced (stable or unstable).

In today’s point-like representation the energy of a BSP is concentrated at a point and scattering with a second BSP requires the emission of a particle (gauge boson) to overcome the distance to the second BSP which then absorbs the particle. The energy violation that results in the rest frame is restricted in time through the uncertainty principle and the maximum distance is calculated assigning a mass to the interchanged particle (Feynman diagrams).

**Conclusion:** In the present approach the emission of FPs by BSPs is continuous and not restricted to the instant particles are scattered. In the rest frame of the scattering partners no energy violation occurs. When particles are destructively scattered, during a transition time the angular momenta of all their FPs interact heavily according to the three interaction postulates defined in chapter 2.2 and new basic arrangements of angular momenta are produced, resulting in balanced and unbalanced configurations of angular momenta that are stable or unstable, configurations of quarks, hadrons, leptons and photons. The interacting particles (force carriers) for all types of interactions (electromagnetic, strong, weak, gravitation) are the FPs with their longitudinal and transversal angular momenta.

The concept is shown in Fig. 78

**Note:** The proposed theory considers elementary particles those which are stable as free particles or as part of composed particles like the electron, positron, neutron, proton, neutrino, photon, nuclei of atoms. All particles with a short life time (transitory particles) are not elementary particles and are produced at collisions. With increasing collision energies more and more transitory particles of higher energies can be produced without adding new substantial information to the theory.
Clasification of particles based on Basic (simple) or Complex (composed)

Elementary particles

<table>
<thead>
<tr>
<th>Free stable</th>
<th>Stabell in configurations</th>
<th>Stabell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron *</td>
<td>Neutrino **</td>
<td>Proton *</td>
</tr>
<tr>
<td></td>
<td>Stabell in configurations</td>
<td>Photon ***</td>
</tr>
<tr>
<td></td>
<td>Neutron *</td>
<td></td>
</tr>
</tbody>
</table>

All other particles with antiparticles

<table>
<thead>
<tr>
<th>Unstable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leptons except electrons and neutrinos</td>
</tr>
<tr>
<td>Hadrons except protons and neutrons</td>
</tr>
<tr>
<td>Bosons except photons</td>
</tr>
</tbody>
</table>

Legend

BSP = Basic Subatomic Particles
CSP = Complex Subatomic Particles (composed of BSP)
* Focal point of rays of FPs
** Pair of FPs with opposed angular momenta
*** Sequence of pairs of FPs with opposed angular momenta

Figure 78: Clasification of particles based on stability
### Classification of particles based on regeneration or Focal Point

<table>
<thead>
<tr>
<th>Simple</th>
<th>Electron</th>
<th>acc</th>
<th>desc</th>
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<tbody>
<tr>
<td>Positron</td>
<td>acc</td>
<td>desc</td>
<td></td>
</tr>
<tr>
<td>Proton</td>
<td>acc</td>
<td>desc</td>
<td></td>
</tr>
<tr>
<td>Antiproton</td>
<td>acc</td>
<td>desc</td>
<td></td>
</tr>
<tr>
<td>Neutron</td>
<td>acc</td>
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<thead>
<tr>
<th>Composed</th>
<th>Neutrino</th>
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<tbody>
<tr>
<td>Simple</td>
<td>$v_i = c$</td>
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<tr>
<td></td>
<td>$v_h \approx \infty$</td>
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<td>Composed</td>
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<td>$v_i = c$</td>
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<tr>
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<td>$v_h \approx \infty$</td>
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**Legend:**

- **acc** = accelerating Focal Points from $v_i = c$ to $v_h \approx \infty$
- **desc** = descelerating Focal Points from $v_h \approx \infty$ to $v_i = c$
- $v_i$ = low speed
- $v_h$ = high speed

Mediating particles like photons, gluons, gravitons, W / Z bosons are not required because of the definition of particles as dynamic configurations of Fundamental Particles that move with $v_i = c$ or $v_h \approx \infty$ relative to the Focal Point or ist emitter.

All other particles are combinations with repetitions of these particles with very short life time.

Figure 79: Classification of particles based on regeneration
13.2.1 Feynman diagram.

The proposed approach postulates that the force carriers between the focal points, which replace the subatomic particles, are the FPs with their $dH$ fields. The forces between the subatomic particles are generated by the interactions of the angular momenta of their FPs or $dH$ fields, and not by the exchanges of particles as the standard model teaches.

A flawless analysis of the disintegration of radioactive nuclei shows that there is no violation of conservation of energy, contrary to Feynman’s conclusions.

![Feynman diagram](image)

Figure 80: Feynman diagram

The concept is shown in Fig. 80

$$(E_o ; 0) \rightarrow (E_p ; p_p) + (E_\gamma ; p_\gamma)$$  \hspace{1cm} (636)

$$E_k = \sqrt{E_o'{}^2 + E_p^2} \quad E_p = p_p c \quad E_\gamma = p_\gamma c$$  \hspace{1cm} (637)

with

$$\bar{p}_p = -\bar{p}_\gamma \quad E_p = E_\gamma$$  \hspace{1cm} (638)

$$\Delta E = E_k + E_\gamma - E_o = \sqrt{E_o'{}^2 + E_p^2} + E_\gamma - E_o$$  \hspace{1cm} (639)

For $\Delta E = 0$ we get

$$E_o' = \sqrt{E_o^2 - 2 E_o E_\gamma} = \sqrt{E_o^2 - 2 E_\gamma E_\gamma}$$  \hspace{1cm} (640)

For stable BSPs like the electron and the positron which don’t disintegrate by radiation $E_p = E_\gamma = 0$ and $E_o' = E_o$.  

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For CSPs like heavy nuclei that disintegrate by radiation $E_p > 0$ and $E_o' < E_o$.

The same analysis is valid for nuclei that radiate $\alpha$, $\beta$ and $\gamma$ particles. The radiated energy goes always in detriment of the rest mass $E_o$ of the nuclei. No violation of conservation of energy occurs.
14 Bending of the trajectory of a BSP.

In this section the equations for the quantified bending momentum for BSP’s that move with $v \neq c$ are deduced.

A BSP that moves with the speed $v$ relatively far from matter does not exchanges linear momentum with the positive and negative BSP’s that form the matter.

If the distance to the matter is reduced, linear momentums are exchanged with the BSP’s of the matter, bending the trajectory of the moving BSP. As the BSP’s forming matter are quantified, also the bending trajectories of the moving BSP’s are quantified. Responsible for bending are the Coulomb, the Ampere and the induced forces. Basically we have to analyze for BSP with $v \neq c$

- Coulomb bending (sec. 14.2)
- Ampere bending (sec. 14.3)
- Induction bending (sec. 14.4)

The basic forms of bending are:

1. Bending at a free target edge
2. Bending through a target slit
3. Bending through a double target slit

14.1 General considerations.

When a BSP is bent the bending momentum $p_b = F_b \Delta t$ is quantized. The concept is shown in Fig. 81.

![Figure 81: Bending of BSPs](image-url)
The quantized bending of BSPs are indirectly observed through the bending patterns generated in diffraction experiments. Sharp patterns are only generated if the bending distance $r_d$ is well defined and equal for all BSPs that are bent. This condition is fulfilled when electrons have the right energy when they pass between two atoms of a crystal. As the radius of a BSP is a function of the energy of the BSP, each target defines with its inter-atomic distance the energy a BSP must have to be properly bent. The concept is shown in Fig. 82.

![Diagram of moving BSP and graphite crystal](image)

**Figure 82:** Relation between interatomic distance $d_A$ and radius $r_o/r_{oc}$ of moving BSP.

The vectorial relation between the bending momentum $\vec{p}_b$, the input momentum $\vec{p}_i$ and the output momentum $\vec{p}_a$ is shown in Fig. 83.

![Vector diagram for the bending of particles](image)

**Figure 83:** Vector diagram for the bending of particles.

For small bending angles $\eta$ the bending momentum $p_b$ is nearly orthogonal to the input momentum $p_i$ and we can write that

$$\vec{p}_i = \vec{p}_{ax} - \vec{p}_{bx}$$

$$\vec{p}_b = \vec{p}_{ay}$$
\[ \tan \eta = \frac{p_{ay}}{p_{ax}} \approx \frac{p_b}{p_i} \]  

(641)

14.2 Coulomb bending.

In sec. 3.2 we have derived the equation for the force between two static BSPs which is

\[ F_2 = \frac{K_F}{d^2} \int_{\phi_1_{\text{min}}}^{\phi_1_{\text{max}}} \int_{\phi_2_{\text{min}}}^{\phi_2_{\text{max}}} |\sin^3(\phi_1 - \phi_2)| \, d\phi_2 \, d\phi_1 \]  

(642)

with

\[ K_F = \frac{a}{4K} \sqrt{m_1m_2} \left( \frac{kg \, m^3}{s^2} \right) \]  

(643)

For \( d \gg r_o \) we get the Coulomb law with \( \int \int_{\text{Coulomb}} = 2.088768 \) for the double integral.

We adapt now the equation for the bending analyses where the distance \( r \) between the moving and static BSPs is variable with the angle \( \phi \) between the speed \( v_2 \) and the distance \( r \). The length from the static BSP perpendicular to the direction of the speed \( v_2 \) we designate with \( r_d \). We assume that the speed \( v_2 << c \) to allow the use of the static Coulomb law. We get

\[ F_2 = K_F \frac{1}{r^2} \int \int_{\text{Coulomb}} \sin^2 \phi \, d\phi \]  

(644)

with \( r \sin \phi = r_d \) we get

\[ F_2 = K_F \frac{1}{r_d^2} \sin^2 \phi \int \int_{\text{Coulomb}} \]  

(645)

We build now the average of \( F_2 \) for the BSP moving from \(-\infty\) to \(+\infty\).

\[ \bar{F}_2 = K_F \frac{1}{r_d^2} \int \int_{\text{Coulomb}} \sin^2 \phi \, d\phi = \frac{\pi K_F}{8} \frac{1}{r_d^2} \int \int_{\text{Coulomb}} \]  

(646)

The force \( F_2 \) acts during the time \( \Delta''t = \Delta''l/v_2 \) where \( \Delta''l \) is a constant acting distance for all BSPs independent of the speed \( v_2 \).

The total bending moment is

\[ p_b = \bar{F}_2 \Delta''t = \frac{\pi K_F}{8} \frac{1}{r_d^2} \int \int_{\text{Coulomb}} \frac{\Delta''l}{v_2} \]  

(647)

\[ \Delta''l = \text{constant} \]

The bending equation is
\[
\tan \eta = \frac{p_b}{p_i} = \frac{\pi K_F}{8} \frac{\Delta'' l}{r_d} \int_{Coulomb} \frac{\Delta l}{v_2 p_i} n
\]  

(648)

14.3 Ampere bending (Bragg law).

14.3.1 Ampere bending deduced from the equation for two infinite parallel currents of BSPs.

From sec. 3.11 we have that the momentum \( d\vec{p} \) generated between two moving BSPs due to the interaction of their transversal angular momentum is

\[
d\vec{p} = \frac{1}{c} \left| \int_{r_1}^{r_2} dH_{n_1} \, \vec{n}_1 \times \int_{r_2}^{r_2} dH_{n_2} \, \vec{n}_2 \right|
\]  

(649)

The BSPs that interact now trough their transversal angular momentum are the moving BSP and the parallel reintegrating BSP of a nucleon described in sec. 16.4. The concept is shown in Fig. 84.

\[ m_1^+ - m_1^- = \Delta m_1 \]

\[ m_2^+ - m_2^- = \Delta m_2 \]

Figure 84: Bending of BSPs

The deduction of the Bragg equation is similar to the deduction of the force density of sec. 3.11 with the following variable transformations:
\[ x = vt \quad \Delta x = v \Delta t \tag{650} \]

and integrating then the time from \( t = -\infty \) to \( t = +\infty \).

With these transformations we arrive to the same eq. (261) of sec. 3.11 for the total force density

\[
\frac{F}{\Delta l} = \frac{b}{c \Delta_\sigma t} \frac{r_o^2}{64 m} \int_{\gamma_{2\min}}^{\gamma_{2\max}} \int_{\gamma_{1\min}}^{\gamma_{1\max}} \sin^2(\gamma_1 - \gamma_2) \frac{\sin \gamma_1}{\sin \gamma_2} \frac{d\gamma_1}{d\gamma_2} \tag{651}
\]

with \( \int \int \text{Ampere} = 5.8731 \).

The concept is shown in Fig. 85

![Geometric relations for single moving BSPs.](image)

Figure 85: Geometric relations for single moving BSPs.

It is also for \( v \ll c \)

\[
\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2 r_o} \quad I_m = \rho m v \quad \Delta_\sigma t = K r_o^2 \quad p = F \Delta_\sigma t \tag{652}
\]

We get for the force

\[
F = \frac{b}{4 \Delta_\sigma t} \frac{5.8731}{64 c} \sqrt{m} v_1 \sqrt{m} v_2 \frac{\Delta l}{d} \tag{653}
\]

We have defined a density \( \rho_x \) of BSPs for the current so that one BSP follows immediately the next without space between them. As we want the force between one pair of BSPs of the two parallel currents we take \( \Delta l = 2 r_o \).

The interaction between the two parallel BSPs takes place along a distance \( \Delta''l = v_2 \Delta''t \) giving a total bending momentum \( p_b = F \Delta''t \). With all that we get

\[
p_b = \frac{b}{2 K r_o} \frac{5.8731}{64 c} \frac{m v_1}{d} \Delta''l \tag{654}
\]
which is independent of the speed \(v_2\). In sec. 16.1 the speed of a reintegrating BSP is deduced giving \(v_1 = k c\) with \(k = 7.4315 \cdot 10^{-2}\). We get

\[
p_b = \frac{b}{2} K r_o \frac{5.8731}{64 c} \frac{m k c}{d} \Delta''l\quad(655)
\]

If we now write the bending equation with the help of \(\tan \eta = 2 \sin \theta\) for small \(\eta\) and with \(2d = d_A\) we get

\[
\sin \theta = \frac{p_b}{2 p_i} = \left(\frac{5.8731 b m v_1}{64 c K r_o h} \Delta''l\right) \frac{h}{2 p_i d_A} n\quad(656)
\]

To get the Bragg law the expression between brackets must be constant and equal to the unit what gives for the constant interaction distance \(\Delta''l\)

\[
\Delta''l = \frac{64 c K r_o h}{5.8731 b m k c} = 8.9357 \cdot 10^{-9} \text{ m}\quad(657)
\]

We get for the bending momentum and force

\[
p_b = \frac{h}{d_A} n\quad F_b = \frac{1}{2} \frac{h}{d} \frac{n E_o}{\Delta''l}\quad(658)
\]

The bending force is quantized in energy quanta equal to the rest energy \(E_o\) of a BSP.

**Conclusion:** We have derived the Bragg equation without the concept of particle-wave introduced by de Broglie. Numerical results obtained using the quantized irradiated energy instead of the particle-wave are equivalent, different is the physical interpretation of the underlying phenomenon.

### 14.3.2 Ampere bending deduced from two parallel moving BSPs.

We start with the equation for one BSP

\[
\int_{r_r}^{\infty} dE_n = \int_{r_r}^{\infty} E_n \, dk = \frac{1}{2} E_n \frac{r_o}{r_r} \sin \varphi \, d\varphi \, d\gamma \frac{d\gamma}{2\pi}\quad(659)
\]

From Fig. 37 with \(\varphi = \Psi\) we get \(h = r_r \sin \varphi\) resulting

\[
\int_{r_r}^{\infty} dE_n = \frac{1}{2} E_n \frac{r_o}{h} \sin^2 \varphi \, d\varphi \, d\gamma \frac{d\gamma}{2\pi}\quad(660)
\]

We now pass to the \(dH_n\) field taking the square root of the energy according the **Note** for the Ampere law from sec. 3.11 and get

\[
\int_{r_r}^{\infty} dH_n = \frac{1}{2} H_n \frac{r_o}{h} \sin^2 \varphi \, d\varphi \, d\gamma \frac{d\gamma}{2\pi}\quad(661)
\]

The equation gives the cumulated \(dH\) field for the different angles \(\varphi\) of the moving
BSP to the distance \( h \). To get all contributions at the distance \( h \) of the \( dH \) field for all positions the moving BSP takes during its path, we must integrate from \( \varphi = 0 \) to \( \varphi = 2\pi \).

\[
\int_{\varphi=0}^{\pi} \int_{r_r}^{\infty} dH_n = \frac{1}{2} H_n \sqrt{\frac{r_o}{h}} \pi \int_{\varphi=0}^{\pi} \sin^2 \varphi \ d\varphi \ d\gamma \frac{d\gamma}{2\pi} = \frac{\pi}{4} H_n \sqrt{\frac{r_o}{h}} \frac{d\gamma}{2\pi} = dH_n(h) \quad (662)
\]

Now we build the cross product of the \( dH_n(h) \) (see Fig. 39) and get

\[
dH_n(h_1) \times dH_n(h_2) = \frac{\pi}{4} H_{n_1} \sqrt{\frac{r_o}{h_1}} \frac{d\gamma_1}{2\pi} \frac{\pi}{4} H_{n_2} \sqrt{\frac{r_o}{h_2}} \frac{d\gamma_2}{2\pi} (\bar{n}_1 \times \bar{n}_2) \quad (663)
\]

For the differential linear momentum we get

\[
dp = \frac{r_o}{64} c \sqrt{mv_1 \sqrt{mv_2}} \sin^2(\gamma_1 - \gamma_2) \sqrt{\sin \gamma_1 \sin \gamma_2} d\gamma_1 d\gamma_2 \quad (664)
\]

With \( \sqrt{E_n} = H_n = \sqrt{m \ v} \) and \( |\bar{n}_1 \times \bar{n}_2| = \sin(\gamma_1 - \gamma_2) \) we get

\[
dp = \frac{r_o}{64} c \sqrt{mv_1} \sqrt{mv_2} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin \gamma_1 \sin \gamma_2}} d\gamma_1 d\gamma_2 \quad (665)
\]

For the momentum we get

\[
p = \frac{r_o \ m \ v_1 \ v_2}{64 \ c} \int \int_{\text{Ampere}} \quad (666)
\]

and for the force

\[
F = \frac{p}{\Delta_o t} = \frac{r_o}{64 \ c \ \Delta_o} \ m \ v_1 \ v_2 \int \int_{\text{Ampere}} \quad (667)
\]

The force acts during the path length \( \Delta''l = v_2 \Delta''t \) giving the total bending momentum

\[
p_b = F \Delta''l = \frac{m \ k}{64 \ c \ K \ r_o} \frac{\Delta''l}{d} \int \int_{\text{Ampere}} \quad (668)
\]

With \( 2d = d_A, \ v_1 = k \ c \) and \( \sin \theta = \frac{p}{2 \ p_i} \) we arrive to

\[
\sin \theta = \frac{p_b}{2 \ p_i} = \left( \frac{2 \ m \ k}{64 \ K \ r_o \ h} \Delta''l \int \int_{\text{Ampere}} \right) \frac{h}{2 \ p_i \ d_A} \quad (669)
\]

Comparing with the Bragg equation the expression in brackets must be equal to the unit. With \( \int \int_{\text{Ampere}} = 5.8731 \) and \( k = 7.4315 \cdot 10^{-2} \) we get
The difference to the path length of the previous section is due to the factor $2/b$ with $b = 0.25$.

### 14.4 Induction bending of a BSP.

The induction bending is based on postulate 8 and described by eq. (374) which has a term with $H_n$ for constant speed $v$ and a term with $dH_n/dt$ for variable speed $v$.

$$\frac{d}{dt} \int_{r_r}^{\infty} dH_n = \frac{1}{2} \frac{d}{dt} [H_n] \frac{r_o}{r_r} \sin \varphi \, d\varphi \, \bar{s}_\gamma - H_n \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, d\varphi \, \bar{s}_\gamma$$

The bending is analyzed for constant speed $v$.

a) Bending with $v \ll c$.

When a BSP passes near a sharp matter edge with the speed $v$ the following forces are induced on the BSP’s of the matter edge, caused by the longitudinal $d'\bar{H}_s$ and transversal $d'\bar{H}_n$ fields.

$$d' \vec{F}_i = d' \vec{F}_{in} + d' \vec{F}_{is} \quad (671)$$

with

$$d' \vec{F}_{in} = \frac{1}{8\pi} \sqrt{m_p} \, r_o \, \text{rot} \, \frac{d}{dt} \int_{r_r}^{\infty} d' \bar{H}_n$$

and

$$d' \vec{F}_{is} = \frac{1}{8\pi} \sqrt{m_p} \, r_o \, \text{rot} \, \frac{d}{dt} \int_{r_r}^{\infty} d' \bar{H}_s$$

For $v \ll c$ and constant speed we have with eq. (374) and $d' \bar{H}_n = \frac{1}{2\pi} d\bar{H}_n$ that

$$\frac{d}{dt} \int_{r_r}^{\infty} d' \bar{H}_n = - \frac{1}{2\pi} \sqrt{m} \, v^2 \frac{r_o}{r_r^2} \sin \varphi \cos \varphi \, \bar{n}$$

(674)

We neglect the influence of $d' \bar{H}_s$ because our interest is on the induced force in the $\bar{r}_r$ direction.

With the already introduced transformations (see Fig. 56)

$$\theta = \pi - \varphi \quad \sin \theta = \sin \varphi \quad \cos \theta = - \cos \varphi \quad d\theta = -d\varphi$$

(675)

and

$$\Delta''l = \frac{64 K r_o h}{5.8731 \, m \, k \, 2} = 1.11697 \cdot 10^{-9} \, m$$

(670)
\[ \tilde{C}_n' = C_r' \tilde{e}_r + C_\gamma' \tilde{e}_\gamma + C_\theta' \tilde{e}_\theta \quad \text{and} \quad \tilde{e}_\gamma = \tilde{n} \quad (676) \]

we get

\[ C_r' \tilde{e}_r = 0 \quad C_\gamma' \tilde{e}_\gamma = \frac{d}{dt} \int_{r_r}^\infty d' \tilde{H}_n = \frac{1}{2\pi} \sqrt{m v^2 r_o r_r^2} \sin \theta \cos \theta \tilde{e}_\gamma \quad \text{and} \quad C_\theta' \tilde{e}_\theta = 0 \quad (677) \]

Because of the small distances \( r_r \) between the moving BSP and the BSP’s of the sharp edge we can neglect the time differences of the emitted fundamental particles and calculate without considering retardation.

We get for the rotor

\[ \text{rot } \tilde{C}_n' = \frac{1}{2\pi} \sqrt{m v^2 r_o r_r^3} \left[ 2 \cos^2 \theta - \sin^2 \theta \right] \tilde{e}_r + 0 \cdot \tilde{e}_\gamma \quad (678) \]

When the particle reaches the closest position to the matter edge, \( n \) induction bursts will occur each lasting \( \Delta t = K r_o r_{op} \) seconds, between the moving BSP and the BSP’s of the matter edge. The concept is shown in Fig. 86

Figure 86: Quantification of the bending trajectory of a basic subatomic particle at a free matter edge.

The induced force is

\[ d' \tilde{F}_{in} = \frac{1}{8 \pi} \sqrt{m_p r_{op}} \text{rot } \tilde{C}_n' \quad (679) \]

For \( r_r \approx r_d \) we have that \( \theta \approx \pi/2 \) and we get for the induced force
The induced bending momentum \( d' \bar{p}_b \) we get with the elementary time \( \Delta t = K r_{op} r_o \)

\[
d' \bar{p}_b = \frac{1}{16\pi^2} \sqrt{m_p} \sqrt{m} \; r_{op} \; r_o \; v^2 \frac{v^2}{r_d^3} \quad (680)
\]

The total bending momentum is

\[
\bar{p}_b = \int \sigma \; d' \bar{p}_b = \frac{K''}{16\pi^2} \sqrt{m_p} \sqrt{m} \; r_{op}^2 \; r_o^2 \; K \; v^2 \frac{v^2}{r_d^3} \quad (682)
\]

with \( K'' \) an equalization constant to be determined through experimental data.

The bending angle is

\[
\sin \eta = \frac{p_{ao}}{p_a} \approx \frac{p_b}{p_i} = \frac{K''}{16\pi^2} \sqrt{m_p} \sqrt{m} \; r_{op}^2 \; r_o^2 \; K \; v^2 \frac{v^2}{r_d^3} \quad \text{for} \quad \eta < \frac{\pi}{10} \quad (683)
\]

The radius \( r_o \) of a BSP is defined by

\[
r_o = \frac{\hbar c}{E} = \frac{\hbar c}{\sqrt{E_o^2 + E_p}} \quad r_{op} = \frac{\hbar c}{E_o} \quad (684)
\]

with \( \hbar c = 3.161529299 \times 10^{-26} [J \; m] \).

The bending equation gives the force on the probe BSP at the bending edge. As velocity is relativ, the same force actuates on the moving BSP but with opposed sign.

Because of the discrete number of BSPs in the matter edge the resulting momentum is quantified and thus the corresponding bending angle \( \eta_k \).

With a constant speed \( v \) the moving BSP and the static BSPs of the edge change linear momentum resulting in a bending angle \( \eta_k \)

\[
\sin \eta_k \approx \eta_k \propto \frac{k_i}{r_d} \quad (685)
\]

with \( r_d \) the distance between the moving BSP and the BSPs of the edge that exchanges linear momentum, and \( k_i \) the number of BSP’s of the edge that exchange linear momentum.

The bending due to the induced force is always in the same direction independent of the sign (electron or positron) of the BSPs that interchanges linear momentum. The two BSP’s always repel each other so that the bending of the moving BSP is always away from the bending edge.

b) Bending with relativistic \( v \).
From sec. 6.1.2 and eq. (374) and the deductions made at b) for \( \Delta v \ll c \) we get for the time differentiation of the transversal field

\[
\frac{d}{dt} \int_{r_c}^{\infty} dH_n = -\sqrt{E_p} v \frac{r_o}{r^2} \sin \varphi \cos \varphi d\varphi \bar{n} \quad (686)
\]

For \( r_r \approx r_d \) we have that \( \theta \approx \pi/2 \) and we get for the induced force

\[
d' \bar{F}_b = \frac{1}{16\pi^2} \sqrt{m_p} \sqrt{E_p} \frac{r_o}{r^2} K \frac{v}{r_d^3} \quad (687)
\]

With the elementary time \( \Delta t = K r_{op} r_o \) we get the induced bending momentum

\[
d' \bar{p}_b = d' \bar{F}_b \Delta t = \frac{1}{16\pi^2} \sqrt{m_p} \sqrt{E_p} \frac{r_o^2}{r^2} K \frac{v}{r_d^3} \quad (688)
\]

The total bending momentum is

\[
\bar{p}_b = \int d' \bar{p}_b = \frac{K''}{16\pi^2} \sqrt{m_p} \sqrt{E_p} \frac{r_o^2}{r^2} K \frac{v}{r_d^3} \quad (689)
\]

with \( K'' \) an equalization constant to be determined through experimental data. The bending angle is

\[
\sin \eta = \frac{p_{b_j}}{p_i} \approx \frac{p_b}{p_i} = \frac{K''}{16\pi^2} \sqrt{m_p} \sqrt{E_p} \frac{r_o^2}{r^2} K \frac{v}{r_d^3} \text{ for } \eta < \frac{\pi}{10} \quad (690)
\]

### 14.5 Bending schemas for BSPs with \( v \neq c \).

1) **At a free target edge.**

The bending of BSPs with \( v \neq c \) is mainly due to the Ampere force which is inverse proportional to the distance \( d \), while the Coulomb bending is inverse to \( d^2 \), and the induction bending is inverse to \( d^3 \). The bending at a free matter edge is shown in Fig. 87. To the distance \( r_{di} \) corresponds the bending angle \( \eta_i \) and to the distance \( r_{dj} \) the smaller bending angle \( \eta_j \). BSP’s designated with the index ”i” pass through the interatomic spaces of the bending matter. If the radii of the BSPs are comparable with the interatomic distances, the distance \( r_{di} \) is well defined and equal for all BSPs and the bending is therefore quantized producing bright and dark patterns. BSP’s designated with the index ”j” have no defined bending distance and are arbitrarily bend not producing bright and dark patterns.
2) At a target slit.

The bending of BSP with $v \neq c$ at a metal slit is shown in Fig. 88.

The bending pattern observed is a superposition of the bending patterns produced by two bending free matter edges. To get well defined bright and dark patterns, the distance $L$ to the screen must be much greater compared with the distance $b$ between the bending edges.

As particles with $v \neq c$ have no wave character and therefore no interference is possible, it is not possible to calculate the distance $b$.

If neutral complex particles (neutrons) are used instead of negative BSP’s (electrons), the discrete bending has its origin in that during the way through the crystal some BSP’s that form the neutral complex particle change linear momentum with the BSP’s of the bending edge.

3) At a double slit, grating or crystal.

The bending of BSP’s with $v \neq c$ at a double slit, a grating or a crystal is the superposition of the bending of BSP’s at single matter edges.
15 Interaction of complex BSPs with $v = c$ (photons) with regenerating and emitted FPs from BSPs of matter.

15.1 General considerations.

A sequence of BSPs with light speed (photon) is not bent when it interacts with regenerating or emitted fundamental particles of BSPs of matter. They are absorbed by the regenerating FPs of BSPs of the matter and

- partly passed to the emitted FPs from the BSPs of matter at the reflection level (reflected).
- and partly re-emitted by the BSPs of the matter (refracted).

The concept is shown in Fig. 89.

Fig. 89 shows a piece of matter with its two parallel refraction levels and two BSPs a and b with their regenerating and emitted rays of FPs.
Figure 89: Light reflection and refraction

From left to right a photon is shown as a sequence of opposed $dH_n$ (dots and crosses) fields perpendicular to the drawing plane. Each pair of opposed $dH_n$ fields is a potential linear momentum perpendicular to the plain that contains the opposed pair. At the reflection level part of the energy of each pair of $dH_n$ field is reflected and the rest of the energy is refracted at the refraction level 1. The reflection follows postulate 8 of interactions between FPs from sec. 2.2 passing part of the energy of pairs of opposed $dH_n$ from regenerating rays of FPs to rays of emitted FPs. The separation between reflection level and refraction level 1 shown in the figure has only a didactic purpose to emphasize the interaction between incoming FPs of the light ray and the FPs of the emitted ray of BSP $a$.

At the refraction level each $dH_n$ pair is absorbed by a BSP of matter transforming the potential linear momentum in an actually one. The now moving BSP is stopped after a certain interval because of its bindings with the other BSPs of the matter and emits the previously absorbed $dH_n$ pair with light speed.

The present approach is a emission theory where FPs are emitted by BSPs with light speed relative to a coordinate system fixed to the BSPs. Light that arrives to matter with speed $c \pm u$ is reflected and refracted at the refraction level 2 with light.
speed. The reduced speed of the light inside matter is due to the time needed for absorbion and re-emission when moving from BSP to BSP.

15.2 Splitting of BSPs with $v = c$.

At Fig. 89 the separation between reflection level and refraction level 1 shows first the splitting of the light ray followed by the refraction to comply with conservation of potential linear momentum. An isolated splitting of the light ray is also possible without the need of a subsequent refraction as the following Fig. 90 shows.

The ray that passes between the two BSP with $v = 0$ carries two FPs with opposed angular momenta $J_n$ (dot and cross) which give the potential linear momentum $p_n$. The two BSPs with $v = 0$ emit FPs with longitudinal angular momenta $J_s$ which are not paired and are not opposed to give a potential linear momentum.

At point $O$, where the three rays cross, their angular momenta interact according postulate 8 resulting the angular momenta $J'_n$ and $J''_n$. Both types of angular momenta have an opposed pair giving respectively potential linear momenta $p'_n$ and $p'_s$ on the two rays. Longitudinal angular momenta $J'_s$ remain at each ray contributing to the balance of linear momentum and energy.

![Diagram of splitting of a BSP with light speed](image)

**Figure 90:** Splitting of a BSP with light speed.

Fig. 91 shows the geometric relations for the balance of linear momentum. We have assumed, that the splitting is symmetric to make calculations easier.
Figure 91: Geometric relations for the splitting of a BSP with light speed.

Fig. 92 shows the splitting of a train of alternated linear momentum $p_n$.

Figure 92: Splitting of a train of BSP with light speed.

The train of linear momenta $p'_n$ interfere as shown in Fig. 93.

We have that

$$dp = \frac{1}{8\pi} \sqrt{m_p r_o \rho \int_{r_r}^{\infty} dH}$$  \hspace{1cm} (691)

As a BSP with light speed is independent of the BSP that has emitted it, it is independent of the distance $r_r$. We define that

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\[ \int_{r_r}^{\infty} dH = \sqrt{J} \nu \quad \text{and} \quad \text{rot} \left( \sqrt{J} \nu \right) = \frac{\sqrt{J} \nu}{r_o} \quad (692) \]

and get for the potential lineal momentum \( p \) for each pair of opposed angular momenta

\[ p = \frac{1}{8\pi} \sqrt{m_p} \sqrt{J} \nu \quad (693) \]

with \( m_p \) the mass of the probe particle. The energy of a train of potential linear momenta that moves with light speed (photon) is \( E_{ph} = h \nu \) with \( h \) the Planck constant.

If the train has \( k \) links we have that

\[ E_{ph} = h \nu = k J \nu = k h \nu' \quad \text{with} \quad \nu' = \frac{\nu}{k} \quad (694) \]

15.3 Differences between bending, reflection, refraction and splitting.

- Bending occurs between BSPs with speeds \( v \neq c \) (with rest mass) which emit and are regenerated by FPs. The bending is the product of the exchange of quantized energy between the bending partners and the bending linear momenta between them are opposed and have equal absolute value.

- Reflection occurs between BSPs with speeds \( v = c \) with potential linear momenta (pair of opposed \( dH_n \)) which don’t emit and are not regenerated by FPs. Reflection is always paired with refraction because of momentum conservation, also in the case of total reflection.

- Refraction occurs between BSPs with \( v \neq c \) and BSPs with \( v = c \). The pairs of opposed \( dH_n \) are absorbed by the BSPs with \( v \neq c \) and then re-emitted. Refraction is always paired with reflection because of momentum conservation, also in the case of total refraction.

- Splitting occurs between BSPs with \( v = c \). Because of momentum conservation splitting requires the interaction of three BSPs with \( v = c \).

15.4 Interference schemas for BSPs with \( v = c \).

A BSP with light speed is formed by a pair of equal but opposed angular momenta which, when absorbed by the regenerating FPs of a probe BSP gives it a linear momentum. The possibility to transform the energy stored in opposed angular momenta to energy stored in linear momentum is expressed with **potential liner momentum**. At
a single BSP with light speed the potential linear momentum can adopt all directions relative to the moving direction of the BSP. Single BSPs with light speed are called neutrinos.

A train of BSPs with light speed with alternating opposed potential linear momenta perpendicular to the moving direction is called photon. Photons interfere giving the known interference patterns at a target edge, at a single slit and at a double slit.

The following schematic representations show how the interference patterns are generated based on the concept of splitting of a train of BSPs with light speed.

1) **At a free target edge.** Fig. 93 shows a free target edge where some rays pass between the limiting atoms of the edge and rays that pass outside the edge. As BSPs with light speed are not bend, the rays outside the edge move without change of direction. The two rays a and b are split according Fig. 90 and Fig. 92. The interference patterns are generated the same way we know from standard theory. The incoming ray is split in rays with splitting angle ±η. Interference produced by splitting angles −η is not visible because of the intensity of outside rays. The distance $d_A$ between atoms is given by

$$d_A = \frac{n \lambda}{\sin \eta_n}$$  \hspace{1cm} (695)

2) **At a target with a single slit.** Fig. 94 shows the bending and corresponding interferences at a single slit. The interference pattern observed with a single slit is simply the superposition of the interference patterns from free edges. To make them visible certain geometric relations between the dimension of the slit and the distance to the screen must be observed. The slit is given by the following equation:

$$b = \frac{\Delta x}{\sin \eta_n} \hspace{1cm} with \hspace{1cm} \Delta x = n \lambda$$  \hspace{1cm} (696)
3) **At a target with a double slit.**

The interference of BSPs with \( v = c \) at a double slit, a grating or a crystal is the superposition of the two interference cases 1) and 2) previously presented.

The distance \( g \) between the two slits is given by

\[
g = \frac{n \lambda}{\sin \eta} \quad (697)
\]

**Note:** As a photon is composed of a train of BSPs with opposed potential linear momenta, it is possible to explain the interference of a single photon at the double slit, in that part of the train passes through one and the other part through the other slit. The two parts are then split in rays that interfere.
Figure 94: Interference of BSPs with $v = c$ at a single slit.

\[ b = \frac{\Delta x}{\sin \eta_n} \]

$\Delta x = n\lambda$

$n = 0$
$n = 1$
$n = 2$

$\eta_n$

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15.5 Derivation of Snell’s refraction law.

In Fig. 95 the potential linear momentum of each pair of opposed $dH_n$ field at each light ray is shown. The potential linear momentum is given by

$$p = \frac{1}{8\pi} \sqrt{m_p} dH_n$$  \hspace{1cm} (698)

where $m_p$ is the mass of the probe BSP.

Because of momentum conservation the linear momenta must have for $\epsilon_i = \epsilon_o$ the geometric relation shown which give the following equations.

$$p_r = p_i \frac{\sin(\epsilon_i - \epsilon')}{\sin(\epsilon_i + \epsilon')} \hspace{1cm} p_o = p_i \frac{\sin(\pi - 2\epsilon_i)}{\sin(\epsilon_i + \epsilon')}$$  \hspace{1cm} (699)

Additionally with the energy conservation $p_i c = p_r c + p_o c'$ we get after some mathematics the Snell’s law of refraction.

$$\frac{c'}{c} = \frac{\sin \epsilon'}{\sin \epsilon_i}$$  \hspace{1cm} (700)

Figure 95: Geometric relations between potential linear momenta of reflected and refracted rays.
15.6 Redshift of the energy of a BSP with light speed in the presence of matter.

Fig. 96 shows a sequence of BSP with light speed with their potential linear momenta $p$ (photon) before and after the interaction with the ray of regenerating FPs of the BSPs of matter. When the regenerating rays are approximately perpendicular to the trajectory of the opposed $dH_n$ (dots and crosses) fields of the photon, part of the energy of the $dH_n$ field is absorbed by the regenerating FPs of the ray and carried to the BSPs of the matter. The photon doesn’t change its direction and loses energy to the BSPs of the matter shifting its frequency to the red. The inverse process is not possible because the BSPs of the photon (opposed $dH_n$ fields) have no regenerating rays of FPs that can carry energy from the BSPs of matter and shift the frequency to the violet.

The process of loss of energy is according postulate 8 which postulates that pairs of regenerating FPs with longitudinal angular momenta from a BSP can adopt opposed pairs of transversal angular momentum from another BSP. As photons have no regenerating FPs they can only leave pairs of transversal angular momentum to other BSPs and lose energy. During the red shift, two adjacent opposed potential linear momenta of the photon compensate partially by passing part of their opposed linear momenta to the BSP of matter.

The energy exchanged between a photon and an electron is

$$E_i = \frac{hc}{\lambda_i}, \quad E_b = \frac{p_b^2}{2m_p}$$

(701)
The frequency shift of the photon is with $E_i = E_o + E_b$

$$\Delta \nu = \nu_i - \nu_o = \frac{1}{h} (E_i - E_o) = \frac{E_b}{h} \quad z = \frac{\Delta \nu}{\nu_i}$$

(702)

where $E_i = h \frac{c}{\lambda_i}$ is the energy before the interaction, $E_o = h \frac{c}{\lambda_o}$ the energy after the interaction and $E_b$ the energy carried to the BSP of matter.

Light that comes from far galaxies loses energy to cosmic matter resulting in a red shift approximately proportional to the distance between galaxy and earth (Big Bang).

Light is not bent by gravitation nor by a bending target, it is reflected and refracted by a target.

### 15.6.1 Refraction and red-shift at the sun.

Fig.97 shows two light rays one passing outside the atmosphere of the sun and one through the atmosphere. The first ray is red shifted due to regenerating FPs of matter of the sun as explained in sec.15.6. The second ray is refracted in the direction of the sun surface when crossing the sun atmosphere. Due to the refractions the speed in the atmosphere is $v < c$. Red-shift is also possible at the second ray but not shown in the drawing.

**Note:** Bending takes place only between BSPs with rest mass.
15.6.2 Cosmic Microwave Background radiation as gravitation noise.

Two explanations are possible:

From Fig. 96 we have learned how a photon passes energy to matter shifting its frequency to red. The transfer of energy takes place according postulate 8 from rays that not necessarily hit directly matter. If we put on the place of the matter the microwave detector of the COBE satellite we see how microwave radiation from radiating bodies that are not placed directly in front of the detector lenses can reach the detector. What is measured at the FIRAS (Far-InfraRed Absolute Spectrophotometer), a spectrophotometer (Spiderweb Bolometer) used to measure the spectrum of the CMB, is the energy lost by microwave rays that pass in front of the detector lenses. The so called Cosmic-Background Radiation is not energy that comes from microwave rays that have their origin in the far space in a small space angle around the detector axis. As the loss of energy from rays of photons to the microwave detector that don’t hit directly the detector is very low, the detector must be cooled down to very low temperatures to detect them.

A more plausible explanation for the CMB radiation is based on gravitation forces. Gravitation also follows postulate 8, which is the foundation of the induction law.

Nuclei of atoms are composed of electrons and positrons. Atoms are formed by nuclei and level electrons which move in orbits with quantized energies. When level electrons pass from a higher to a lower energy level the energy difference is emitted as gamma radiation of energy $\Delta E = \hbar \omega$.

At very low temperatures all level electrons are at the lowest possible energy level and no gamma radiation exists.

Gravitation is independent of the temperature because it has its origin at the atomic nuclei by reintegrating migrated electrons and positrons to their nuclei. The reintegration of migrated electrons and positrons to their nuclei generates momenta not only at electrons and positrons of other nuclei, but also at level electrons of other atoms. The gravitation momenta on the level electrons move them to a higher energy level, energy difference that is radiated as gamma signal when the electrons return to their original energy level.

The detectors of FIRAS, etc. are oriented to the Cosmic Background where no radiation is generated, nevertheless microwaves are detected. The only possible source of the measured microwaves at very low temperatures are the microwaves generated by gravitation between the components of the satellite. It is the gravitation noise that is detected when no thermal noise is present.
16 Induction between an accelerated and a static BSPs.

We assume, that a BSPs is accelerated from $v = 0$ to a fraction $k$ of the light speed $v_{max} = k \cdot c$ in the time $\Delta t$ and returned then to its original position through an external force in the time $\Delta t \to \infty$. We also assume that the acceleration has the direction of the probe BSP. According to postulate 8 the induced force on the static probe BSP is independent of the sign of the accelerated BSP and has always the direction of the acceleration. See Fig. 100 where BSP $b$ is accelerated in the direction of the nucleus of neutron 1 and BSP $p$ from neutron 2 is the probe BSP.

16.1 Induction between an accelerated and a probe BSP expressed as closed path integration over the whole space.

We start with the general dynamic equation (389) for the induced force on a static probe BSP produced by a BSP with speed $v$

$$dF_i = \frac{1}{c} \oint \frac{dl}{2\pi R} \cdot \frac{d}{dt} \int_{r_r}^{\infty} \bar{d}H_n \int_{r_p}^{\infty} dH_{sp}$$

and the eq. (374) with $\bar{n} = \bar{s}_\gamma$

$$\frac{d}{dt} \int_{r_r}^{\infty} \bar{d}H_n = \frac{1}{2} \frac{d}{dt} [H_n] \frac{r_o}{r_r} \sin \varphi \, d\varphi \, s_\gamma - H_n \, v \, \frac{r_o}{r_r^2} \sin \varphi \, \cos \varphi \, d\varphi \, s_\gamma$$

For $v = k \cdot c \ll c$ with $k$ a dimensionless factor (see also sec. 3.6), we have

$$H_n = v \sqrt{m} \quad \text{and} \quad \frac{d}{dt} [H_n] = \frac{dv}{dt} \sqrt{m}$$

and

$$r_o = \frac{\hbar c}{E_o} \quad \text{and} \quad \frac{dr_o}{dt} = 0$$

We now assume in Fig. 52 that $r_d = 0$ and that the moving BSP has a speed $v = 0$ but is accelerated in the direction of the probe BSP from $v = 0$ to $v = k \cdot c$ in the time $\Delta t$ over the distance $\Delta x$, and then returned to its original position in the time $\Delta t \to \infty$ by an external force. We get
\[ \frac{d}{dt} \int_{r_r}^{\infty} dH_n = \sqrt{m} \frac{k_c}{\Delta t} \frac{r_o}{r_r} \sin \varphi \, d\varphi \, \tilde{n} \]  

(707)

For the static probe BSP we have

\[ H_{s_p} = c \sqrt{m} \quad \text{and} \quad \frac{d}{dt} [H_{s_p}] = 0 \]  

(708)

and we get

\[ \int_{r_p}^{\infty} dH_{s_p} = \frac{1}{2} c \sqrt{m p} \frac{r_{o p}}{r_p} \sin \varphi_p \, d\varphi_p \]  

(709)

We introduce this expressions in the first equation and get

\[ dF_i = \frac{k_c r_o r_{o p} \sqrt{m} \sqrt{m p}}{4 \Delta t} \int \frac{dI}{2\pi R} \cdot \frac{\sin \varphi \sin \varphi_p}{r_r r_p} \, d\varphi \, d\varphi_p \, \tilde{n} \]  

(710)

With the following geometric relations already defined in sec.3.2 for the Coulomb law

\[ R = r_r \sin \varphi \quad R = r_p \sin \varphi_p \quad -r_r \cos \varphi + r_p \cos \varphi_p = d \]  

(711)

we get

\[ r_r r_p = d^2 \frac{\sin \varphi \sin \varphi_p}{\sin \varphi \cos \varphi_p - \sin \varphi_p \cos \varphi} \]  

(712)

resulting

\[ dF_i = \frac{k_c r_o r_{o p} \sqrt{m} \sqrt{m p}}{4 \Delta t \, d^2} \sin^2(\varphi - \varphi_p) \, d\varphi \, d\varphi_p \]  

(713)

We get for the total force

\[ F_i = \frac{k_c r_o r_{o p} \sqrt{m} \sqrt{m p}}{4 \Delta t \, d^2} \int_{\varphi_{min}}^{\varphi_{max}} \int_{\varphi_{p min}}^{\varphi_{p max}} |\sin^2(\varphi - \varphi_p)| \, d\varphi \, d\varphi_p \]  

(714)

where the integration limits are functions of the radii \( r_o \) and \( r_{o p} \) and the distance \( d \). For \( d \geq \sqrt{r_o^2 + r_{o p}^2} \) the integration limits are

\[ \varphi_{min} = \arcsin \frac{r_o}{d} \quad \varphi_{max} = \pi - \arcsin \frac{r_{o p}}{d} \]  

(715)

\[ \varphi_{p min} = \arcsin \frac{r_o}{d} \quad \varphi_{p max} = \pi - \arcsin \frac{r_{o p}}{d} \]  

(716)

For \( d \gg r_o \) the \( \int \int \) is independent of the distance \( d \) and equal to \( \int \int_{\text{Induction}} = 2.4662 \).
\[
F_i = \frac{k c \sqrt{m} \sqrt{m_p}}{4 K d^2} \int \int_{\text{Induction}} \text{ with } \int \int_{\text{Induction}} = 2.4662 \tag{717}
\]

We get
\[
F_i = 3.10447 \cdot 10^{-27} \frac{k}{d^2} N \tag{718}
\]

If we make \(F_i\) equal to the attraction force between an electron and a positron
\[
F_s = \frac{1}{4\pi\varepsilon_0} \frac{q^2}{d^2} \text{ we get } k = 7.4315 \cdot 10^{-2} \tag{719}
\]

The maximum speed is thus \(v_{\text{max}} = k c = 2.22944 \cdot 10^7 \text{ m/s} < c\).

**Note:** If we compare \(k = 7.4315 \cdot 10^{-2}\) with \(a = 8.7743 \cdot 10^{-2}\) from sec. 3.2 we see that they are very close. The difference comes from sec. 3.6 where we have introduced the equation for the induced force based on the equation for the Coulomb force. We have eliminated the cross product \(|\vec{s}_1 \times \vec{s}_2| = \sin \beta\) from eq. (166) resulting in the difference between \(\int \int_{\text{Coulomb}}\) and \(\int \int_{\text{Induction}}\).

### 16.2 Induction between an accelerated and a probe BSP expressed as rotor.

We start with the induced force expressed as rotor of the \(d'\vec{H}_n\) field
\[
d'\vec{F}_{in} = \frac{1}{8\pi} \sqrt{m_p} r_o \text{ rot } \frac{d}{dt} \int_{r_r}^{\infty} d'\vec{H}_n \tag{720}
\]

We make the same assumptions from sec. 16.1 that \(r_d = 0\) and that the moving BSP has a speed \(v = 0\) but is accelerated in the direction of the probe BSP from \(v = 0\) to \(v = k' c\) in the time \(\Delta t\) over the distance \(\Delta x\), and then returned to its original position in the time \(\Delta t \to \infty\) by an external force. With the transformation \(\varphi = \pi - \theta\) we get
\[
\frac{d}{dt} \int_{r_r}^{\infty} d'\vec{H}_n = \frac{1}{4\pi} \sqrt{m} \frac{k' c}{r_r} r_o \sin \theta \vec{n} \tag{721}
\]

We build the rotor
\[
\text{rot } \frac{d}{dt} \int_{r_r}^{\infty} d'\vec{H}_n = \frac{1}{2\pi} \sqrt{m} \frac{k' c}{r_r^2} r_o \cos \theta \vec{s}_r \tag{722}
\]

and get the force
\[ d'F_i = \frac{1}{16 \pi^2} \sqrt{\frac{m_p}{m}} r_{op}^2 \frac{k' c}{\Delta t} \cos \theta \bar{s}_r \]  

(723)

For aligned BSPs we have that \( \theta = 0 \) and with \( \Delta t = K r_o^2 \) we get

\[ d'F_i\left|_{\theta=0} = \frac{1}{16 \pi^2} \sqrt{\frac{m_p}{m}} \frac{k' c}{K} \frac{1}{d^2} \bar{s}_r \]  

(724)

or

\[ d'F_i\left|_{\theta=0} = 3.1886 \cdot 10^{-29} \frac{k'}{d^2} \bar{s}_r \ [N] \]  

(725)

If we make \( F_i \) equal to the attraction force between an electron and a positron

\[ F_s = \frac{1}{4\pi\epsilon_0} \frac{q^2}{d^2} \quad \text{we get} \quad k' = 7.2354 \]  

(726)

The maximum speed thus is \( v_{\text{max}}' = k' c = 2.1706 \cdot 10^9 \text{ m/s} > c \), which is not realistic, but shows, that the rotor gives a smaller value compared with the exact space integration of the previous section. The rotor nevertheless can be used as a more practical calculation instrument if the right proportionality factor is introduced as follows:

Eq. (720) must be written as

\[ d'F_i = \frac{97.3612}{8 \pi} \sqrt{\frac{m_p}{m}} r_{op} r_{rot} \frac{d}{dt} \int_{r_r}^{\infty} d'H_n \]  

(727)

and eq. (721) as

\[ \frac{d}{dt} \int_{r_r}^{\infty} d'H_n = \frac{1}{4\pi} \sqrt{\frac{m}{\Delta t}} \frac{v_{\text{max}}}{r_r} \sin \theta \bar{n} \quad \text{with} \quad v_{\text{max}} = 2.22944 \cdot 10^7 \text{ m/s} \]  

(728)

\[ |d'F_i\left|_{\theta=0} = dF_r = 2.30706 \cdot 10^{-28} \frac{1}{r^2} \ [N] \]  

(729)

16.2.1 Fundamental moment for the generation of forces.

The calculations of the variation of the speed \( \Delta v = v_{\text{max}} - v = v_{\text{max}} \) to generate the Coulomb force of the previous sections, namely integration over the whole space and as a rotor, gave values very close to the light speed.

\[ v_{\text{max}} = 2.22944 \cdot 10^7 \text{ m/s} < c < v_{\text{max}}' = 2.1706 \cdot 10^9 \text{ m/s} \]  

(730)
Our intention now is to give the force $F_r$ the following form

$$dF_r = dp_o \nu_r \ [N] \quad \text{with} \quad dp_o = m \nu_{max} \quad (731)$$

We are free to choose any value for the fundamental moment $dp_o = m \nu_{max}$ and take $\nu_{max} = c$. The reason is that it gives a simple relation between $dp_o$ and $\nu_o = \frac{1}{\Delta_o t}$ as shown in sec. 8.1 where we have deduced that

$$E_e \Delta t = E_o \Delta_o t = h \quad \text{or} \quad m \frac{h}{c} \nu_o \quad (732)$$

where $h$ is the Planck constant.

We now define that the force $dF_r$ is the product of a fundamental momentum $dp_o = m \nu_{max}$ and the frequency $\nu_r$ at which the fundamental moment is generated.

$$dF_r = dp_o \nu_r \ [N] \quad \text{with} \quad dp_o = m \nu_{max} \quad (733)$$

and make $\nu_{max} = c \ m/s$. We get

$$dp_o = m \ c = 2.73282 \cdot 10^{-22} \quad \text{and} \quad \nu_r = 8.44205 \cdot 10^{-7} \ \frac{1}{\nu^2} \ [s^{-1}] \quad (734)$$

The linear momentum $dp_o$ is the momentum generated by the transversal angular momenta of regenerating FPs when they arrive to the focus, as shown in Fig. 98. From

$$dE_n = \nu |\vec{J_n}| \quad dE_p = \frac{\nu}{2\pi R} \oint \vec{J_n} \cdot \vec{l} \quad dp = \frac{1}{c} dE_p \quad (735)$$

with $J_n = h$ and $\nu = \nu_o = 1/\Delta_o t$ we get

$$dp = \frac{\nu_o h}{c} = 2.73282 \cdot 10^{-22} = m \ c = dp_o \quad (736)$$

a simple relation between between $dp_o$ and $\nu_o = \frac{1}{\Delta_o t}$ as anticipated.

To get a moment $dp_o = m \ c$ the electron or positron must move with

$$dp_o = m \ c = \frac{m v}{\sqrt{1 - \frac{v^2}{c^2}}} \quad \rightarrow \quad v = \frac{1}{\sqrt{2}} \ c = 2.12132 \cdot 10^8 \ m/s \quad (737)$$

The fundamental force $F_o = dp_o \nu_o$ is generated with $\nu_o = 1/\Delta_o t = 1.23725 \cdot 10^{20} \ [s^{-1}]$ and gives $F_o = 2.51271 \cdot 10^{-3} \ N$. 

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The concept is shown at Fig. 98

Linear momentum out of opposed angular momenta.

If we now concentrate on the orbit electron with the Bohr radius \( a_o = 5.29189 \cdot 10^{-11} \) m we get from (734)

\[
\nu_B = 8.44205 \cdot 10^{-7} \frac{1}{a_o^2} [s^{-1}] = 3.014576 \cdot 10^{14} \text{ s}^{-1}
\]  

(738)

and

\[
\Delta_B t = \frac{1}{\nu_B} = 3.31722 \cdot 10^{-15} \text{ s} \gg \Delta_o t = 8.0824 \cdot 10^{-21} \text{ s}
\]

(739)

The distance between two consecutive Fundamental Particles for the Bohr radius is
\[ d_r = d_B = c \Delta_B t = 9.951648 \cdot 10^{-7} \text{ m} \] (740)

**Note:** In the previous analysis we have concentrated on region 5 of the curve Fig. 64 of sec. 9 where the Coulomb law is valid. At the region 2 we must write in (734) that

\[ \nu_r \propto r^2 \] (741)

### 16.3 Stern-Gerlach experiment.

To explain the splitting of the atomic ray in the Stern-Gerlach experiment, electrons were assigned an intrinsic spin with a quantized magnetic field that takes two positions, up and down relative to an external magnetic field, although it is not possible to explain how the intrinsic spin and magnetic field are generated. Measurements with individual electrons to detect the magnetic spin are fruitless because of the strong Lorenz force. The proposed approach with particles as focal points of rays of FPs has also no possibility to explain how such an intrinsic spin and magnetic field could exist on the electron.

An explanation is now given how the magnetic field at the orbit electron is generated.

The concept is shown in Fig: 99

![Figure 99: Magnetic spin \(dH_r\) of an orbital electron.](image)

\[ dF_r = m \frac{dv_r}{dt} \]

The approach \(E&R\) UFT shows that electrons and positrons coexist in nucleons without repelling or attracting each other. They can be seen as swarms of electrons
and positrons forming the nucleon. As nuclei are composed of nucleons they are also composed of electrons and positrons as shown in Fig. 99.

The charge $Q$ of a nucleus is replaced by the expression $\Delta n = n^+ - n^-$ which gives the difference between the constituent numbers of electrons and positrons that form the nucleus. As the $n_i$ are integer numbers, the Charge of the nucleus is quantified.

As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{prot}} = -6.9489 \cdot 10^{-14}$ $J = -0.43371$ $MeV$, and for the neutron $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{neutr}} = 5.59743 \cdot 10^{-14}$ $J = 0.34936$ $MeV$.

The tangential speed $v_t$ and the radial orthogonal speed $v_r$ of the orbital electron with its charge $q$ generate orthogonal transversal fields $dH_n$.

$$dH_{n_t} \propto \sqrt{m} v_t \quad \text{and} \quad dH_{n_r} \propto \sqrt{m} v_r \quad (742)$$

The speed $v_r$ of the electron with mass $m_1$ generates the field $dH_{n_1}$ which defines the state $\frac{1}{2}$ of its spin. The speed $v_r$ of the opposed orbital electron with mass $m_2$ generates the opposed field $dH_{n_2}$ which defines the state $-\frac{1}{2}$ of its spin. Each electron that is added to the orbit electrons when building an atom, tends to occupy a position relative to the other electrons with the minimum interaction. In the case of the two electrons of Fig: 99 the electrons are placed at the opposed sides of the diameter of the atom.

The neutral atoms used in the Stern-Gerlach experiment have all complete shells plus the first electron of the next shell. The configuration of the Ag is $[Kr]4d_{10}5s^1$. The $5s^1$ electron has according to the Standard Model no orbital angular moment and also no magnetic moment associated with it. The only way to explain the Stern-Gerlach experiment is assigning the electron an intrinsic magnetic moment.

According to the $E&R$ UFT approach the $5s^1$ electron generates two perpendicular magnetic fields, the orbital and the radial magnetic fields. The external inhomogeneous magnetic field can force the electron to move on an orbit where no net force is generated by the orbital field, but not simultaneously also for the radial field.

16.4 Induced gravitation force between two complex SPs.

We have defined complex subatomic particles (SPs) like the proton, neutron, etc, as composed of positive and negative BSPs that are grouped in the zone left to the maximum of the momentum curve of Fig. 27 (See also lower part of Fig. 100). The neutron for instance with 919 positrons and 919 electrons, neglecting the binding energy. Accelerating and decelerating BSPs of Fig. 3 don’t mix in the nucleus of complex SPs. They have different emitting and regenerating fundamental particles with different angular momentums and speeds. They are in a dynamic equilibrium in the nucleus of
We now show at Fig. 100 the generation of the gravitation force between two neutrons. If at neutron 1 a positron or electron migrates outside the zone where $\beta = 0$, opposed momentum $dp$ are induced at the positron or electron and the rest of the neutron 1. The momentum $dp_b$ reintegrates the escaped positron or electron to the nucleus of the neutron 1 generating the transversal field $dH_n$, whose direction is the same for the positron or electron. If now during the reintegration process the transversal field $dH_n$ is transferred according postulate 8 to the regenerating FPs of neutron 2 with its field $dH_s$, the positron or electron will stop moving towards the center of the nucleus of neutron 1, and neutron 2 will now move in the direction of neutron 1 with the momentum $dp_p = dp_b$. If to the contrary, during the reintegration process the
transversal field \( dH_n \) is not transferred to the regenerating FPs of neutron 2 with its longitudinal field \( dH_s \), then the opposed momentums \( dp_a \) at the positron or electron and \( dp_b \) at the rest of the neutron 1 compensate. Escaped electrons and positrons are continuously forced to reintegrate to the center of the nucleus of neutron 1. The probability that the transversal field \( dH_n \) is transferred to the regenerating FPs of neutron 2 follows the law of the inverse square distance \( d \) between the neutrons, resulting the known gravitation force for distances \( d \gg r_n \), where \( r_n \) is the radius of the neutron.

### 16.5 Transmission of gravitation momentum.

The neutron is composed of \( n^+ = 919 \) positrons and \( n^- = 919 \) electrons. Positrons of the neutron provide the required regenerating FPs to electrons and vice versa. The fields of positrons and electrons compensate and no external field of FPs exist. The proton is composed of \( n^+ = 919 \) positrons and \( n^- = 918 \) electrons. One positron of the proton is not compensated by an electron and therefore an external field exists. The concept is shown in Fig. 101.

For the following figures see conventions introduced for the representation of the positron and electron in sec. 3.3.

![Neutron and proton](image)

*Figure 101: Neutron and proton*

Fig. 102 shows a neutron with one migrated BSP and the corresponding leaking fields.
Fig. 103 shows the linear momentum $dp_b$ generated by a migrated BSP when reintegrated to the nucleus of neutron 1. Also rays ($v_e$) followed by emitted FPs of the migrated BSP and rays ($v_r$ and $v_r'$) followed by regenerating FPs of BSPs of neutron 2 are shown.

Figure 103: Transmission of momentum $dp$ from neutron 1 to neutron 2
The $d\vec{H}_n$ field induced at a point $P$ during reintegration of a migrated BSP to its nucleus.

An electron that has migrated slowly outside the core of a neutron formed by $n^+ = 919$ positrons and $n^- = 919$ electrons will interact with one of the positrons of the core of the neutron and be reintegrated to the neutron. Because of moment conservation they will have the same moment. The moment of the positron who moves in the core of the neutron will pass its moment to the $n^+ = 919$ positrons and now $n^- = 918$ electrons so that the core will move as a unit.

The $d\vec{H}_n$ fields induced at a point $P$ in space due to the moving electron and neutron core are:

$$dH_{n_1} = v_1 \sqrt{m_1} \, d\kappa_1$$  \hspace{1cm} $$dH_{n_2} = v_2 \sqrt{m_2} \, d\kappa_2$$

where the sub-index 1 stands for the electron and 2 for the neutron which now has a positive charge. The distances $r_1$ and $r_2$ to the point in space are nearly equal so that $r_1 = r_2$ and $d\kappa_1 = d\kappa_2$. We also have
\[ p_1 = m_1 v_1 \quad p_2 = m_2 v_2 \quad \text{with} \quad p_1 = p_2 \quad v_2 = \frac{m_1}{m_2} v_1 \quad (744) \]

and we get

\[ dH_{n_2} = \sqrt{\frac{m_1}{m_2}} dH_{n_1} \quad \text{resulting} \quad dH_{n_2} = 2.3321 \cdot 10^{-2} dH_{n_1} \quad (745) \]

For the analysis of the induced gravitation force and the induced current in an superconductor only the \( dH_{n_1} \) field generated by the reintegrating electron or positron is relevant. The induced opposed \( dH_{n_2} \) field generated by the movement of the neutron core can be neglected.

### 18 Newton gravitation force.

To calculate the gravitation force induced by the reintegration of migrated BSPs, we need to know the number of migrated BSPs in the time \( \Delta t \) for a neutral body with mass \( M \).

The equation (717) for the **induced gravitation** force generated by one reintegrated electron or positron is

\[
F_i = \frac{dp}{\Delta t} = \frac{k c \sqrt{m} \sqrt{m_p}}{4 K d^2} \int \int \text{Induction} \quad \text{with} \quad \int \int \text{Induction} = 2.4662 \quad (746)
\]

with \( m \) the mass of the reintegrating BSP, \( m_p \) the mass of the resting BSP, \( k = 7.4315 \cdot 10^{-2} \). It is also

\[
\Delta t = K r_o^2 \quad r_o = 3.8590 \cdot 10^{-13} \quad \text{and} \quad K = 5.4274 \cdot 10^4 \quad \text{s/m}^2 \quad (747)
\]

The direction of the force \( F_i \) on BSP \( p \) of neutron 2 in Fig. 103 is independent of the sign of the BSPs and is always oriented in de direction of the reintegrating BSP \( b \) of neutron 1.

Fig. 105 shows reintegrating BSPs \( a \) and \( d \) at Neutron 1 that transmit respectively opposed momenta \( p_g \) and \( p_c \) to neutron 2. Because of the grater distance from neutron 2 of BSP \( a \) compared with BSP \( d \), the probability for BSP \( d \) to transmit his momentum is grater than the probability for BSP \( a \). Momenta are quantized and have all equal absolute value independent if transmitted or not. The result computed over a mass \( M \) gives a net number of transmitted momentum to neutron 2 in the direction of neutron 1, what explains the attraction between neutral masses.
For two bodies with masses $M_1$ and $M_2$ and where the number of reintegrated BSPs in the time $\Delta t$ is respectively $\Delta G_1$ and $\Delta G_2$ it must be

$$ F_i \Delta G_1 \Delta G_2 = G \frac{M_1 M_2}{d^2} \quad \text{with} \quad G = 6.6726 \cdot 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^2 (748) $$

As the direction of the force $F_i$ is the same for reintegrating electrons $\Delta_{G^-}$ and positrons $\Delta_{G^+}$ it is

$$ \Delta G = |\Delta_{G^-}| + |\Delta_{G^+}| (749) $$

We get that

$$ \Delta G_1 \Delta G_2 = G \frac{4 K M_1 M_2}{m k c \int \overline{f_{\text{induction}}}} (750) $$

or

$$ \Delta G_1 \Delta G_2 = 2.8922 \cdot 10^{17} M_1 M_2 = \gamma_G^2 M_1 M_2 (751) $$

The number of migrated BSPs in the time $\Delta t$ for a neutral body with mass $M$ is thus

$$ \Delta G = \gamma_G M \quad \text{with} \quad \gamma_G = 5.3779 \cdot 10^8 \text{ kg}^{-1} (752) $$
**Calculation example:** The number of migrated BSPs that are reintegrated at the sun and the earth in the time $\Delta t$ are respectively, with $M_{\odot} = 1.9891 \cdot 10^{30} \text{ kg}$ and $M_{\oplus} = 5.9736 \cdot 10^{24} \text{ kg}$

$$\Delta G_{\odot} = 1.0697 \cdot 10^{39} \quad \text{and} \quad \Delta \oplus = 3.2125 \cdot 10^{33}$$ (753)

The power exchanged between two masses due to gravitation is

$$P_G = F_i c = \frac{E_p}{\Delta t} = \frac{k m c^2}{4 K d^2} \Delta G_1 \Delta G_2 \int \int_{\text{Induktion}}$$ (754)

The power exchanged between the sun and the earth is, with $d_{\odot \oplus} = 1.49476 \cdot 10^{11} \text{ m}$

$$P_G = F_G c = G \frac{M_{\odot} M_{\oplus}}{d_{\odot \oplus}^2} c = 1.0646 \cdot 10^{31} \text{ J/s}$$ (755)

19 Ampere gravitation force.

In the previous sections we have seen that the induced gravitation force is due to the reintegration of migrated BSPs in the direction $d$ of the two gravitating bodies (longitudinal reintegration). When a BSP is reintegrated to a neutron, the two BSPs of different signs that interact, produce an equivalent current in the direction of the positive BSP as shown in Fig. 106.

![Figure 106: Resulting current due to reintegration of migrated BSPs](image)

As the numbers of positive and negative BSPs that migrate in one direction at one neutron are equal, no average current should exists in that direction in the time $\Delta t$. It
\[ \Delta_R = \Delta_R^+ + \Delta_R^- = 0 \quad (756) \]

We now assume that because of the power exchange (754) between the two neutrons, a synchronization between the reintegration of BSPs of equal sign in the direction orthogonal to the axis defined by the two neutrons is generated, resulting in parallel currents of equal sign that generate an attracting force between the neutrons. The synchronization is generated by the relative movements between the gravitating bodies and is zero between static bodies. Thus the total attracting force between the two neutrons is produced first by the induced (Newton) force and second by the currents of reintegrating BSPs (Ampere).

\[
F_T = F_G + F_R \quad \text{with} \quad F_G = G \frac{M_1 M_2}{d^2} \quad \text{and} \quad F_R = R \frac{M_1 M_2}{d} \quad (757)
\]

To derive an equation we start with the following equation (261) derived for the total force density due to Ampere interaction.

\[
F = \frac{b}{c} \frac{r_o^2}{\Delta d} \frac{I_m_1}{64 m} \frac{I_m_2}{d} \int_{\gamma_{2_{\text{max}}}}^{\gamma_{2_{\text{min}}}} \int_{\gamma_{1_{\text{min}}}}^{\gamma_{1_{\text{max}}}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sqrt{\sin \gamma_1 \sin \gamma_2}} d\gamma_1 d\gamma_2 \quad (758)
\]

with \( \int \int \text{Ampere} = 5.8731 \).

It is also for \( v \ll c \)

\[
\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2 r_o} \quad I_m = \rho m v \quad \Delta_o t = K r_o^2 \quad I_m = \frac{m}{q} I_q \quad (759)
\]

We have defined a density \( \rho_x \) of BSPs for the current so that one BSP follows immediately the next without space between them. As we want the force between one pair of BSPs of the two parallel currents we take \( \Delta l = 2 r_o \).

For one reintegrating BSP it is \( \rho = 1 \). The current generated by one reintegrating BSP is

\[
I_m_1 = i_m = \rho m v_m = \rho m k c \quad \text{with} \quad v_m = k c \quad k = 7.4315 \cdot 10^{-2} \quad (760)
\]

We get for the force between one transversal reintegrating BSP at the body with mass \( M_1 \) and one longitudinal reintegrating BSP at \( M_2 \) moving parallel with the speed \( v_2 \)

\[
dF_R = 5.8731 \frac{b}{\Delta d} \frac{2 r_o^3}{64} \rho^2 m k v_2 \frac{v_2}{d} = 2.2086 \cdot 10^{-50} \frac{v_2}{d} N \quad (761)
\]
with \( I_{m_2} = i_2 = \rho m v_2 \).

The concept is shown in Fig. 107.

**Note:** The sign that takes the current \( i_m \) of the reintegrating BSP at the body with mass \( M_1 \) which interacts with the current \( i_2 \), is a function of the direction of the magnetic poles of \( M_1 \). The Ampere gravitation force \( F_R \) is therefore an attraction or a repulsion force depending on the relative directions of the magnetic poles of \( M_1 \) and the speed \( v_2 \).

In sec. 18 we have derived the mass density \( \gamma_G \) of reintegrating BSPs. At Fig. 105 we have seen that half of the longotudinal reintegrating BSPs of a neutron 1 induce momenta on neutron 2 in one direction while the other half of longitudinal reintegrating BSPs induce momenta in the opposed direction on neutron 2. In Fig. 107 we see, that all longitudinal reintegrating BSPs at \( M_2 \) generate a current component \( i_2 \) in the direction of the speed \( v_2 \). This means that we have to take for the density \( \gamma_A \) of reintegrating BSPs for the Ampere gravitation force approximately twice the value of the density \( \gamma_G \) of the Newton gravitation force

\[
\gamma_A \approx 2 \gamma_G = 2 \cdot 5.3779 \cdot 10^8 = 1.07558 \cdot 10^9 \text{ kg}^{-1}
\]  

(762)

resulting for the total Ampere gravitation force between \( M_1 \) and \( M_2 \)

\[
F_R = \frac{5.8731}{\Delta_o} \frac{b}{64} \frac{2 v_o^3}{\rho^2 m k v_2} \gamma_A^2 \frac{M_1 M_2}{d} = 2.5551 \cdot 10^{-32} v_2 \frac{M_1 M_2}{d} N
\]

(763)
where

\[ F_R = R \frac{M_1 M_2}{d} \quad \text{with} \quad R = 2.5551 \cdot 10^{-32} v_2 = R(v_2) \]  

(764)

The total gravitation force gives

\[ F_T = F_G + F_R = \left[ \frac{G}{d^2} + \frac{R}{d} \right] M_1 M_2 \]  

(765)

The concept is shown in Fig. 108.

---

19.1 Flattening of galaxies’ rotation curve.

For galactic distances the Ampere gravitation force \( F_R \) predominates over the induced gravitation force \( F_G \) and we can write eq. (765) as

\[ F_T \approx F_R = R \frac{M_1 M_2}{d} \]  

(766)

The equation for the centrifugal force of a body with mass \( M_2 \) is

\[ F_c = M_2 \frac{v_{\text{orb}}^2}{d} \quad \text{with} \ v_{\text{orb}} \ \text{the tangential speed} \]  

(767)

For steady state mode the centrifugal force \( F_c \) must equal the gravitation force \( F_T \). For our case it is

\[ F_c = M_2 \frac{v_{\text{orb}}^2}{d} = F_T \approx F_R = R \frac{M_1 M_2}{d} \]  

(768)

215
We get for the tangential speed

\[ v_{\text{orb}} \approx \sqrt{R M_1} \quad \text{constant} \quad (769) \]

The tangential speed \( v_{\text{orb}} \) is independent of the distance \( d \) what explains the flattening of galaxies’ rotation curves.

**Calculation example**

In the following calculation example we assume that the transition distance \( d_{\text{gal}} \) is much smaller than the distance between the gravitating bodies and that the Newton force can be neglected compared with the Ampere force.

For the Sun with \( v_2 = v_{\text{orb}} = 220 \text{ km/s} \) and \( M_2 = M_\odot = 2 \cdot 10^{30} \text{ kg} \) and a distance to the core of the Milky Way of \( d = 25 \cdot 10^{19} \text{ m} \) we get a centrifugal force of

\[ F_c = M_2 \frac{v_{\text{orb}}^2}{d} = 3.872 \cdot 10^{20} \text{ N} \quad (770) \]

With

\[ R(v_2) = 2.5551 \cdot 10^{-32} \quad v_2 = 5.6212 \cdot 10^{-27} \text{ Nm/kg}^2 \quad (771) \]

and

\[ F_c \approx R \frac{M_1 M_2}{d} \quad (772) \]

we get a Mass for the Milky Way of

\[ M_1 = F_c d \frac{1}{R M_\odot} = 4.3 \cdot 10^6 M_\odot \quad (773) \]

and with

\[ F_G = F_R \quad \text{we get} \quad d_{\text{gal}} = \frac{G}{R} = 1.1870 \cdot 10^{16} \text{ m} \quad (774) \]

justifying our assumption for \( F_T \approx F_R \) because the distance between the Sun and the core of the Milky Way is \( d \gg d_{\text{gal}} \).

**Note:** The mass of the Milky Way calculated with the Newton gravitation law gives \( M_1 \approx 1.5 \cdot 10^{12} M_\odot \) which is huge more than the bright matter and therefore called dark matter. The mass calculated with the present approach corresponds to the bright matter and there is no need to introduce virtual masses in space.

For sub-galactic distances the induced force \( F_G \) is predominant, while for galactic distances the Ampere force \( F_R \) predominates, as shown in Fig. 108

\[ d_{\text{gal}} = \frac{G}{R} \quad (775) \]
**Note:** The flattening of galaxies’ rotation curve was derived based on the assumption that the gravitation force is composed of an induced component and a component due to parallel currents generated by reintegrating BSPs and, that for galactic distances the induced component can be neglected.

### 19.2 Current induced on a rotating body.

In sec. 19 we have analysed the interactions between reintegrating BSPs of two bodies that move relative with the speed $v_2$. Now we analyse the case of two bodies where one of them rotates relative to the other.

The concept is shown in Fig. 109

![Diagram showing induced current and field on a rotating neutral body.](image)

Figure 109: Induced current $I_M$ and field $dH_n$ on a rotating neutral body.

Comparing with Fig.107 all BSPs at the distance $d_1$ move with $-v_2$ and all BSPs at the distance $d_2$ move with $v_2$. Reintegrating BSPs at $M_2$ that are at the distance $d_1$ from $M_1$ define the direction of the currents $i_m$ at $M_1$ because they are closer than reintegrating BSPs of $M_2$ at the distance $d_2$. The net result is a closed loop of currents $i_2$ at $M_2$ giving the current $I_M$ which generates the transversal field $dH_n$. Please see also subsection **Permanent magnetism** at [24.9].
Electromagnetic and Gravitation emissions.

Fig. 110 shows the generation of the electromagnetic emission and the gravitation emission.

At a) a Subatomic Particle (SP), electron or positron, shows transversal angular momenta $J_n$ of its Fundamental particles (FPs) when moving with constant moment $p$ relative to a second SP (not shown). The transversal angular momenta of its FPs follow the right screw law in moving direction independent of the charge. FPs with opposed angular momenta are entangled and are fixed to the SP. No FPs are emitted when moving with constant speed.

When the moving SP approaches a second SP (not in the drawing), the opposed transversal angular momenta are passed to the second SP via their regenerating FPs so that the first SP looses moment while the second SPs gains moment.

At b) a oscillating SP is shown with the pairs of emitted FPs with opposed angular momenta at the closed circles changing ciclically their directions. At far distances from the SP trains of FPs with opposed angular momenta become independent from the SP and move with light speed (photons) relative to its source. According to which combination of opposed entangled FPs become independent we have a train with potentially transversal momenta $p$ (shown) or potentially longitudinal momenta $p$ (not shown).

At c) a SP is shown that migrates slowly to the right outside the atomic nucleus and is than reintegrated to the left with high speed to its nucleus. The migration is so slow that no transversal angular momenta are generated at their FPs. When reintegrated, FPs with opposed transversal angular momenta become independent and move until absorbed by regenerating FPs of a second SP (not shown). As the transversal angular momenta of a moving SP follow the right screw law in moving direction independent of the charge of the SP, the reintegration will generate always potential longitudinal momenta $p$ in the direction of the nucleus. The emitted pairs of opposed angular momenta with potential longitudinal momenta $p$ have all the same direction, and when passed to a second SP generate the gravitation force.
a) **SP moving with constant** $\dot{p}$  
\[
\frac{d\dot{p}}{dt} = 0
\]

**No emission**  

\[
\ddot{p} = \int d\dot{p}
\]

b) **SP moving with armonic oscillation** $\dot{p} \propto \sin(\omega t)$  
\[
\frac{d\dot{p}}{dt} \neq 0
\]

**EM emission (photon)**

c) **SP migrating slowly** $\frac{d\dot{p}}{dt} \approx 0$ and than re-integrating $\frac{d\dot{p}}{dt} \approx \infty$

**Gravitation emission**

Figure 110: Electromagnetic and Gravitation emissions
21 Quantification of forces between BSPs and CSPs.

In sec. 16.1 we have derived the speed \( v = k c \) with which migrated BSP are re-integrated generating the Coulomb force and the two components of the gravitation force. In sec. 8.2.1 we have seen that the momentum generated by one pair of FPs with opposed angular momenta is

\[
p_{FP} = \frac{2 E_{FP}}{c} = 2.20866 \cdot 10^{-34} \text{ kgms}^{-1}
\]

We define now an elementary momentum

\[
p_{elem} = m k c = 2.0309 \cdot 10^{-23} \text{ kgms}^{-1}
\]

The number of pairs of FPs required to generate the momentum \( p_{elem} \) in the time \( \Delta o t \) is

\[
\frac{p_{elem}}{p_{FP}} = 9.1951 \cdot 10^{10}
\]

In the following subsections we express all known forces quantized in elementary linear momenta \( p_{elem} \).

21.1 Quantification of the Coulomb force.

In Sec. 3.2 we have derived the Coulomb force between two BSPs arriving to eq. (182) that follows

\[
F_2 = \frac{a m c r_o^2}{4 \Delta o t \Delta d^2} \int \int_{\text{Coulomb}} \int \int_{\text{Coulomb}} \text{ with } \int \int_{\text{Coulomb}} = 2.0887
\]

We now write the equation as follows

\[
F_2 = N_C(d) \frac{1}{\Delta o t} p_{elem} = N_C(d) \nu_o p_{elem} \quad p_{elem} = m k c \quad a = 8.774 \cdot 10^{-2}
\]

with

\[
N_C(d) = \frac{a r_o^2}{4 k \Delta d^2} \int \int_{\text{Coulomb}} = 9.1808 \cdot 10^{-26} \frac{1}{\Delta d^2}
\]

\[
\nu_C(d) = N_C(d) \nu_o \text{ gives the number of elementary linear momenta } p_{elem} \text{ during the time } \Delta o t \text{ resulting in the force } F_2.
\]

For an inter-atomic distance of \( d = 10^{-10} \text{ m} \) we get \( N_C = 9.1808 \cdot 10^{-6} \) resulting a frequency of elementary momenta of
\[ \nu_C(d) = N_C(d) \nu_o = 1.1359 \cdot 10^{15} \text{ s}^{-1} \quad \text{for} \quad d = 10^{-10} \text{ m} \quad (782) \]

### 21.2 Quantification of the Ampere force between straight infinite parallel conductors.

In Sec. 3.11 we have derived the Ampere force between two parallel conductors arriving to eq. (261) that follows

\[ \frac{F}{dl} = \frac{b}{c} \frac{r_o^2}{\Delta t} \frac{I_{m_1} I_{m_2}}{d} \int \int \text{Ampere} \quad \text{with} \quad \int \int \text{Ampere} = 5.8731 \quad (783) \]

and \( b = 0.25 \). We now write the equation in the following form assuming that the velocity of the electrons is \( v \ll c \) so that \( \Delta t \approx \Delta_o t \) and the currents are \( I_m \approx \rho_x m c \), where \( \rho_x = N_x/\Delta x \) is the linear density of electrons that move with speed \( v \) in the conductors.

\[ F = N_A(d, I_{m_1}, I_{m_2}, \Delta l) \nu_o p_{\text{elem}} \quad p_{\text{elem}} = k m c \quad \nu_o = \frac{1}{\Delta_o t} \quad (784) \]

with

\[ N_A(d, I_{m_1}, I_{m_2}, \Delta l) = \frac{b}{64} \frac{r_o^2}{k m^2 c^2} \frac{I_{m_1} I_{m_2}}{d} \int \int \text{Ampere} \quad \Delta l \quad (785) \]

or

\[ N_A(d, I_{m_1}, I_{m_2}, \Delta l) = 6.1557 \cdot 10^{17} \frac{I_{m_1} I_{m_2}}{d} \Delta l \quad (786) \]

For a distance of 1 m between parallel conductors with a length of \( \Delta l = 1 \text{ m} \) and currents of 1 A we get \( N_A = 6.1557 \cdot 10^{17} \). The frequency of elementary momenta for this particular case

\[ \nu_A = N_A(d, I_{m_1}, I_{m_2}, \Delta l) \nu_o = 7.6158 \cdot 10^{37} \text{ s}^{-1} \quad (787) \]

### 21.3 Quantification of the induced gravitation force (Newton).

From sec. 18 eq. (746) we have that the gravitation force for one aligned reintegrating BSPs is

\[ 221 \]
\[ F_i = \frac{k m c}{4 K d^2} \int \int_{\text{Induction}} \quad \text{with} \quad \int \int_{\text{Induction}} = 2.4662 \quad (788) \]

which we can write with \( \Delta_o t = K r_o^2 \) and \( p_{\text{elem}} = k m c \) as

\[ F_i = N_i \, \nu_o \, p_{\text{elem}} \quad \text{with} \quad N_i = \frac{r_o^2}{4 d^2} \int \int_{\text{Induction}} \quad (789) \]

Considering that \( \Delta G_1 \Delta G_2 = \gamma_G^{2} M_1 M_2 \) we can write for the total force between two masses \( M_1 \) and \( M_2 \)

\[ F_G = F_i \, \Delta G_1 \Delta G_2 = N_G \, \nu_o \, p_{\text{elem}} \quad \text{with} \quad N_G = N_i \, \Delta G_1 \Delta G_2 \quad (790) \]

where \( N_G \) represents the probability of elementary forces \( f_{\text{elem}} = \nu_o \, p_{\text{elem}} \) in the time \( \Delta_o t = K r_o^2 \).

Finally we get

\[ F_G = N_G(M_1, M_2, d) \, \nu_o \, p_{\text{elem}} \quad \text{with} \quad N_G = 2.6555 \cdot 10^{-8} \frac{M_1 M_2}{d^2} \quad (791) \]

The frequency with which elementary momenta are generated is

\[ \nu_G = N_G(M_1, M_2, d) \, \nu_o = 3.2856 \cdot 10^{12} \frac{M_1 M_2}{d^2} \quad (792) \]

For the earth with a mass of \( M_\oplus = 5.974 \cdot 10^{24} \text{ kg} \) and the sun with a mass of \( M_\odot = 1.9889 \cdot 10^{30} \text{ kg} \) and a distance of \( d = 147.1 \cdot 10^9 \text{ m} \) we get a frequency of \( \nu_G = 1.8041 \cdot 10^{45} \text{ s}^{-1} \) for aligned reintegrating BSPs.

### 21.4 Quantification of the gravitation force due to parallel reintegrating BSPs (Ampere).

From sec. 19 eq. (761) we have for a pair of parallel reintegrating BSPs that

\[ dF_R = 5.8731 \frac{b}{\Delta_o t} \frac{2 r_o^3}{64} \rho^2 m k \frac{v_2}{d} = 2.2086 \cdot 10^{-50} \frac{v_2}{d} \quad N \quad (793) \]

which we can write as

\[ dF_R = N \, \nu_o \, p_{\text{elem}} \quad \text{with} \quad N = 8.7893 \cdot 10^{-48} \frac{v_2}{d} \quad (794) \]

where
\[ p_{\text{elem}} = k \, m \, c \quad \text{and} \quad k = 7.4315 \cdot 10^{-2} \] (795)

The total Ampere force between masses \( M_1 \) and \( m_2 \) is given with eq. (763)

\[ F_R = 2.5551 \cdot 10^{-32} \, v_2 \, \frac{M_1 M_2}{d} \, N \] (796)

We now write the equation in the form

\[ F_R = N_R(M_1, M_2, d) \, \nu_o \, p_{\text{elem}} \quad \text{with} \quad N_R = 1.01682 \cdot 10^{-29} \, v_2 \, \frac{M_1 M_2}{d} \] (797)

The frequency with which pairs of FPs cross in space is

\[ \nu_R = N_R(M_1, M_2, d) \, \nu_o = 1.25811 \cdot 10^{-9} \, v_2 \, \frac{M_1 M_2}{d} \, s^{-1} \] (798)

For the earth with a mass of \( M_\oplus = 5.974 \cdot 10^{24} \, \text{kg} \) and the sun with a mass of \( M_\odot = 1.9889 \cdot 10^{30} \, \text{kg} \) and a distance of \( d = 1.5 \cdot 10^8 \, \text{m} \) and a tangential speed of the earth around the sun of \( v_2 = 30 \, \text{m/s} \) we get a frequency of \( \nu_R = 2.9896 \cdot 10^{39} \, s^{-1} \) for parallel reintegrating BSPs. The frequency \( \nu_G \) for aligned BSPs is nearly \( 10^6 \) times greater than the frequency for parallel reintegrating BSPs and so the corresponding forces.

### 21.5 Quantification of the total gravitation force.

The total gravitation force is given by the sum of the induced force between aligned reintegrating BSPs and the force between parallel reintegrating BSPs.

\[ F_T = F_G + F_R = [N_G(M_1, M_2, d) + N_R(M_1, M_2, d)] \, p_{\text{elem}} \, \nu_o \] (799)

or

\[ F_T = F_G + F_R = p_{\text{elem}} \, \nu_o \left[ \frac{2.6555 \cdot 10^{-8}}{d^2} + \frac{1.01682 \cdot 10^{-29}}{d} \, v_2 \right] \, M_1 \, M_2 \] (800)

We define the distance \( d_{\text{gal}} \) as the distance for which \( F_G = F_R \) and get

\[ d_{\text{gal}} = \frac{2.6555 \cdot 10^{-8}}{1.01682 \cdot 10^{-29} \, v_2} = 2.6116 \cdot 10^{21} \, \frac{1}{v_2} \, m \] (801)
21.6 Transmission speed of elementary momenta between BSPs.

Fig. 111 shows at a) and b) for the Ampere and at c) for the Coulomb and the Induction laws the emission $v_e$ and regeneration $v_r$ speeds of the rays of FPs with the corresponding distribution function $d\kappa$ drawn for $r$ or $h$ constant and variable emission angle $\varphi$.

Accelerating BSPs emit FPs with infinite speed and are regenerated by FPs with light speed. Decelerating BSPs emit FPs with light speed and are regenerated by FPs with infinite speed.

As accelerating BSPs provide the FPs for decelerating BSPs and vice versa only two combinations of BSPs for the Ampere, the Coulomb and the Induction laws must be analysed.

At Fig. 111 the distribution function $d\kappa$ was drawn for each BSP for a constant distance $r$ to show the contribution of the emitted FPs in the directions of $\varphi$ and $\gamma$ (see also Fig. 106 and Fig. 39).

$$d\kappa = \frac{1}{2} \frac{r_o}{r^2} dr, \sin \varphi \, d\varphi \quad \text{and} \quad \int_{r_r}^{\infty} d\kappa = \frac{1}{2} \frac{r_o}{r} \sin \varphi \, d\varphi$$

(802)

For the Ampere Law the distribution functions for $\varphi = \pi/2$ are shown for the two BSPs in b) which is a view from below of a). We see that for $\varphi = \pi/2$ the distribution faction $d\kappa$ is independent of $\gamma$. The transmission speed $v_{trans}$ of the elementary momenta between the two BSPs is a function of the distances $h_1$ and $h_2$ as shown in b).

- For the Ampere law the elementary momenta $dp_2$ are passed from an accelerating BSP to a decelerating BSP with the speed $v_{trans} = \infty$.

- For the Ampere law the elementary momenta $dp_2$ are passed from a decelerating BSP to an accelerating BSP with the speed $v_{trans} = c$.

For the Coulomb and the Induction laws the distribution functions $d\kappa$ at the two BSPs are functions of the distances $r_1$ and $r_2$ and the angle $\varphi$.

- For the Coulomb and the Induction laws the elementary momenta $dp_2$ are passed from a accelerating BSP to a decelerating BSP with the speed $v_{trans} = \infty$.

- For the Coulomb and the Induction laws the elementary momenta $dp_2$ are passed from a decelerating BSP to an accelerating BSP with the speed $v_{trans} = c$.

We have seen in sec. 5 that a neutron is composed of 919 electrons and 919 positrons. The 919 electrons are composed of 459 accelerating, 459 decelerating and 1 acc/dec electrons. The 919 positrons are composed of 459 accelerating, 459 decelerating and 1
dec/acc positrons. We see, that at each neutron the required combinations are present to pass the elementary momenta between neutrons with speed $v_{trans} = \infty$ what explains that gravitation transmits with infinite speed.

**Ampere**

![Diagram of Ampere's law with labels for currents and magnetic field](image)

**Coulomb / Induction**

![Diagram of Coulomb's law and electromagnetic induction with labels for forces and fields](image)

Figure 111: Transmission speeds of elementary momenta $dp$ between BSPs
22 Types of particles and interactions.

General considerations.

FPs are the energy recipients of all kind of manifestations in physics. The energy is stored in longitudinal and transversal rotations of FPs, storage that is independent of any kind of coordinate system. Rotation momentum of FPs is transformed into linear momentum of BSPs out of pairs of opposed angular momentum of FPs. Interactions between FPs are described as products between the square roots of their energies.

Types of Particles

- Fundamental Particles (FPs)
  - FPs are the energy recipients of all kind of manifestations in physics. The energy is stored in as rotation, storage that is independent of any kind of coordinate system.

- Basic Subatomic Particles (BSPs = Elementary Particles)
  - BSPs with FPs bound to focal points in space (electron and positron)
  - BSPs with FPs independent of focal points in space formed by two FPs with opposed angular momenta (neutrinos)

- Complex Subatomic Particles (CSPs)
  - CSPs with FPs bound to focal points in space (neutrons and protons which are formed by electrons and positrons)
  - CSPs with FPs independent of focal points in space but bound to a sequence of FPs with opposed angular momenta (photons which are formed by neutrinos)

- Transitory Subatomic particles
  - Particles with unstable configurations of FPs with short lifetimes (Leptons and Hadrons except electrons, positrons, neutrinos, neutrons, protons and photons).

Types of Interactions

Interaction laws between FPs of two BSPs are defined as products between their $d\hat{H}$ fields.
• **Coulomb law:** The close path integration of the cross product between longitudinal $d\vec{H}_s$ fields gives the Coulomb equation.

• **Ampere law:** The close path integration of the cross product between transversal $d\vec{H}_a$ fields gives the Lorentz, Ampere, Bragg and one component of the gravitation equations.

• **Induction law:** The close path integration of the product between the transversal field $d\vec{H}_a$ and the absolute value of the longitudinal $d\vec{H}_s$ field of a static BSP gives the Maxwell equations and one component of the gravitation equations.

### 23 Relativity.

#### 23.1 Introduction.

Space and time are variables of our physical world that are intrinsically linked together. Laws that are mathematically described as independent of time, like the Coulomb and gravitation laws, are the result of repetitive actions of the time variations of linear momenta.

To arrive to the transformation equations Einstein made abstraction of the physical interactions that make that light speed is the same in all inertial frames. The result of the abstraction are transformation rules that show time dilation and length contraction.

The physical interactions omitted by Einstein are:

• photons are emitted with light speed $c$ relative to their source

• photons emitted with $c$ in one frame that moves with the speed $v$ relative to a second frame, arrive to the second frame with speed $c \pm v$.

• photons with speed $c \pm v$ are reflected with $c$ relative to the reflecting surface

• photons refracted into a medium with $n = 1$ move with speed $c$ independent of the speed they had in the first medium with $n \neq 1$.

The concept is shown in Fig. 112

The Lorenz transformation applied on speed variables, as shown in the proposed approach, is formulated with absolute time and space for all frames and takes into account the physical interactions at measuring instruments that produce the constancy of the measured light speed in all inertial frames.
23.2 Lorenz transformation based on speed variables.

The general Lorentz Transformation (LT) in orthogonal coordinates is described by the following equation and conditions for the coefficients [6]:

\[
\sum_{i=1}^{4} (\theta^i)^2 = \sum_{i=1}^{4} (\bar{\theta}^i)^2 \quad \sum_{i=1}^{4} \bar{a}_k^i \bar{a}_i^j = \delta_{kl} \quad \sum_{i=1}^{4} \bar{a}_i^k \bar{a}_i^l = \delta^{kl} \tag{803}
\]

with

\[
\bar{\Theta}^i = \bar{a}_k^i \Theta^k + \bar{b}^i \tag{804}
\]

The transformation represents a relative displacement \(\bar{b}^i\) and a rotation of the frames and conserves the distances \(\Delta \Theta\) between two points in the frames.

Before we introduce the LT based on speed variables we have a look at Einstein’s formulation of the Lorentz equation with space-time variables as shown in Fig. 113.

\[
x^2 + y^2 + z^2 + (ic_o t)^2 = \bar{x}^2 + \bar{y}^2 + \bar{z}^2 + (ic_o \bar{t})^2 \tag{805}
\]

For distances between two points eq. (805) writes now

\[
(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 + (ic_o \Delta t)^2 = (\Delta \bar{x})^2 + (\Delta \bar{y})^2 + (\Delta \bar{z})^2 + (ic_o \Delta \bar{t})^2 \tag{806}
\]

The fact of equal light speed in all inertial frames is basically a speed problem and
not a space-time problem. Therefore, in the proposed approach, the Lorentz equation is formulated with speed variables and absolute time and space. Dividing eq. (806) through the absolute time \((\Delta t)^2\) and introducing the forth speed \(v_c\) we have

\[
v_x^2 + v_y^2 + v_z^2 + (iv_c)^2 = \bar{v}_x^2 + \bar{v}_y^2 + \bar{v}_z^2 + (i\bar{v}_c)^2
\]  

(807)

The concept is shown in Fig. 2.

The forth speed \(v_c\) introduced is the speed of the Fundamental Particles (FPs) that move radially through a focus in space as shown in Fig. 114. The FPs store the energy of the subatomic particles as rotations defining longitudinal and transversal angular momenta. The speed \(v_c\) is independent of the speeds \(v_x\), \(v_y\) and \(v_z\), forming together a four dimensional speed frame.

For the Lorentz transformation with speed variables Fig. 115 we get the following transformation rules between the source frame \(K\) and the virtual frame \(\bar{K}\):

\[
\begin{align*}
\text{a)} & \quad \bar{v}_x = v_x \\
\text{b)} & \quad \bar{v}_y = v_y \\
\text{a)} & \quad v_x = \bar{v}_x \\
\text{b)} & \quad v_y = \bar{v}_y
\end{align*}
\]
c) \( \bar{v}_z = (v_z - v) \gamma_v \) \( \bar{v}_z = (v_z + v) \gamma_v \)

d) \( \bar{v}_c = \left( v_c - \frac{v}{v_c} v_z \right) \gamma_v \) \( \bar{v}_c = \left( v_c + \frac{v}{v_c} v_z \right) \gamma_v \)

with \( \gamma_v = \left( 1 - \frac{v^2}{v_c^2} \right)^{-1/2} \)

23.3 Transformations for momentum and energy of a particle.

For \( v_z = 0 \) and \( v_c = c \), where \( c \) is the light speed, we get

a) \( \bar{v}_x = v_x \)  

b) \( \bar{v}_y = v_y \)  

c) \( \bar{v}_z = -v \gamma_v \)  

d) \( \bar{v}_c = c \gamma_v \)  

We see that for \( v_z = 0 \) the transformed speeds \( \bar{v}_z \) and \( \bar{v}_c \) are not linear functions of the relative speed \( v \) because

\[
\gamma_v = \left( 1 - \frac{v^2}{v_c^2} \right)^{-1/2} = 1 + \frac{1}{2} \frac{v^2}{v_c^2} + \frac{1}{2} \cdot \frac{3}{4} \left( \frac{v^2}{v_c^2} \right)^2 + \frac{1}{2} \cdot \frac{3}{4} \cdot \frac{5}{6} \left( \frac{v^2}{v_c^2} \right)^3 + \cdots
\]

The case \( v_z = 0 \) is the case of a particle placed at the origin of the frame \( K \). The momentum and the energy of the particle in the frame \( \bar{K} \) are given by

\[
\bar{p} = m \bar{v}_z = -m v \gamma_v \quad \bar{E} = mc \bar{v}_c = mc c \gamma_v = \sqrt{E_o^2 + E_p^2}
\]

\[
E_o = mc^2 \quad \text{and} \quad E_p = mc \bar{v}_z = mc v \gamma_v
\]
As the speed $v_z$ in the frame $K$ is parallel to the relative speed $v$ between the frames, the momentum and the energy of a particle moving with $v$ in the frame $K$ and a relative speed $v_z$ between the frames must give the same values. That we obtain multiplying the transformed speeds $\bar{v}_i$ with $\gamma_{v_z}$

$$\gamma_{v_z} = \left[1 - \frac{v_z^2}{c^2}\right]^{-1/2} \quad (811)$$

We get for the general case with $v_z \neq 0$ the momentum and the energy in the frame $\bar{K}$

$$\bar{p} = m \bar{v}_z \gamma_{v_z} = m (v_z - v) \gamma_{v_z} \quad \bar{E} = mc \bar{v}_c \gamma_{v_z} = mc \left(v_c - \frac{v}{v_c}\right) \gamma_{v_z} \quad (812)$$

**Note:** The frame $\bar{K}$ is a virtual frame because the speeds calculated with the Lorentz transformation equations for this frame are virtual speeds and not the real Galilean speeds of the particles, which are $\bar{v}_{rs} = v_z \pm v$. The frame $\bar{K}$ gives the virtual velocities that allow the calculation of the values of the momentum and energy, which are not linear functions of the real Galilean speed $\bar{v}_{rs}$.

For the distances between the frames $K$ and $\bar{K}$ the Galilean relativity is valid.

$$\Delta \bar{z} = z_o \pm v \Delta t \quad \text{with} \quad \Delta \bar{t} = \Delta t \quad \text{for all speeds} \quad v \quad (813)$$

If we start counting time when the origin of all frames coincide so that it is

$$z = \bar{z} = z^* = 0 \quad \text{for} \quad t = 0 \quad (814)$$

we get for the different types of measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>$K$</th>
<th>$\bar{K}$</th>
<th>$K^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ideal</td>
<td>$z = z_o$</td>
<td>$\bar{z} = z_o \pm v t$</td>
<td>$z^* = z_o \pm v t$</td>
</tr>
<tr>
<td>non destructive</td>
<td>$z = z_o$</td>
<td>$\bar{z} = z_o \pm v t$</td>
<td>$z^* \approx z_o \pm v t$</td>
</tr>
<tr>
<td>destructive</td>
<td>$z = z_o$</td>
<td>$\bar{z} = z_o \pm v t$</td>
<td>$z^* = z_o \pm v t_{meas}$</td>
</tr>
</tbody>
</table>

where $t_{meas}$ is the time the destructive measurement took place at the instrument placed in $K^*$.

As time and space are absolute variables it is

$$\Delta t = \Delta \bar{t} = \Delta t^* \quad \Delta z = \Delta \bar{z} = \Delta z^* \quad (815)$$
Note: The Lorentz transformation equations a), b) and c) are independent equations with the variables \(v_x, v_y\) and \(v_z\); there is no cross-talking between them. Not so equation d) where \(\bar{v}_c\) is a function of \(v_c\) and \(v_z\). The speed \(v_z\) is modifying \(\bar{v}_c\).

23.4 Transformations for electromagnetic waves at measuring instruments.

According to the present approach measuring instruments are composed of an interface and the signal comparing part. Interfaces are optical lenses, mirrors or electric antennas.

The concept is shown in Fig. 116

Electromagnetic waves that are emitted with the speed \(c_o\) from its source, arrive to a relative moving frame of the measuring instrument with speeds different than light speed, are first absorbed by the atoms of the interface and than emitted with light speed \(c_o\) to the signal comparing part.

To take account of the behaviour of light in measuring instruments an additional transformation is necessary.

In Fig 116 the instruments are placed in the frame \(K^*\) which is linked rigidly to the virtual frame \(\bar{K}\). Electromagnetic waves from the source frame \(K\) move with the real speed \(\bar{v}_r = c_o \pm v\) in the virtual frame \(\bar{K}\). The real velocity \(\bar{v}_r\) can take values that are bigger than the light speed \(c_o\).

The links between the frames for an electromagnetic wave that moves with \(c_o\) in the frame \(K\) are:

\[
\begin{align*}
\text{K} & \quad \text{\(K^*\)} \\
\lambda_z & \quad \bar{\lambda} = \lambda_z \\
v_z = c_o & \quad \bar{v}_r = c_o \pm v \\
& \quad v^*_z = c_o
\end{align*}
\]
e) shows the link between the frames $K$ and $\tilde{K}$. The wavelengths $\lambda_z = \bar{\lambda}_z$ because there is no length contraction.

f) shows the real Galilean speed $\bar{v}_{rz}$ in frame $\tilde{K}$.

g) shows the real frequency $\bar{f}_{rz}$ in the frame $\tilde{K}$.

h) shows the virtual frequency $\bar{f}_z$ in the frame $\tilde{K}$ and the link to the frequency $f^*$ of the frame $K^*$.

i) shows the equation for the energy of a photon for each frame.

**Note:** Also for electromagnetic waves the frame $\tilde{K}$ gives the virtual velocity that allows the calculation of the values of the momentum, energy and frequency, which are not linear functions of the real speed $\bar{v}_{rz}$.

For electromagnetic waves we have the following real speeds for the different types of measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>$K$</th>
<th>$\tilde{K}$</th>
<th>$\tilde{K}^*$</th>
<th>$K^*$</th>
<th>Refraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>ideal</td>
<td>$v_z = c_o$</td>
<td>$\bar{v}_{rz} = c_o \pm v$</td>
<td>$v_z^* = c_o$</td>
<td>$n = 1$</td>
<td></td>
</tr>
<tr>
<td>non destructive</td>
<td>$v_z = c_o$</td>
<td>$\bar{v}_{rz} = c_o \pm v$</td>
<td>$v_z^* &lt; c_o$</td>
<td>$n &gt; 1$</td>
<td></td>
</tr>
<tr>
<td>destructive</td>
<td>$v_z = c_o$</td>
<td>$\bar{v}_{rz} = c_o \pm v$</td>
<td>$v_z^* = 0$</td>
<td>$n \Rightarrow \infty$</td>
<td></td>
</tr>
</tbody>
</table>

with $n$ the optical refraction index $n = c_o/v_z^*$.

### 23.5 Equations for particles with rest mass $m \neq 0$.

Following, equations for physical magnitudes are derived for particles with rest mass $m \neq 0$ that are measured in an inertial frame that moves with constant speed $v$. For this case the transformation equations a), b), c) and d) from $K$ to $\tilde{K}$ are used. The transformation from $\tilde{K}$ to $K^*$ is the unit transformation, because of conservations of momentum and energy between rigid linked frames.

#### 23.5.1 Linear momentum.

To calculate the linear momentum in the virtual frame $\tilde{K}$ of a particle moving in the source frame $K$ with $v_z$ and $v_x = v_y = 0$ we use the equation c) of sec 23.2, with $v_c = c_o$. The speed $v_c = c_o$ describes the speed of the Fundamental Particles (FP)
emitted continuously by electrons and positrons and which continuously regenerate them, also when they are in rest in the frame \( K \) \((v_x = v_y = v_z = 0)\). From (812) we define

\[
\vec{v}_z' = (v_z - v)\gamma_{v_z} \gamma_v \tag{816}
\]

The linear momentum \( \bar{p}_z \) we get multiplying \( \vec{v}_z' \) with the rest mass \( m \) of the particle.

\[
\bar{p}_z = m \vec{v}_z' = m (v_z - v)\gamma_{v_z} \gamma_v = p_z^* \tag{817}
\]

Because of momentum conservation the momentum we measure in \( K^* \) is equal to the momentum calculated for \( K \), expressed mathematically \( p_z^* = \bar{p}_z \).

Eq. (817) is the same equation as derived with special relativity.

**Note:** The rest mass is simply a proportionality factor which is not a function of the speed and is invariant for all frames.

### 23.5.2 Acceleration.

To calculate the acceleration in the virtual frame \( K \) we start with

\[
\ddot{a}_z = \frac{d\vec{v}_z'}{dt} \quad \text{with} \quad \vec{v}_z' = \bar{v}_z \gamma_{v_z} = (v_z - v)\gamma_v \gamma_{v_z} \tag{818}
\]

what gives for \( v_z(t) \) and \( \gamma_{v_z}(t) \)

\[
\ddot{a}_z = \frac{d\vec{v}_z'}{dt} = \frac{d\vec{v}_z}{dt} \gamma_{v_z} + \vec{v}_z \frac{d\gamma_{v_z}}{dt} = \frac{dv_z}{dt} \gamma_{v_z} \gamma_v + (v_z - v)\gamma_v \frac{d}{dt}\gamma_{v_z} \tag{819}
\]

From momentum conservation \( p_z^* = \bar{p}_z \) we have that

\[
\ddot{a}_z = a_z^* \tag{820}
\]

### 23.5.3 Energy.

To calculate the energy in the virtual frame \( K \) for a particle that moves with \( v_z \) in the frame \( K \) we use the equation d) of sec 23.2, with \( v_c = c_o \). The equation d) is used because it gives the speeds of the FPs where the energy of the subatomic particles is stored.

\[
\bar{v}_c = \frac{v_c - v}{\sqrt{1 - v^2/v_c^2}} = \frac{v_c}{v} \left( v_c - v \right) \gamma = \bar{v}_r \gamma \tag{821}
\]

To get the energy in the frame \( K \) we multiply \( \bar{v}_c \) with \( mc \gamma_{v_z} \). See also eq. (812).

We get
\[ \bar{E} = mc \bar{v}_c \gamma_{v_z} = mc \left( v_c - \frac{v}{v_c} v_z \right) \gamma v \gamma_{v_z} \]  

Eq. (822) is the same equation as derived with special relativity.

With \( v_z = 0 \) we get

\[ \bar{E} = \frac{m c^2}{\sqrt{1 - v^2/c^2}} = \sqrt{E_o^2 + \bar{E}_p^2} \]  

with

\[ \bar{E}_p = m |\bar{v}_z| c_o = |\bar{p}_z| c_o \quad \bar{v}_z = v_z \gamma v_z \quad E_o = m c_o^2 \]  

To calculate the energy \( \bar{E}_p = m \bar{v}_z c_o \) we must calculate \( \bar{v}_z \) as explained in sec. 23.5.1 with \( v_z = 0 \).

The energy \( E_o \) is part of the energy in the frame \( \bar{K} \) and invariant, because if we make \( v = 0 \) we get \( E_o \) as the rest energy of the particle in the frame \( K \).

Because of energy conservation between frames without speed difference the energy \( E^* \) in the frame \( K^* \) is equal to the energy \( \bar{E} \) in the frame \( \bar{K} \).

### 23.6 Equations for particles with rest mass \( m = 0 \).

In this section the equations for electromagnetic waves observed from an inertial frame that moves with the relative speed \( v \) are derived. A comparison between the proposed approach and the Standard Model is made.

#### 23.6.1 Relativistic Doppler effect.

The speed \( v_c = c_o \) describes the speed of the Fundamental Particles (FP) emitted continuously by electrons and positrons and which continuously regenerate them, also when they are in rest in frame \( K \) \((v_x = v_y = v_z = 0)\). In the case of the photon no emission and regeneration exist.

The photon can be seen as a particle formed by only two parallel rays of FPs. The first ray carries FPs with opposed transversal angular momenta of equal orientation and the second ray carries FPs with transversal angular momenta opposed to the first ray. At each ray FPs exist only along the length \( L \) of the photon.

The concept is shown in Fig. 117

To calculate the energy of a photon in the virtual frame \( \bar{K} \) that moves with \( v_z = c_o \) in the frame \( K \) we use the same equation d) of sec 23.2 used for particles with \( m \neq 0 \), with \( v_z = c_o \) and \( v_c = c_o \). We use equation d) because the energy is stored in FPs. We get
Note: As the energy of a photon is a function of the frequency, the energy in the frame $\bar{K}$ is not affected by the non-linear factor $\gamma_z$.

The momentum of a photon in the frame $K$ is $p_c = E_{ph}/c_o = h f/c_o$ which we multiply with $\vec{v}_c$ to get the energy of the photon in the frame $\bar{K}$. The transformation of the energy between the frames $\bar{K}$ and $\bar{K}^\ast$ is $E^\ast = \bar{E}$ and we get:

For the measuring instrument moving away from the source

$$\bar{E} = p_c \vec{v}_c = \frac{E_{ph}}{c_o} (c_o - v) \gamma_v = E_{ph} \frac{\sqrt{c_o - v} \gamma_v}{\sqrt{c_o + v}} = E^\ast = h f^\ast$$

(826)

With $E_{ph} = h f$ we get the well-known equation for the relativistic Doppler effect

$$f^\ast = f \frac{\sqrt{c_o - v}}{\sqrt{c_o + v}} \quad \text{or} \quad \frac{f}{f^\ast} = \frac{\sqrt{1+v/c_o}}{\sqrt{1-v/c_o}}$$

(827)

and with $c_o = \lambda f$ and $c_o = \lambda^\ast f^\ast$ we get the other well-known equation for the relativistic Doppler effect

$$\frac{\lambda}{\lambda^\ast} = \frac{\sqrt{1-v/c_o}}{\sqrt{1+v/c_o}}$$

(828)

Eq. (827) is the same equation as derived with special relativity.
Note: No transversal relativistic Doppler effect exists.

Note: The real frequency $\tilde{f}_{r_z}$ in the frame $\tilde{K}$ is given by the Galilean speed $\tilde{v}_{r_z} = c_o \pm v$ divided by the wavelength $\tilde{\lambda} = \lambda$. The energy of a photon in the frame $K$ is given by the equation $E_{ph} = h \tilde{f}_z$ where $\tilde{f}_z = \tilde{f}_{r_z} \gamma$, with $\tilde{f}_{r_z} = (c_o \pm v)/\lambda_z$ the real frequency of particles in the frame $\tilde{K}$.

Note: All information about events in frame $K$ are passed to the frames $\tilde{K}$ and $K^*$ exclusively through the electromagnetic fields $E$ and $B$ that come from frame $K$. Therefore all transformations between the frames must be described as transformations of these fields, what is achieved through the invariance of the Maxwell wave equations.

23.6.2 Transformation steps for photons from emitter to receiver.

Electromagnetic signals (photons) have to pass an interface at the receiver until a measurement can be made. The interface is an optical lens, a mirror or an antenna. The signals undergo two transformations when travelling from the emitter to the receiver. The first transformation occurs before the interface and the second behind the interface.

The concept is shown in Fig.118

\[ c = \lambda f \]  
\[ (829) \]

the signal before the interface of the receiver in the $\tilde{K}$ frame is;
for the measuring instrument moving away from the source

\[ \tilde{f} = f \sqrt{\frac{c-v}{c+v}} \quad \text{and} \quad \tilde{\lambda} = \lambda \quad \text{and} \quad \tilde{v}_z = c - v \] (830)

At the output of the interface we get the signal in the \( K^* \) frame that is finally processed by the receiver.

\[ f^* = f \sqrt{\frac{c-v}{c+v}} \quad \text{and} \quad \lambda^* = \lambda \sqrt{\frac{c+v}{c-v}} \quad \text{and} \quad v^*_z = c \] (831)

At the first transformation the wavelength \( \lambda = \tilde{\lambda} \) doesn’t transform (absolute space) and at the second transformation the frequency \( \tilde{f} = f^* \) (absolute time).

The speed before the interface \( c \pm v \) is the galilean speed which changes to \( v^*_z = c \), the speed of light, before the processing in the receiver. This explains why always \( c \) is measured in all relative moving frames.

### 23.7 Relativistic energy of FPs.

A photon is a sequences of pairs of FPs with opposed angular momenta at the distance \( \lambda/2 \) as shown in Fig. 117. The potential linear moment \( p \) of a pair of FPs with opposed angular momenta is perpendicular to the plane that contains the opposed angular momenta. The potential linear moment of a pair of FPs with opposed angular momenta can take every direction in space relative to the moving direction of the pair.

The emission time of photons from isolated atoms is approximately \( \tau = 10^{-8} \) s what gives a length for the wave train of \( L = c \tau = 3 \) m. The total energy of the emitted photon is \( E_t = h \nu_t \) and the wavelength is \( \lambda_t = c/\nu_t \). We have defined that the photon is composed of a train of FPs with alternated angular momenta where the distance between two consecutive FPs is equal \( \lambda_t/2 \). The number of FPs that build the photon is therefore \( L/(\lambda_t/2) \) and we get for the energy of one FP

\[ E_{FP} = \frac{E_t \lambda_t}{2 L} = \frac{h}{2 \tau} = 3.313 \cdot 10^{-26} \ J = 2.068 \cdot 10^{-7} \ eV \] (832)

and for the angular frequency of the angular momentum \( h \)

\[ \nu_{FP} = \frac{E_{FP}}{h} = \frac{1}{2 \tau} = 5 \cdot 10^7 \ s^{-1} \] (833)

We can define an equivalent proportionality factor \( m_{FP} \)

\[ E_{FP} = m_{FP} c^2 \quad \text{with} \quad m_{FP} = 2.29777 \cdot 10^{-24} \ kg \] (834)

The relativistic energy of a FP is
\[ \tilde{E}_{FP} = m_{FP} c_0 \tilde{v}_c = \frac{m_{FP} c_0^2}{\sqrt{1 - v^2/c^2}} = \frac{2.068 \cdot 10^{-7}}{\sqrt{1 - v^2/c^2}} \text{ eV} \quad (835) \]

A neutrino can be seen as \( N_{FP} \) pairs of FPs with opposed angular momenta that all contribute to one potential linear momentum.

\[ E_{\text{neutrino}} = N_{FP} E_{FP} = N_{FP} 2.068 \cdot 10^{-7} \text{ eV} \quad (836) \]

Photons can be seen as a sequence of neutrinos with opposed potential linear momenta at the distance \( \lambda/2 \).

### 23.8 The proposed approach and the Standard Model.

The proposed approach represents a photon as a package of a sequence of FPs with opposed angular momenta. Packages are emitted with the speed \( c_o \) relative to its source. A monochromatic source emits packages with equal distances \( \lambda \) between FPs.

A package emitted with the speed \( c_o \), the frequency \( f \) and the wavelength \( \lambda \) in the frame \( K \) will move in the virtual frame \( \bar{K} \) with the real speed \( \bar{v}_r = c_o \pm v \), will have the same wavelength \( \bar{\lambda} = \lambda \) and a real frequency \( \bar{f}_r = (c_o \pm v)/\lambda \). In the frame \( K^* \) the package is absorbed by the atoms of the measuring instruments and immediately reemitted with the speed \( c_o \) relative to \( K^* \). The frequency \( f^* \) in the frame \( K^* \) is equal to the virtual frequency \( \bar{f} \) in the frame \( K \) which is given by the product of the real frequency \( \bar{f}_r \) and the factor \( \gamma \).

The proposed approach unifies the frames \( \bar{K} \) and \( K^* \) defining that the packages move from their source in frame \( K \) through space with the speed \( c_o \pm v \) relative to the frame \( K^* \) of the instruments.

The Standard Model unifies the frames \( K \) and \( \bar{K} \) to one frame defining that the packages (photons) move already from their source through space with the speed \( c_o \) relative to the frame \( K^* \) where the measuring instruments are located. This gives the impression that an absolute frame (aether) must exist for the photons to move always with light speed \( c_o \) independent of their sources.

For the Standard Model the length of a package in space (length of the wave train or coherence length) is \( l = (c_o \pm v)\tau \) while for the present approach it is \( l = c_o \tau \) (\( \tau \) is the time needed for traversing the coherence length \( l \)), which is independent of the relative speed \( v \).

Theories normally known as “Emission Theories” analysed by Willem de Sitter and Daniel Frost Camstock are theories that don’t produce well defined spectroscopic lines for a star rotating around a neutron star (Astrometric binaries), contrary to what is observed. In the proposed approach packages with equal distances between their
FPs (equal $\lambda$) but with different speeds $c_o \pm v$ from a star rotating around a neutron star (Astrometric binaries) produce well defined spectroscopic lines in accordance with experimental observations.

23.9 Conclusions.

The special Lorentz transformation formulated by Einstein is based on space and time variables and the definition of different times for inertial frames, what leads to transformation rules between frames with time dilation and space contraction.

Based on the proposed approach “Emission & Regeneration” Unified Field Theory, where electrons and positrons continuously emit and are regenerated by Fundamental Particles (FP), the following conclusions about special relativity based on speed variables were deduced:

- The fact of equal light speed in all inertial frames is basically a speed problem and not a space and time problem. Time and space are absolute variables and equal for all frames according to Galilean relativity.

- Electromagnetic waves are emitted with light speed $c_o$ relative to the frame of the emitting source.

- Electromagnetic waves that arrive at the atoms of measuring instruments like optical lenses or electric antennae are absorbed and subsequently emitted with light speed $c_o$ relative to the measuring instruments, independent of the speed they have when arriving to the atoms of the measuring instruments. That explains why always light speed $c_o$ is measured in the frame of the instruments.

- The transformation rules of special relativity based on space-time variables as done by Einstein describe the macroscopic results between frames making abstraction of the physical cause (measuring instruments) of constant light speed in all frames and require therefore space and time distortions. The transformation rules of special relativity based on speed variables as done in the proposed approach, take into consideration the physical cause (measuring instruments) of the constant light speed in all frames and therefore don’t require space and time distortions.

- All relevant relativistic equations can be deduced with the proposed approach. The transformation rules have no transversal components, nor for the speeds neither for the Doppler effect.

- The speed $v_c$ of the fourth orthogonal coordinate gives the speed of the FPs emitted continuously by electrons and positrons and which continuously regenerate them.
• Particles with rest mass are more stable when moving because of the interactions of their Fundamental Particles (FPs) with the FPs of the masses of real reference frames as explained in the proposed approach, and not because of time dilation.

The transformation equations based on speed variables are free of time dilation and length contraction and all the transformation rules already existent for the electric and magnetic fields, deduced on the base of the invariance of the Maxwell wave equations are still valid for the proposed approach.

The electric and magnetic fields have to pass two transformations on the way from the emitter to the receiver. The first transformation is between the relative moving frames while the second is the transformation that takes into account that measuring instruments convert the speed of the arriving electromagnetic waves to the speed of light $c_0$ in their frames.

The present work shows how the measuring equipment must be integrated in the chain of interactions to avoid unnatural conclusions like time dilation and length contraction.

**Note:** General Relativity introduced by Einstein is based on time dilation and length contraction and is the gravitation theory of the Standard Model. With the abolition of time and length distortions General Relativity is not more valid and is replaced by the gravitation theory based on the reintegration of migrated electrons and positrons to their nuclei as explained in sec. 16 of the proposed approach.

## 24 Miscellaneous.

The strong and weak forces are presented as forces that don’t need to be especially defined as separate forces.

The possibility of entanglement of BSPs is explained with the strong coupling of corresponding opposed angular momenta of fundamental particles.

The origin of permanent magnetic fields is explained with the energy flow between atoms or molecules.

The relation between the elementary bending momentum and the total momentum between two straight conductors is presented.

The Stern-Gerlach experiment and the spin of the electron are explained based on Ampere bendin.

The origin of the instability of free positrons is explained.

Energy levels of electrons in atoms are commented.

Radiation of accelerated BSPs is explained.

Coulomb force on a level electron.

Gravitation and background-noise.

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Binding energy of BSPs in the nucleons.

24.1 Strong and weak forces.

a) **Strong forces** are defined in standard physics theory as those forces that bind quarks into hadrons. They explain why protons coexist in the atomic nucleus even having the same charge.

The proposed approach explains the coexistence of BSPs with equal signs (electrons or positrons) in nuclei with the annihilation of linear momenta when the distance between them tends to zero. As nucleons are formed by electrons and positrons, no special strong force has to be defined to explain this physical phenomenon, thus allowing the existence of stable complex particles (see Fig. 27). When electrons and positrons join to form protons or neutrons, the difference between the rest masses is emitted or absorbed as photons or neutrinos.

We have defined as \( \Delta n_i = n_i^+ - n_i^- \) the difference between the number of positive and negative BSPs that form the complex particle \( i \).

For the proton we have \( n^+ = 919 \) and \( n^- = 918 \) with a binding Energy of \( E_{B_{prot}} = -6.9489 \times 10^{-14} \text{ J} \). For the neutron we have \( n^+ = 919 \) and \( n^- = 919 \) with a binding Energy of \( E_{B_{neutr}} = 5.59743 \times 10^{-14} \text{ J} = 0.34936 \text{ MeV} \).

b) **Weak forces** are defined in standard physics theory as those forces that bind heavy leptons and quarks.

According to the proposed approach all BSPs (electrons and positrons) that form protons and neutrons of an atomic nucleus must move in the zones left of the maximum of the momentum curve of Fig. 27. BSPs in zone 1 don’t repel neither attract each other because the linear momenta are zero. For BSPs that migrate outside zone 1 of the atomic nucleus the linear momenta are not more zero. A polarization with the remaining BSPs of zone 1 emerges, generating an attracting or repelling force. At nuclei with low atomic numbers \( Z \) all migrated BSPs are reintegrated to the nucleus. At nuclei with high \( Z \) and high numbers of protons and neutrons forming their atomic nuclei, migrated BSPs at zone 2 of the nuclei are closer to the maximum of the curve of Fig. 27, and less energy is required to overcome the maximum of the curve allowing a tunnelling effect explaining radioactivity.

24.2 Light speed.

All fundamental particles emitted by an electron move with light speed relative to a coordinate system which is fix with the electron. When a level electron changes its energy level it looses or gains pairs of fundamental particles with opposed angular momenta. The pairs of fundamental particles form chains with alternated potential linear
momenta, resulting in a configuration known as photon (see Fig. 66 c). Photons that are emitted by a coordinate system that moves with the speed $u$ relative to a second coordinate system will arrive at the second with the speed $c \pm u$. In Fig. 119 one constituent of a photon (opposed $dH_n$) is shown just before being absorbed by an electron of the second coordinate system transferring its potential linear momentum $dp_r$. The now moving electron in the second coordinate system will generate opposed transversal $dH_n$ which are irradiated with the speed of light when the electron is stopped after a distance $\Delta x$ because of the bindings to its atom. The Light that we measure is first absorbed by level electrons of our instrument (glass of the optical system, etc.) and subsequently emitted with light speed relative to the instrument, what explains why we always measure light speed. Light that moves through matter (glass, water, etc.) is constantly absorbed by level electrons and immediately emitted with light speed. The resulting reduced speed through matter is due to the time spent in the absorption and emission by level electrons.

The concept is shown in Fig. 119

![Figure 119: Mechanism responsible for constant light speed in all inertial frames](image)

24.3 Life time of muons.

The life time of muons increases with speed according experimental verifications. On Fig. 120 we will show the mechanism how the mean life of muons increases with speed. Muons are complex SPs composed of electrons and positrons except for the binding energy. Electrons or positrons that migrate outside the first region (see sec. 9) will be reintegrated or expelled. For a muon with $v = 0$ the tunnel barrier for expelled particles is given by curve $p_{stat}$, which flattens with increasing $v$ while the field $dH_n$ increases. For $v \neq 0$ electrons and positrons that are accelerated to $v_{exp}$ in the second region are forced by the $dH_n$ field to follow a circular path, thus reducing the probability for the
electron and positron to be expelled.

The comparison of the statistical counts of muons made at different heights involves no measurements of time nor length with the help of light, and therefore does not require time nor length corrections according to special relativity.

The concept is shown in Fig. 120

Figure 120: Increase of mean life time of muons with speed
24.4 Reflection and refraction of light.

On sec. 24.2 we have seen, that light adjusts its speed to the light speed \( c \) relative to a coordinate system fix with matter that has absorbed and then emitted it. Light that is reflected also takes the speed \( c \) relative to a coordinate system fix with matter that has reflected it because of the emission speed of FPs of the BSPs of the matter.

24.5 Entangled BSP.

When we analyzed the balance of energy and rotational momenta in the following sections

- 2.11 for BSPs that move with constant speed \( v \) and
- 3.8 for induced momentums between two static BSPs and
- 3.11.2 for induced momentums between two parallel straight conductors

we have seen that there is a strong coupling between the rotational momenta of fundamental particles, so that constantly corresponding opposed rotational momenta are generated and destroyed. We have also seen that the coupling is independent of the distance between corresponding rotational momenta and that it is defined by \( d\kappa(\varphi, r, v) = d\kappa(\pi - \varphi, r, v) \).

There is a configuration that is common for all BSPs, namely rings of transversal rotational momenta \( \bar{J}_n \) with sum zero. For BSPs with \( v \neq c \) this rings cannot exist independently because of the balance conditions for the longitudinal rotational momenta \( \bar{J}_s \). For BSPs with \( v = c \) the longitudinal rotational momenta \( \bar{J}_s \) are zero and therefore the rings exist as independent configurations in the form of opposed transversal angular momenta.

When complex particles with \( v = c \) (photons) are split, couplings remain between the two parts of the trains of opposed transversal rotational momenta, couplings that are independent of the distance between the splitting products. Because of the near infinite speed of one of the two types of fundamental particles, the splitting products change their quantum state instantly independent of the distance between them.

24.6 Electron and positron compensation and annihilation.

The representation of electrons and positrons as focal points of rays of FPs, where the energy is stored in the angular momenta of their FPs, explains the compensation and annihilation of electrons and positrons as follows: (see also Fig. 7)

Fig. 121 shows the electron positron compensation. When the electron shown at \( a \) and the positron shown at \( b \) are moved slowly together, they compensate each other
Compensation of angular momenta

Figure 121: Electron positron compensation

for the interactions with other external charged particles. At c) the compensation is shown as the result of the compensation of the longitudinal angular momenta $J_z$ of all their FPs.

Fig. 122 shows the annihilation of an electron with an positron. At the regenerating FPs of moving electrons or positrons transversal angular momenta $J_n$ are generated as shown at a) and b. When the electron and positron collide, trains of pairs of FPs with opposed transversal angular momenta (photons) are expelled with the speed “c“, as shown at c). Also individual pairs of FPs with opposed transversal angular momenta (neutrinos) may be expelled with the speed $c$. The photons and neutrinos are entities where the sum of their angular momenta is equal zero and therefore they can become independent entities of the focal point.
24.7 Differences between the Standard and the E & R Models in Particle Physics.

An important difference between the two models we have in particle physics. The concept is shown in Fig.123.

The SM defines carrier particles $X$ for the interaction between particles $A$ and $B$ and leads to energy violation during the time $\hbar/\Delta E$. The range $R$ of these carrier particles defines the distance over which the interaction can take place and is given by

$$R = \frac{\hbar}{M_X c}$$  \hspace{1cm} (837)

where $M_X$ is the mass of the carrier particle with the coupling strength $g$ to the particles $A$ and $B$. For electromagnetic interactions the carrier particles are the photons with $M_X = 0$, the range is $R = \infty$. For the weak interactions the carrier particles are the $W$ and $Z$ bosons with masses in the order of $80 - 90 \text{ GeV}/c^2$ corresponding to a range of $2 \cdot 10^{-3} \text{ fm}$. For the strong and gravitation interactions the carrier particles are the gluons and gravitons respectively with $M_X = 0$ and range $R = \infty$.

The $E & R$ model has no carrier. The particles $A$ and $B$ are formed by rays of $FPs$ that go from $\infty$ to $\infty$ through a point in space which is called “Focal Point”. $FPs$ are continously emitted from the Focal Point and $FPs$ continously regenerate the Focal Point. The regenerating $FPs$ are the $FPs$ emitted by other Focal Points in space. The particles $A$ and $B$ are continously interacting through their $FPs$, independent of the
distance between them. There is no difference between subatomic particles and their FPs which are the constituents of subatomic particles.

FPs have no rest mass and are emitted with the speed c or \( \infty \) relative to the Focal Point. They have longitudinal and transversal angular momenta and their interaction is given by the cross product of their angular momenta, cross product which is proportional to \( \sin \beta \). To get the total force between the particles A and B, the integration over the whole space of all the interactions of their FPs is required.

All interactions are electromagnetic interactions and are generated out of the combinations of the interactions of the longitudinal and transversal angular momenta of the FPs.

The strong interaction is explained with the zero electromagnetic force between
electrons and positrons, which are the constituents of nucleons, for the distance between
$A$ and $B$ tending to zero. No force is required to hold nucleons together.

**Weak interactions** is an electromagnetic interaction between migrated electrons
or positrons that interact with the remaining electrons and positrons of the nuclei core.
The small electromagnetic force is explained with the small distances between $A$ and
$B$, force which is proportional to the cross product which is proportional to $\sin \beta$. See
Fig. 123.

**Gravitational interactions** are the result of electromagnetic interactions between
electrons and positrons that have migrated slowly out of their nuclei and are then
reintegrated with high speed.

### 24.8 Mass and charge in the E & R Model

The SM defines mass and charge as different physical characteristics, although it cannot
explain what charge is. It defines particles like the neutrons having mass but no charge.

The E & R Model defines mass and charge as physical characteristics that are
intrinsic to particles and cannot be separated. The charge of an electron and positron
is defined by the sign of the longitudinal angular momentum of emitted $FPs$. Positive
rotation in moving direction corresponds to a positive charge and negative rotation to
a negative charge. Neutrons are composed of equal numbers of electrons and positrons
so that their longitudinal angular momenta of emitted $FPs$ compensate, resulting an
effective zero charge.

A mass unit is associated with a charge unit. To the mass $9.1094 \cdot 10^{-31} \text{ kg}$ of a
positron or electron corresponds a charge of $\pm 1.6022 \cdot 10^{-19} \text{ C}$.

For complex particles that are formed by more than one electron or positron we
have for the Coulomb force

$$ F = 2.307078 \cdot 10^{-28} \frac{\Delta n_1 \cdot \Delta n_2}{d^2} N \quad (838) $$

The charge $Q$ of the Coulomb law is replaced by the expression $\Delta n = n^+ - n^-$
which gives the difference between the *constituent* numbers of positive and negative
particles (positrons and electrons) that form the complex particle. As the $n_i$ are integer
numbers, the Coulomb force is quantified.

The expression $\Delta n = n^+ - n^-$ corresponds to the nuclear charge number or atomic
number $Z$.

$$ \Delta n = n^+ - n^- = Z \quad (839) $$

As examples we have for the proton $n^+ = 919$ and $n^- = 918$ with a binding Energy
of $E_{Bprot} = -6.9489 \cdot 10^{-14} \text{ J} = -0.43371 \text{ MeV}$, and for the neutron $n^+ = 919$ and
\(n^- = 919\) with a binding Energy of \(E_{B_{\text{neutr}}} = 5.59743 \cdot 10^{-14} \text{ J} = 0.34936 \text{ MeV}\).

### 24.9 Permanent magnetism.

Based on the present theory, two possible mechanism of how permanent magnetism is generated can be imagined:

- An energy flow along a closed chain of static BSPs.
- A current flow along a closed chain of reintegrating BSPs.

**An energy flow along a closed chain of static BSPs.**

Between two static isolated BSPs that are separated by the distance \(d\), energy is exchanged because of the flow of fundamental particles. The transversal rotational momenta \(\vec{J}_n^{(s)}\) generated on the regenerating fundamental particles compensate each other. The concept is shown in Fig. 124.

![Image of energy flow between two static basic subatomic particles](image)

Figure 124: Energy flow between two static basic subatomic particles

If the energy flow is between static BSPs that belong to a close chain of atoms or molecules as shown in Fig. 125, the transversal rotational momenta \(\vec{J}_n^{(s)}\) generated between two adjacent BSPs of the chain don’t compensate, resulting in a field that is equal to the magnetic field generated by a current of BSPs in a closed circuit but without the moving of the BSPs.

The concept is shown in Fig. 125.

The same is valid for a closed chain of positive complex particles (atomic nucleus or ions).
Figure 125: Energy flow along a closed chain of static basic subatomic particles

Figure 126: Current flow along a closed chain of reintegrating BSPs
A current flow along a closed chain of reintegrating BSPs. The concept is shown in Fig. 126.

In sec.19 we have described how the reintegration of BSPs to their nuclei generates a current. If we have a synchronized reintegration of BSPs along a closed chain of nuclei, a closed current $I_m$ is generated that produces a permanent magnetic field. It is important to remember that BSPs migrate slowly outside their nuclei and are then reintegrated with high speed.

24.9.1 Induced Magnetic spin in nucleons by an external magnetic field.

Fig. 127 shows a nucleon in an external permanent magnetic field $H_n$. Electrons and positrons that have migrated outside the nucleus core are reintegrated with the speed $v_r$. The Lorentz force generates a current $i_m$ which generates a magnetic field $H_r$ opposed to $H_n$.

$$\bar{i}_m \propto \bar{H}_n \times \bar{v}_r$$

(840)

An external applied perturbing electro-magnetic field, usually radio frequency pulse, absorb and re-emit electro-magnetic radiation. This is the mechanism used in nuclear magnetic resonance.
Nucleons have a magnetic moment independent of the externally applied magnetic field $H_n$ because of the mutually interacting magnetic fields of the reintegrating electrons and positrons.

**24.9.2 Faraday paradox.**

The Faraday paradox or Faraday’s paradox is an experiment in which Michael Faraday’s law of electromagnetic induction appears to predict an incorrect result. The paradoxes fall into two classes:

- Faraday’s law appears to predict that there will be zero EMF but there is a non-zero EMF.

- Faraday’s law appears to predict that there will be a non-zero EMF but there is a zero EMF.
The setup consists of a disc and a magnet that are fitted a short distance apart on the axle, on which they are free to rotate about their own axes of symmetry. An electrical circuit is formed by connecting sliding contacts: one to the axle of the disc, the other to its rim. A galvanometer can be inserted in the circuit to measure the current.

The concept is shown in Fig. 128

According to the present approach permanent magnets are generated by current loops $i_m$ that are produced by the reintegration of electrons and positrons to their nuclei. In a metal that is not magnetized, the reintegration occurs randomly in all directions at each nucleus and no current loop exists. When magnetized, the reintegration is oriented along a closed loop of nuclei what gives a current $I_M$ where each reintegrating electron and positron remains associated to its nucleus. When the magnet rotates, according the direction of rotation the current in the magnet increases or decreases relative to the measuring equipment.

When the disc rotates, the free electrons at the disc generate a current loop $I_D$ relative to the measuring equipment. So we have two parallel current loops, one at the...
magnet and one at the rotating disc. The parallel currents will attract or repel each other according to the Ampere law. Between differential $dl$ of the loops at points 1 and 2 the force is perpendicular to the surface of the disc and no EMF is induced at the disc by these currents. Between points 2 and 3 the force has a component in the direction of the surface of the disc and an EMF is generated.

The following situations are possible:

a) Only the disc rotates. We have two parallel current loops that induce an EMF at the disc.

b) Only the magnet rotates. We have no current in the disc and no EMF is induced in the disc.

c) Disc and magnet rotate. We have again case a) and an EMF is induced in the disc.

If one intends to explain the above situations with the help of the Lorentz law which describes the forces based on the magnetic field, the question arises if the field rotates or not with the magnet. With the Ampere law no use of a magnetic field is made and all situations are explained satisfactorily.

24.10 Emission Theory.

The present approach is based on the postulate that light is emitted with light speed relative to the emission source.

Fig 129 shows how bursts of FPs with opposed angular momenta (photons) emitted with light speed $c$ travel from frame $K$ to frames $\bar{K}$ and $K^*$ with speeds $c+u$ from $A$ and $c-u$ from $B$. When they arrive at the measuring instruments at $C$, the transformations to the frames $\bar{K}$ and $K^*$ take place from where they continue than with the speed of light $c$.

The emission time of photons from isolated atoms is approximately $\tau = 10^{-8}$ s what gives a length for the wave train of $L = c \tau = 3$ m. The total energy of the emitted photon is $E_t = h \nu_t$ and the wavelength is $\lambda_t = c/\nu_t$. We have defined that the photon is composed of a train of FPs with alternated angular momenta where the distance between two consecutive FPs is equal $\lambda_t/2$. The number of FPs that build the photon is therefore $L/(\lambda_t/2)$ and we get for the energy of one FP

$$E_{FP} = \frac{E_t}{2} \frac{\lambda_t}{L} = \frac{h}{2 \tau} = 3.313 \cdot 10^{-26} \text{ J} = 2.068 \cdot 10^{-7} \text{ eV}$$  \hspace{1cm} (841)

and for the angular frequency of the angular momentum $\hbar$

$$\nu_{FP} = \frac{E_{FP}}{\hbar} = \frac{1}{2 \tau} = 5 \cdot 10^7 \text{ s}^{-1}$$  \hspace{1cm} (842)
The number $N_{FP_o}$ of FPs of an resting BSP (electron or positron) is

$$N_{FP_o} = \frac{E_o}{E_{FP}} = 2.4746 \cdot 10^{12}$$  \hspace{1cm} (843)

**Note:** The assumption of our standard model that light moves with light speed $c$ independent of the emitting source induces the existence of an absolute reference frame or ether, but at the same time the model is not compatible with such absolute frames. The objections made by Willem de Sitter in 1913 about Emission Theories is based on a representation of light as a continuous wave and not as a sequence of bursts of equal length $L$ of FPs of opposed angular momenta with equal wave length $\lambda$. The analysis makes no use of the quantized description of nature. Photons with speeds $c + v$ and $c - v$ may arrive simultaneously at the measuring equipment showing the two Doppler spectral lines corresponding to the red and blue shifts in accordance with Kepler’s laws of motion. No bizarre effects will be seen because photons of equal length $L$ and $\lambda$ with speeds $c + v$ and $c - v$ giving well defined lines corresponding to the Doppler effects will arrive to the spectral instruments.

The present approach is based on a modern physical description of nature postu-
lating that

- photons are emitted with light speed $c$ relative to their source
- photons emitted with $c$ in one frame that moves with the speed $v$ relative to a second frame, arrive to the second frame with speed $c \pm v$.
- photons with speed $c \pm v$ are reflected with $c$ relative to the reflecting surface
- photons refracted into a medium with $n = 1$ move with speed $c$ independent of the speed they had in the first medium with $n \neq 1$.

\[ \begin{array}{ccc}
  c \pm v & \varepsilon_i & \varepsilon_o \\
  & & c \\
  n = 1 & & n \neq 1 \\
  & & \varepsilon_r \\
  & & c \\
  n = 1 \\
\end{array} \]

Figure 130: Light speed at reflections and refractions

The concept is shown in Fig. 130

When the Lorentz transformation is applied with the above postulates, “Special Relativity without time delay and length contraction” results as shown in Sec. 23.1.

### 24.11 The gravitation field.

The gravitation field is an induction field and has its origin in the reintegration of migrated electrons/positrons to their atomic nuclei. When reintegrated, rays of FPs emitted with light speed carry opposed transversal angular momenta $J_n$, which are passed to electrons and positrons of an other atomic nuclei generating at them the gravitation force.

Fig. 131 shows two neutrons which are composed of electrons and positrons. At neutron 1 we have an electron/positron $d$ which has migrated out of the neutron core and which is reintegrated to the core when its FPs interact with FPs of an electron/positron.
The moment $p_d$ generated during the reintegration is passed per induction to an electron/positron of neutron 2, remaining finally the opposed momenta $p_c$ and $p_e$ which explains the attraction of the two neutrons. The gravitational moment $p_d$ is passed through the FPs emitted with light speed “$c$” by the electron/positron $d$.

If Neutron 1 moves with the speed $u$ relative to neutron 2 the gravitational moment is passed through FPs that move with the speed $c \pm u$.

24.11.1 The gravitation field of a binary pulsar.

Fig. 132 shows the masses $M_1$ and $M_2$ of the two bodies of a binary pulsar and their orbits around the center of gravity. From each mass rays of FPs are emitted with the light speed $c$ in all directions as shown at Fig. 131 for neutron 1. Due to the tangential speed $\bar{u}$ of the mass the speed of the FPs at each ray is $\bar{c} \pm \bar{u}$. When two FPs emitted by the two masses cross in space, the opposed components of the tangential speed $\bar{u}$ cancel out and the FPs continue with the light speed $\bar{c}$ as shown for the two points in space. The result is a configuration of gravitational FPs equivalent to two masses moving on the $x$ coordinate for each position of the binary pulsar.

If we have a look at the rays of FPs that are parallel to the $y$ coordinate in the $y \to -\infty$ direction, at the mass $M_1$ the sequence of the emitted FPs with the speed $\bar{c} + \bar{u}$ are reduced to the speed $\bar{c}$ and are compressed, while at the mass $M_2$ the sequence of the emitted FPs expanded to the speed $c$. All gravitational FPs emitted by the binary pulsar move, at a certain distance far from it, with light speed $\bar{c}$ relative to the centre of mass of the binary pulsar, independent of the tangential speed $\bar{u}$ of the two masses.
24.11.2 Interactions between photons and the gravitation field of a binary pulsar.

The following analysis is to show why photons emitted with light speed from its source at a binary pulsar arrive to a receiver far from it with light speed, independent of the relative movement between them and, without the need to postulate that light moves with $c$ independent of its source.

Photons have their origin at the orbital electrons of atoms and are emitted with light speed relative to the atoms which are their source. A photon is an independent ray of FPs with alternate opposed transversal angular momenta.

Gravitational rays of FPs have their origin at the atomic nuclei and the FPs have transversal angular momenta that are all oriented in the same direction.

As both are sequences of FPs, the same mechanism as described for the gravitational field of the binary pulsar is valid for the gamma rays emitted by the magnetic field of the atom. Photons are emitted with light speed $\bar{c}$ from their source at the mass $M_1$. 

Figure 132: Speed of the gravitational Fundamental Particles at binary pulsars.
They move then with $\bar{c} \pm \bar{u}$ relative to a coordinate system placed in the center of gravity of the binary pulsar, as shown in Fig. 132. They then interact with the gravitational FPs emitted by the mass $M_2$, which also move with $\bar{c} \pm \bar{u}$. During the interaction the opposed tangential speeds $\pm \bar{u}$ cancel out and the photon and the gravitational FPs continue with light speed $\bar{c}$. The modification of the speed on the photons produces a red or a blue Doppler effect.

The result is that all photons emitted by the binary pulsar move with light speed $\bar{c}$ relative to the centre of mass of the binary pulsar at the far distance, independent of the tangential speed $\bar{u}$ of the source of the photons.

### 24.12 Sagnac effect.

In the SM the results of the Sagnac experiment are not compatible with Special Relativity and are easily explained with non relativistic equations but still assuming that light moves with light speed independent of its source. As the present approach postulates that light is emitted with light speed relative to its source, equations for the Sagnac experiment are derived based on the mentioned postulate.

The concept is shown in Fig. 133.
The Postulate also includes the possibility of speeds that are greater than the light speed “c”.

Fig. 1 of Fig. 133 shows the arrangement with a light source at point “0” and a detector for the two counter-rotating light rays also at point “0’. Mirrors are placed at points “1”, “2”, .....”n” of the ring. The tangential speed of the rotating arrangement is “v”.

Points “0” and “1” are placed in the parallel planes “a” and “b”. For the time a photon of the length $L$ and wavelength $\lambda$ takes to pass from plane “a” to plane “b” the relative speed between them of $v_r = v(1 - \cos \varphi)$ can be assumed constant. If we imagin that plane “a“ moves relative to plane “b” then, according to the emission theory, the
speed of the ray that leaves “a” in the direction of “b” has the speed $v_b = c - v_r$ as shown in Fig. 2 of Fig. 133.

Also according to the emission theory the output wavelength $\lambda_{ao}$ at “a” must be equal to the input wavelength $\lambda_{bo}$. We get for the frequencies $\nu$

$$\lambda_{bi} = \frac{c - v_r}{\nu_{bi}} = \lambda_{ao} \quad \rightarrow \quad \nu_{bi} = \frac{c - v_r}{\lambda_{ao}}$$  \hspace{1cm} (844)

The frequencies at the input and output of plane “b” must be equal

$$\nu_{bi} = \frac{c - v_r}{\lambda_{ao}} = \nu_{bo} = \frac{c}{\lambda_{bo}} \quad \rightarrow \quad \lambda_{bo} = \frac{c}{c - v_r} \lambda_{ao}$$  \hspace{1cm} (845)

Writing the last equation with the nomenclature used for the points “0” and “1” we get

$$\lambda_{1o} = \frac{c}{c - v_r} \lambda_{0o}$$  \hspace{1cm} (846)

and for the points “1” and “2” we get

$$\lambda_{2o} = \frac{c}{c - v_r} \lambda_{1o} = \left(\frac{c}{c - v_r}\right)^2 \lambda_{0o}$$  \hspace{1cm} (847)

Generalising for “n” we get for the ray in counter clock direction

$$\lambda_{no} = \left(\frac{c}{c - v_r}\right)^n \lambda_{0o} = \frac{1}{(1 - v_r/c)^n} \lambda_{0o}$$  \hspace{1cm} (848)

and for the ray in clock direction

$$\lambda'_{no} = \left(\frac{c}{c + v_r}\right)^n \lambda_{0o} = \frac{1}{(1 + v_r/c)^n} \lambda_{0o}$$  \hspace{1cm} (849)

With

$$(1 \pm v_r/c)^{-n} = 1 \mp n(v_r/c) + \frac{n(n+1)}{2!}(v_r/c)^2 \mp \ldots \ldots \quad \text{for } |v_r/c| < 1$$  \hspace{1cm} (850)

neglecting all non linear terms we get for the wavelength

$$\lambda_{detect} = 1 + n(v_r/c)\lambda_{0o} \quad \lambda'_{detect} = 1 - n(v_r/c)\lambda_{0o}$$  \hspace{1cm} (851)

and for the difference

$$\Delta\lambda_{detect} = \lambda_{detect} - \lambda'_{detect} = 2 n(v_r/c)\lambda_{0o}$$  \hspace{1cm} (852)

With $R$ the radius of the ring we have that $\Omega = v/R$ and with $v_r = v(1 - \cos \varphi)$ we
\[ \Delta \lambda_{\text{detect}} = 2 n \frac{R(1 - \cos \varphi) \lambda_0}{c} \Omega \quad (853) \]

For \( n \gg 1 \) and with \( l \) the length of the arc on the ring between two consecutive mirrors, we can write that \( 2\pi R m \approx n l \) with \( m \) the number of windings of the fibre coil. We also have that \( \cos \varphi \approx 1 - \varphi^2/2 \) and that \( \varphi = l/R \). We get

\[ \Delta \lambda_{\text{detect}} = 2 \pi m \frac{l}{c} \lambda_0 \Omega \quad (854) \]

The wavelength difference between the clock and anticlockwise waves is proportional to the angular speed \( \Omega \) of the arrangement.

The interference of two sinusoidal waves with nearly the same frequencies \( \nu \) and wavelengths \( \lambda \) is given with

\[ F(r, t) = 2 \cos \left[ 2\pi \left( \frac{r}{\lambda_{\text{mod}}} - \Delta \nu t \right) \right] \sin \left[ 2\pi \left( \frac{r}{\lambda} - \nu t \right) \right] \lambda_{\text{mod}} \approx \frac{\lambda^2}{\Delta \lambda} \quad (855) \]

For our case it is \( \Delta \nu = 0 \) and \( \Delta \lambda = \Delta \lambda_{\text{detect}} \) and we get

\[ F(r, t) = 2 \cos \left[ 4\pi^2 m \frac{l}{\lambda_0 c} r \Omega \right] \sin \left[ 2\pi \left( \frac{r}{\lambda_0} - \nu_0 t \right) \right] \quad (856) \]

For a given arrangement the argument of the sinus wave varies with \( r \) for a given \( \Omega \) following a cosinus function.

For the intensity of the interference of two light waves with equal frequencies but differing phases we have

\[ I(r) = I_1(r) + I_2(r) + 2 \sqrt{I_1(r) I_2(r)} \cos[\varphi_1(r) - \varphi_2(r)] \quad (857) \]

The phases are in our case

\[ \varphi_1(r) = 2\pi \frac{r}{\lambda_0^2} \Delta \lambda_{\text{detect}} \quad \varphi_2(r) = -2\pi \frac{r}{\lambda_0^2} \Delta \lambda_{\text{detect}} \quad (858) \]

The intensity of the interference fringes are given with

\[ I(r) = I_1(r) + I_2(r) + 2 \sqrt{I_1(r) I_2(r)} \cos \left[ 4\pi^2 m \frac{l}{\lambda_0 c} r \Omega \right] \quad (859) \]

The fringes of the intensity vary with \( r \) for a given \( \Omega \) following a cosinus function.

We have derived the interference patterns for the sagnac arrangement based on the emission postulate that light is emitted with light speed \( c \) relative to its source and that light is refracted or reflected with light speed independent of the input speed. There
is no incompatibility with “SR without time delay and length contraction”.

24.13 Precession of a gyroscope due to the Ampere gravitation force.

To derive the precession of a gyroscope in the presence of a massive body we start with equation (261) derived for the total force density due to Ampere interaction.

\[
\frac{F}{\Delta l} = \frac{b}{c \Delta_o t} \frac{r_o^2}{64 m} \frac{I_m}{I_{m1}} I_{m2} \int_{\gamma_{1\min}}^{\gamma_{1\max}} \int_{\gamma_{2\min}}^{\gamma_{2\max}} \frac{\sin^2(\gamma_1 - \gamma_2)}{\sin \gamma_1 \sin \gamma_2} d\gamma_1 d\gamma_2
\]  

with \( \int \int_{\text{Ampere}} = 5.8731 \).

It is also for \( v \ll c \)

\[
\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2 r_o} \quad I_m = \rho m v \quad \Delta_o t = K r_o^2 \quad I_m = \frac{m}{q} I_q
\]  

We have defined a density \( \rho_x \) of BSPs for the current so that one BSP follows immediately the next without space between them. As we want the force between one pair of BSPs of the two parallel currents we take \( \Delta l = 2 r_o \).

The concept is shown in Fig. 134

![Gyroscopic precession](image)

Figure 134: Gyroscopic precession.

For one reintegrating BSP it is \( \rho = 1 \). The current generated by one reintegrating BSP is

\[
i_m = \rho m v_m = \rho m k c \quad \text{with} \quad v_m = k c \quad k = 7.4315 \cdot 10^{-2}
\]  

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The currents at the rotating gyroscope that are parallel to the current $i_m$ of $M_1$ are

$$i_\omega = \pm \rho m v_\omega \quad \text{with} \quad v_\omega = \omega R_2 \quad (863)$$

For the two opposed forces that give the momentum at the gyroscope and which generate the precession we get

$$F_{\omega_1} \propto + \frac{v_m v_\omega}{d - R_\omega} \quad F_{\omega_2} \propto - \frac{v_m v_\omega}{d + R_\omega} \quad (864)$$

From eq. (860) with $v_1 = v_m = k c$ we get for a pair of moving BSPs

$$dF_R = 5.8731 \frac{b}{c \Delta v \omega} \frac{2 r_o^3}{64} \rho^2 m v_1 v_2 \frac{M_1 M_2}{d} \quad (865)$$

and $d >> R_2$ we get the total force

$$F_R = 5.8731 \frac{b}{c \Delta v \omega} \frac{2 r_o^3}{64} \rho^2 m v_\omega M_1 M_2 \frac{\gamma_A^2}{d} \quad (866)$$

$$F_R = 2.551 \cdot 10^{-32} v_\omega M_1 M_2 \frac{d}{d} \quad (867)$$

with $M_1$ and $M_2$ the masses of the bodies.

**Note:** For distances $d$ between gravitating masses smaller than $d_{gal}$ the precession due to the Ampere force is neglectable compared with the precession due to the Newton gravitation force.

### 24.14 Thirring-Lense-Effect.

The Thirring-Lense-Effect is an effect that is based on the induction law and on the Doppler effect.

In sec. 14.4 about induction bending the following equation was deduced for the force induced on a probe BSP by a BSP moving with speed $v$.

The concept is shown in Fig. 135

$$d' F'_{in} = \frac{1}{8 \pi} \sqrt{m_H} r_{op} \ rot \vec{C}'_n \quad (868)$$

with

$$rot \vec{C}'_n = \frac{1}{2 \pi} \sqrt{m_H} \frac{r_o}{r^3} \left[ 2 \cos^2 \theta - \sin^2 \theta \right] \vec{e}_r + 0 \cdot \vec{e}_\gamma \quad (869)$$

$$+ \frac{1}{2 \pi} \sqrt{m_H} \frac{r_o}{r^3} \sin \theta \cos \theta \vec{e}_\theta$$

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For the analysis of the dragging produced by a rotating mass on a probe mass placed in the equatorial plane, the components of the induced force in the direction $\bar{e}_r$ and the direction $\bar{e}_\theta$ are required.

The concept is shown in Fig. 136

$$d' F_{in} \bar{e}_r = \frac{1}{16 \pi^2} m v^2 \frac{r_o^2}{r_r^3} \left[ 2 \cos^2 \theta - \sin^2 \theta \right] \bar{e}_r \quad (870)$$

$$d'' F_{in} \bar{e}_\theta = \frac{1}{16 \pi^2} m v^2 \frac{r_o^2}{r_r^3} \sin \theta \cos \theta \bar{e}_\theta \quad (871)$$

Figure 136: Plotting of the trigonometric relation for the analysis of Dragging.

For equal speed $v$ and distance $r_r$, the components of the forces in the direction of the speed $v$ are equal but opposed for the angles $\theta$ and $2\pi - \theta$. This means that two BSPs located at $\theta$ and $2\pi - \theta$ induce on the probe BSP forces in the direction of $v$ that compensate each other.

Fig. 137 shows two BSPs from the surface of the earth that moves with the speed $v$ relative to a probe $BSP_p$ located at the distance $d$. Each moving BSP emits rays of
Figures 137: Dragging due to Doppler effect.

FPs with light speed $c$ relative to the BSP, with a constant interval $\lambda$ between them. The speed of the FPs relative to a probe $BSP_p$ located at the ray is

$$c + v \cos \theta = \lambda \nu$$  \hspace{1cm} (872)

FPs located at the proximity of the probe $BSP_p$ have a higher probability to contribute to the generation of the force on the probe $BSP_p$. The angle $\theta = \arcsin(d/r)$ of the probe $BSP_p$ is therefore used to calculate the force.

For the two $BSP$s located at the angles $\theta_1 = \theta$ and $\theta_2 = 2\pi - \theta$ we get the frequencies of FPs at the probe $BSP_p$

$$\nu_1 = \frac{c + v \cos \theta_1}{\lambda} \quad \nu_2 = \frac{c + v \cos \theta_2}{\lambda} \quad \nu_o = \frac{c}{\lambda}$$  \hspace{1cm} (873)

With eqs. (870) and (871) we get for the components of the forces in the direction of the speed $v$ taking into consideration the Doppler effect

$$d' \tilde{F}_v = \frac{\nu}{\nu_o} d' F_{i_n} \cos \theta \bar{e}_r \quad \theta = \arcsin(d/r)$$  \hspace{1cm} (874)

$$d'' \tilde{F}_v = \frac{\nu}{\nu_o} d'' F_{i_n} \sin \theta \bar{e}_\theta \quad \theta = \arcsin(d/r)$$  \hspace{1cm} (875)

The dragging forces in the direction of the speed $v$ on the probe $BSP_p$ are
\[ \bar{F}_{\text{drag}}^\prime = (d \bar{F}_{v_1} - d \bar{F}_{v_2}) = \frac{\nu_1 - \nu_2}{\nu_\circ} d \bar{F}_{i_n} \cos \theta e_r \] 

\[ \bar{F}_{\text{drag}}^\prime = (d \bar{F}_{v_1} - d \bar{F}_{v_2}) = \frac{\nu_1 - \nu_2}{\nu_\circ} d \bar{F}_{i_n} \sin \theta e_\theta \]  

The total dragging force is

\[ \bar{F}_{\text{drag}} = \frac{2}{\pi} \int_{\theta=0}^{\pi/2} (\bar{F}_{\text{drag}}^\prime + \bar{F}_{\text{drag}}^\prime) \, d\theta \]  

**24.15 Atomic clocks and gravitation.**

Oscillations of mechanical instruments like a pendulum have been used in the past to define time unit of second. Big efforts were made to minimise the influence of factors like temperature, vibrations, humidity, gravitation, etc. on the precision. Modern clocks make use of the quantized change of states of atoms which takes place at a much higher frequency leading to better precisions. When comparing the precision of clocks it is very important to compare them under the same conditions of temperature, vibrations, humidity, gravitation, etc. If this is not possible, corrections for each deviation must be made. The origin of the variation of the precision of atomic clocks due to gravitation is unknown and can be attributed to changes in the energy levels of the atoms itself or to changes in the frequencies of photons after emission.

The intention of the present section is to show a possible mechanism based on the approach that gravitation is generated by the reintegration of BSP to their nuclei. According to the approach, the energies of level electrons are given by stable dynamic configurations of BSPs in nuclei, which change for each atom and its ions. The number of regenerating FPs with opposed angular momenta that arrive to a nucleus is a function of the distance to the other gravitating nucleus. They influence the stable dynamic configuration of BSPs in the nucleus changing the energy of level electrons.

The gravitation components are due to:

- Reintegration of BSPs in the direction of the distance between the gravitating bodies (induction, Newton).

\[ F_G = G \frac{M_1 M_2}{r^2} \]  

- Reintegration of BSPs perpendicular to the distance between the gravitating bodies (Ampere).
\[ F_R = \pm R(v) \frac{M_1 M_2}{r} \quad \text{with} \quad R(v) = 2.551 \cdot 10^{-32} v \quad (880) \]

24.15.1 Hafele-Keating Experiment.

We assume that the atomic transition frequencies of the atoms used in atomic clocks change proportional to the gravitation force and so the gains and losses expressed in \( ns \). Each Caesium atom \( C_s^{133} \) of an atomic clock changes its frequency with the gravitation force.

The following measured data were obtained during the Hafele-Keating Experiment:

The concept is shown on Fig. 138.

![Figure 138: Influence of gravitation on clocks frequency.](image)

**a)** Flying eastwards a total loss of \( \Delta t^E = -59 \ ns \) was measured during a flight of 41.2 hours at a hight of \( h^E = 8.900 \ m \) and a speed of \( v = 950 \ km/h \) relative to the earth surface.

**b)** Flying westwards a total gain of \( \Delta t^W = 273 \ ns \) was measured during a flight of 48.6 hours at a hight of \( h^W = 9.400 \ m \) and a speed of \( v = 950 \ km/h \) relative to the earth surface.

The gain or loss was measured relative to an equivalent atomic clock based on the earth.
At Fig. 138 we have the earth with mass $M_1$ and the mass $M_2$ of an Caesium atom $C_s^{133}$ moving with the speed $v$ east or westwards relative to the surface of the earth at an altitude $h$. The current $I_M$ due to the interaction of reinteigrating BSPs of the earth and the sun has the same direction as the rotation $\omega$ of the earth on its axis relative to the sun (see sec.19.2).

The results of the Hafele-Keating Experiment are better expressed in $ns$ loss or gain per day.

Eastwards the plane was flying during $41,2\,h$ which is equivalent to $1,716\,days$ and which gives a total loss eastwards of $\Delta t^E = -59/1.716 = -34,38\,ns/day$.

Westwards the plane was flying during $48,6\,h$ which is equivalent to $2,025\,days$ and which gives a total loss westwards of $\Delta t^W = 273/2,025 = 134,81\,ns/day$.

We get for the losses and gains in $ns/day$

$$\Delta t^E = -34,38\,ns/day \quad \text{and} \quad \Delta t^W = 134,81\,ns/day$$ (881)

The total gain or loss eastwards and westwards is

$$\Delta t^E = \Delta t_G^E + \Delta t_R^E \quad \text{and} \quad \Delta t^W = \Delta t_G^W + \Delta t_R^W$$ (882)

The proportionality factors are not the same for the Newton and Ampere gravitation forces because of the different generation mechanism of the gravitation forces.

The proportionality factors are defined as

$$K_G = \frac{\Delta t_G}{\Delta F_G} \quad \text{and} \quad K_R = \frac{\Delta t_R}{\Delta F_R}$$ (883)

where $\Delta t_G$ are the $ns/day$ due to the Newton gravitation and $\Delta t_R$ are the $ns/day$ due to the Ampere gravitation.

The difference between the Newton gravitation forces between the distances $d_1$ and $d_2$ from the centre of the earth is given by

$$\Delta F_G = F_{G2} - F_{G1} = G\,M_1\,M_2\left[\frac{1}{d_2^2} - \frac{1}{d_1^2}\right] \quad \text{where} \quad d_2 < d_1$$ (884)

The difference between the Ampere gravitation forces of a body moving with $v_{tot}$ at the hight $d_1$ and $d_2$ from the centre of the earth is given by

$$\Delta F_R = R(v_{tot})\,M_1\,M_2\left[\frac{1}{d_2} - \frac{1}{d_1}\right] \quad \text{where} \quad d_2 < d_1$$ (885)

where $v_{tot}$ is a velocity still to be deduced.
As the Hafele-Keating experiment doesn’t give measured values of $\Delta t_G$, we calculate the proportionality factor $K_G$ with measured values of an experiment made by Briatore and Leschiutto in 1976. The experiment concentrates exclusively on the influence of the Newton gravitation on the frequency of clocks. The measured data are:

a) Turin $h_2 = 250 \, m$ and Plateau Rosa $h_1 = 3.500 \, m$

b) $\Delta t_G = 33,8 – 36,5 \, ns/day$

For the calculation of $\Delta F_G$ we use

a) The mass of $^{133}_s Cs$ with $M_2 = 2,2061 \cdot 10^{-25} \, kg$

b) The mass of the earth $M_1 = 5,972 \cdot 10^{24} \, kg$

c) For Plateau Rosa $d_1 = R_\oplus + h_1 = 6.378,0 \, km + 3,5 \, km = 6.381,5 \, km$

d) For Turin $d_2 = R_\oplus + h_2 = 6.378,0 \, km + 0,25 \, km = 6.378,25 \, km$

We get $\Delta F_G = 2,2201 \cdot 10^{-27} \, N$ and for the proportionality factor

$$K_G = \frac{\Delta t_G}{\Delta F_G} = \frac{33,8}{2,2201 \cdot 10^{-27}} = 1,5362 \cdot 10^{28} \frac{ns}{N \, day} \quad (886)$$

Now we can calculate for the Hafele-Keating Experiment the clock variations that correspond to the Newton gravitation for the east flight with $d_2^E = 8,9 \, km$ and the west flight with $d_2^W = 9,4 \, km$. We get

$$\Delta t_E^G = 92,45 \frac{ns}{day} \quad \text{and} \quad \Delta t_W^G = 97,63 \frac{ns}{day} \quad (887)$$

With

$$\Delta t^E = \Delta t_G^E + \Delta t_R^E \quad \text{and} \quad \Delta t^W = \Delta t_G^W + \Delta t_R^W \quad (888)$$

we get

$$\Delta t_R^E = -126,83 \quad \text{and} \quad \Delta t_R^W = 37,18 \quad (889)$$

With

$$\Delta t_R = K_R R(v_{tot}) M_1 M_2 \left[ \frac{1}{d_2} - \frac{1}{d_1} \right] \quad R(v_{tot}) = 2.551 \cdot 10^{-32} \, v_{tot} \quad (890)$$

we get with $v_{tot} = v_E$ in the east direction and $v_{tot} = v_W$ in the west direction.
\[ \frac{\Delta t^E_R}{\Delta t^W_R} = - \frac{v_E}{v_W} \left[ \frac{1}{d^E_2} - \frac{1}{d^E_1} \right] / \left[ \frac{1}{d^W_2} - \frac{1}{d^W_1} \right] \]  

(891)

and

\[ \frac{\Delta t^E_R}{\Delta t^W_R} = - 0.9468 \frac{v_E}{v_W} \quad \text{or} \quad \frac{v_E}{v_W} = k = 3.6029 \]  

(892)

We define that

\[ v_E = v_S + v \quad \text{and} \quad v_w = v_S - v \]  

(893)

where \( v \) is the velocity of the plane relative to the surface of the earth and \( v_S \) a velocity still to be determined. We get that

\[ v_S = \frac{k + 1}{k - 1} v = 1,7683 \, v \]  

(894)

If we assume that the velocity of the commercial plane used was \( v = 750 \, \text{km/h} \) we get for \( v_S = 1.326 \, \text{km/h} \) or \( v_S = 368 \, \text{m/s} \).

The speed of the surface of the earth at the equator in a frame with centre at the sun and the earth placed at an axis of the frame is \( v_{center} = 463 \, \text{m/s} \), which is not far from \( v_S = 368 \, \text{m/s} \). The difference could come from the not very reliable data of the Hafele-Keating experiment.

The conclusion is, that the speed \( v_S = 368 \, \text{m/s} \) calculated on the basis of the variations of the frequencies of atomic clocks due to the influences of the Newton and Ampere gravitation forces based on the mass of the \( \text{C}^{133}_1 \) atom, is not far from the speed \( v_{center} = 463 \, \text{m/s} \) of the surface of the earth at the equator for a frame placed at the centre of the earth. This can be seen as a confirmation of the proposed approach for the gravitation mechanism as the result of the reintegration of migrated electrons and positrons to their nuclei.

Finally we calculate also the proportionality factor \( K_R \) for the Ampere gravitation.

\[ K_R = \frac{\Delta t_R}{\Delta F_R} \bigg|_E = \frac{\Delta t_R}{\Delta F_R} \bigg|_W \]  

(895)

\[ \Delta F_R = R(v_{tot}) \, M_1 \, M_2 \left[ \frac{1}{d_2} - \frac{1}{d_1} \right] \quad \text{where} \quad d_2 < d_1 \]  

(896)

with \( v_{tot} = v_E \) for the east direction and \( v_{tot} = v_W \) for the west direction. We get

\[ K_R = \frac{\Delta t_R}{\Delta F_R} \bigg|_E = \frac{\Delta t_R}{\Delta F_R} \bigg|_W = 2.9965 \times 10^{40} \frac{n_s}{N \, \text{day}} \]  

(897)
For $K_G$ we had
\[
K_G = \frac{\Delta t_G}{\Delta F_G} = \frac{33.8}{2.2201 \cdot 10^{-27}} = 1.5362 \cdot 10^{28} \frac{ns}{N \text{ day}}
\] (898)

Now we calculate the current $I_M$ generated by the speed $v_S$ of BSPs. From sec. 19 we have with $v_S$ that $i_S = \rho_x m v_S$ and for the earth we get $I_M = i_S \gamma_A M_{\oplus}$.

We defined a density $\rho_x$ of BSPs for the current $I_M$ so that one BSP follows immediately the next without space between them and get

\[
\rho_x = \frac{N_x}{\Delta x} = \frac{1}{2r_o} \quad \text{with} \quad r_o = 3.8590 \cdot 10^{-13} m
\] (899)

With $\rho_x = 1.2957 \cdot 10^{12} m^{-1}$, $m = 9.1094 \cdot 10^{-31} kg$, $v_S = 368 m/s$, $\gamma_A = 1.07558 \cdot 10^9 kg^{-1}$, and $M_{\oplus} = 5.972 \cdot 10^{24} kg$ we get for the current $I_M$ at the equator that generates the transversal field $dH_n$ of the earth.

\[
I_M = \rho_x m v_S \gamma_A M_{\oplus} = 2.7900 \cdot 10^{18} kg/s
\] (900)

### 24.16 Instability of positive BSP.

In sec. 5 we have assumed that bright matter is composed of accelerating and decelerating BSPs that regenerate each other. Positive accelerating with negative decelerating BSPs and positive decelerating with negative accelerating BSPs form two independent groups of BSPs.

The condition for BSPs to become level BSPs is that they have BSPs in the nucleus that provide them with regenerating FPs instantaneously and without fluctuations.

Fig. 34 shows a negative decelerating level BSP and a positive accelerating nuclei BSP.

Level electrons move constantly while electrons and positrons that constitute the nuclei are confined in a small volume with a bigger inertia and provide the FPs required by the level electrons. Emitted FPs from level electrons are fully used to regenerate the corresponding positrons in the nucleus. In such an environment a free positron has not a stable regenerating source of FPs and transforms to photons and neutrinos, which don’t need regeneration.
24.17 Energy levels of electrons in atoms.

To analyze qualitatively the origin of the energy levels for electrons in atoms we take a hydrogen atom which has in his nucleus 919 positive BSPs and 918 negative BSPs. These BSPs in the nucleus are in a dynamic balance and their emitted fundamental particles meet with the fundamental particles of an external level-electron. The probability that the emitted fundamental particles of a BSP in the nucleus meet with the regenerating fundamental particles of a level-electron depends on the position the BSP has relatively to the other BSP in the nucleus. This relative position varies constantly and is influenced by the external level-electron.

If we now take an atom with more than one proton, the first level-electron will influence the distribution of the BSPs in the atomic nucleus to get the maximum binding force. Each following level-electron will find a less favourable distribution of the BSPs in the atomic nucleus and thus have a weaker binding force than the previous one.

The external electrons are therefore coupled to the atomic nucleus by different binding forces and have different energy levels. Because of the quantified numbers of BSPs in the atomic nucleus the energy levels of the external electrons are also quantified.

24.18 Radiation of accelerated BSPs.

We have seen, that BSPs that move with constant velocity \( v \) emit and are regenerated constantly by FPs. At the time \( t_o = 0 \) a BSP is regenerated by FPs that have interacted with FPs that were emitted during the time \( -\infty < t < 0 \). FPs emitted by the BSP in the past, interact with regenerating FPs that meet the same BSP at \( t_o = 0 \), if the BSP moves with constant speed. If the constant movement of the BSP is perturbated (acceleration), part of the regenerating FPs miss the BSP and are irradiite in space.

In the case of a level electron that is constantly accelerated in radial direction, the regenerating FPs that miss the electron are not irradiated into space, but absorbed by the regenerating FPs of a BSP of the nucleus that is very close. The BSP of the nucleus is accelerated generating transversal angular momenta on its regenerating FPs that are absorbed by the level electron. The energy, that in the case of an accelerated free electron is irradiated into space, is in the case of the radially accelerated level electron returned to the level electron via the atomic nucleus.
24.19 Coulomb force on a level electron.

For increasing speed of a BSP, the regenerating longitudinal field $d\vec{H}_s$ of the BSP decreases while the transversal regenerating field $d\vec{H}_t$ increases. With decreasing longitudinal field $d\vec{H}_s$ the Coulomb force to an other BSP decreases.

If we imagine an electron with an elliptic orbit around the nucleus, moving from the aphelion to the perihelion the speed increases, decreasing the Coulomb force. When the electron is moving from the perihelion to aphelion the speed decreases and the Coulomb force increases.

24.20 Binding energy of BSPs in the nucleons.

The binding energy is defined as

$$E_B = (n^+ + n^-) m_e c^2 - m_{\text{nucleon}} c^2$$

with $n^+$ the number of positive and $n^-$ the number of negative BSP that form the nucleon. $m_e$ and $m_{\text{nucleon}}$ are the masses of the electron and the nucleon.

For the proton we have $n^+ = 919$ and $n^- = 918$ with a binding Energy of $E_{B_{\text{prot}}} = 6.9489 \cdot 10^{-14} \text{ J} = 0.43371 \text{ MeV}$.

For the neutron we have $n^+ = 919$ and $n^- = 919$ with a binding Energy of $E_{B_{\text{neut}}} = -5.59743 \cdot 10^{-14} \text{ J} = -0.34936 \text{ MeV}$.

Stable complex particles have positive binding energies, meaning that the nucleon has less energy than the sum of the rest energies of its component BSPs.

24.21 Interpretation of Data in a theoretical frame.

A theory like our Standard Model was improved over time to match with experimental data introducing fictitious entities (particle wave, gluons, gravitons, dark matter, dark energy, time dilation, length contraction, Higgs particle, Quarks, Axions, etc.) and helpmates (duality principle, equivalent principle, uncertainty principle, violation of energy conservation, etc.) taking care that the theory is as consistent and free of paradoxes as possible. The concept is shown in Fig. 139. These improvements were integrated to the existing model trying to modify it as less as possible what led, with the time, to a model that resembles a monumental patchwork. To return to a mathematical consistent theory without paradoxes (contradictions) a completely new approach is required that starts from the basic picture we have from a particle. “E & R” UFT is such an approach representing particles as focal points in space of rays of FPs. This representation contains from the start the possibility to describe interactions between particles through their FPs, interactions that the SM with its particle representation
attempts to explain with fictious entities.

**Fallacy used to conclude that the existence of fictitious entities is experimentally proven**

1. Detection of experimental data that don’t fit with the current SM
2. Definition of fictious entities based on the experimental data that don’t fit.
3. Making the SM consistent with new fictious entities as good as possible
4. Inventing justifications for remaining contradictions
5. Declaring fictitious entities and contradictions as the new standard
6. **Glorifying and idolizing the fictious entities and their creators**
7. Detection of additional experimental data that can be explained with the fictious entities
8. **Prove that fictious entities really exist**

**Examples of fictious entities of the SM**
- Gluons
- Gravitons
- Dark matter
- Dark energy
- Time dilation
- Length contraction

Figure 139: Fallacy used to conclude that fictious entities really exist
Fig. 139 is an organigram where the main steps of the integration of fictitious entities to the SM are shown. All experiments where the previously defined fictitious entities are indirectly detected (point 7. of Fig. 139) are not a confirmation of the existence of the fictitious entities (point 8. of Fig. 139), they are simply the confirmation that the model was made consistent with the fictitious entities (point 3. of Fig. 139).

All experiments where time dilation or length contraction are apparently measured are indirect measurements and where the experimental results are explained with time dilation or length contraction, which stand for the interactions between light and the measuring instruments, interactions that were omitted.

In the case of the increase of the life time of moving muons the increase is because of the interactions between the FPs of the muons with the FPs of the matter that constitute the real frame relative to which the muons move. To explain it with time dilation only avoids that scientists search for the real physical origin of the increase of the life time.

### 24.21.1 Characteristics of a good theory.

The present work is not only limited to show the pragmatic approach of SR and GR by Einstein and its consequences, it presents also an alternative theory where the interactions omitted by Einstein are considered. The question that arises is how to decide for one of these theories.

The primordial objective of a physical theory or a scientific model is to allow calculations that match with experimental data obtained with measurements. A second objective is to allow theoretical predictions that still must be corroborated through experimental data.

A good theory is a theory that

- describes mathematically the biggest number of physical interactions based on the fewest postulates.

- has mathematical descriptions that give calculated data that best match experimental data.

- needs the less number of fictitious entities (particle wave, gluons, gravitons, dark matter, dark energy, time dilation, length contraction, Higgs particle, etc.)

- needs the less number of helpmates (duality principle, equivalent principle, uncertainty principle, violation of energy conservation (Faynman), etc.)

- is consistent with the less number of paradoxes and contradictions.

- has the biggest potential to predict new interactions and particles.
24.22 Epicycles of the Standard Model.

The Geocentric model with its circular orbits was too simple to get a good match between experimental and calculated data. The model was improved adding for each planet a set of epicycles to the circular orbits resulting a complicated description which was still far from the real movement of the planets.

The concept is shown in Fig. 140

A big improvement was done when switching first to the Heliocentric representation and then introducing the elliptic orbits.

The concept is shown in Fig. 141

If we have a look on the presently accepted SM, also big efforts are made to improve the capacity to describe new experimental data adding more and more new particles.
and concepts, trying at the same time to make the model consistent. This procedure has its limits as shown with the geocentric model and its epicycles, which became so abstract and strange from reality that a radical new approach was required. This is the present state of our SM.

Following a list of epicycles added to the SM during the last 150 years:

<table>
<thead>
<tr>
<th>Examples</th>
<th>Epicycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Relativity</td>
<td>time dilation and length contraction</td>
</tr>
<tr>
<td>General relativity</td>
<td>time space curvature</td>
</tr>
<tr>
<td>Coexistence of protons in nuclei</td>
<td>Strong force (Gluons)</td>
</tr>
<tr>
<td>Radioactivity</td>
<td>Weak force (W, Z Bosons)</td>
</tr>
<tr>
<td>Stern Gerlach</td>
<td>Electron intrinsic magnetic spin</td>
</tr>
<tr>
<td>Flattening of Galaxies’s speed</td>
<td>Dark matter</td>
</tr>
<tr>
<td>Expansion of Galaxies</td>
<td>Dark energy</td>
</tr>
<tr>
<td>Quarks</td>
<td>Fraction of electric charge Q/e</td>
</tr>
</tbody>
</table>

![Heliocentric model]

Figure 141: Heliocentric model

With the “E & R “ UFT approach, where particles are represented as focal points, and the finding that electrons and positrons neither attract nor repel each other when the distance between them tend to zero, the epicycles added during the last 150 years are not more required.
The affirmation that epicycles are experimentally confirmed is a fallacy.

25 Quantum mechanics expressed in terms of the approach “Emission & Regeneration” UFT.

Quantum mechanics differential equations are based on the de Broglie postulate. In sec. 6.5 the following relation between the radius \( r_o \) and the energy of a particle was deduced

\[
\frac{\hbar c}{E_{\text{rel}}} \quad \text{with} \quad E_{\text{rel}} = \sqrt{E_o^2 + E_p^2} \quad \text{the relativistic energy.} \quad (902)
\]

This relation is used instead of the de Broglie wavelength, to build wave packages with a Gauss distribution, and to derive the corresponding probability differential equations of quantum mechanics.

The effect on the uncertainty relations and the most important quantum mechanics operators are presented.

Note: When deriving the wave-package with the radius-energy relation, the mass of a particle is considered as concentrated in a sphere with a diameter equal approximately to two times the radius \( r_o \) given by the radius energy-relation. This is not according to the approach that represents particles as Focal Points which led to the radius-energy relation where the mass (energy) of a particle is distributed from \( r_o \) to infinity, outside the sphere with radius \( r_o \).

25.1 General considerations.

To make use of the of Fourier-Transformation, the movement of a particle is first described as a sequence of particles represented by a sinus wave, having a wavelength \( \lambda \) equal to \( 2\pi r_o \). Then the Fourier-Transformation of a wave package of sinus waves with a Gauss shaped amplitude is build.

We have that

\[
\lambda = 2\pi r_o = 2\pi \frac{\hbar c}{E_{\text{rel}}} \quad \text{with} \quad E_{\text{rel}} = \sqrt{E_o^2 + E_p^2} \quad (903)
\]

with

\[
E_o = m_o c^2 \quad E_p = p c \quad p = \frac{m_o v}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (904)
\]

The sinus wave on the x-axis is
\[ \xi_x = A e^{i(k_x x - \omega_x t)} \quad \text{with} \quad k_x = \frac{2\pi}{\lambda_x} \quad \text{and} \quad \omega_x = \frac{2\pi v_x}{\lambda_x} \quad (905) \]

If we now introduce in the expression that \( \lambda_x = 2\pi r_o = 2\pi \hbar c/E_{rel} \), we get

\[ \xi_x = A \exp \left[ i \frac{c}{\hbar} \left( \frac{E_{rel}}{c^2} x - \frac{v_x}{c^2} E_{rel} t \right) \right] \quad (906) \]

or

\[ \xi_x = A \exp \left[ i \frac{c}{\hbar} \left( \frac{E_{rel}}{c^2} x - p_x t \right) \right] \quad (907) \]

with

\[ E_{rel} = m_o c^2 \left( 1 - \frac{v_x^2}{c^2} \right)^{-1/2} \quad \text{and} \quad p_x = \frac{v_x}{c^2} E_{rel} \quad (908) \]

with \( E_{rel} \) the relativistic energy of the particle on the x-axis.

**Note:** The wavelength used by Schroedinger is based exclusively on the kinetic energy \( E_{kin} \) for the non-relativistic case as follows.

\[ \lambda = 2\pi r_o = 2\pi \frac{\hbar c}{E_{rel}} \quad \text{with} \quad E_o = 0 \quad \text{and} \quad E_p = p c \quad \text{where} \quad p = m v \quad (909) \]

The proposed approach includes for the calculation of the wavelength the total energy with the rest energy of a particle. For the relativistic cases we get

\[ \lambda = 2\pi r_o = 2\pi \frac{\hbar c}{E_{rel}} = 2\pi \frac{\hbar}{m c \gamma} \quad \text{with} \quad \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (910) \]

For \( v \to c \) we get that \( \lambda \to 0 \).

### 25.2 The wave package.

We define the Fourier-Transformation of a wave package [1,2] on the x-axis as

\[ \phi_x(x,t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \kappa_x(p_x) \exp \left\{ i \frac{c}{\hbar} \left[ m_{rel_x}(p_x) x - p_x t \right] \right\} dp_x \quad (911) \]

with a Gauss distribution \( \kappa_x(p_x) \) on the \( p_x \)-axis

\[ \kappa_x(p_x) = B \exp \left\{ -\frac{(p_x - \mu_x)^2}{4(\Delta p_x)^2} \right\} \quad (912) \]

and the dispersion \( m_{rel_x} = m_{rel_x}(p_x) \) with
Because of symmetry reasons we can write also a wave package

$$\psi(x,t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \chi_x(m_{rel_x}) \exp \left\{ i \frac{c}{\hbar} [m_{rel_x} x - p_x(m_{rel_x}) t] \right\} dm_{rel_x} \quad (914)$$

with the Gauss distribution on the $m_{rel_x}$-axis

$$\chi_x(m_{rel_x}) = A \exp \left\{ -\frac{(m_{rel_x} - m_{rel_0})^2}{4(\Delta m_{rel_x})^2} \right\} \quad (915)$$

and the dispersion

$$p_x(m_{rel_x}) = c \sqrt{m_{rel_x}^2 - m_o^2} \quad \text{and} \quad m_o = \frac{E_o}{c^2} \quad (916)$$

### 25.3 Unrestricted differential equations.

In this and the following section the probability differential equations are derived. The differential equations are classified into unrestricted and non-relativistic. Then they are subclassified in groups of general, time or space independent.

The unrestricted differential equations are valid for the whole range of speed $0 \leq v \leq c$.

We start with the wave package

$$\psi_x(x,t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \chi_x(m_{rel_x}) \exp \left\{ i \frac{c}{\hbar} [m_{rel_x} x - p_x(m_{rel_x}) t] \right\} dm_{rel_x} \quad (917)$$

with

$$m_{rel_x} = \frac{E_{rel_x}}{c^2} \quad \text{and} \quad p_x(m_{rel_x}) = c \sqrt{m_{rel_x}^2 - m_o^2} \quad (918)$$

with

$$E_{rel_x} = E_o + E_{kin_x} = \sqrt{E_o^2 + E_{p_x}^2} \quad E_o = m_o c^2 \quad E_{p_x} = p_x c \quad (919)$$

For the unrestricted range of velocities $0 \leq v \leq c$ we have that
\[ p_x = \frac{v_x}{c^2} E_{rel_x} \]  

(920)

and \( E_{kin_x} \) represents the kinetic energy for the whole range of speed.

### 25.3.1 The wave equation.

The wave differential equation we obtain by derivation of \( \psi_x \) two times versus \( t \) and two times versus \( x \). The results are then connected through

\[ p_x = \frac{v_x}{c^2} E_{rel_x} \]  

(921)

We get

\[ \frac{\partial^2}{\partial x^2} \psi_x = \frac{1}{v_x^2} \frac{\partial^2}{\partial t^2} \psi_x \]  

(922)

For \( v_x \to c \) we have

\[ \frac{\partial^2}{\partial x^2} \psi_x(x,t) = \frac{1}{c^2} \frac{\partial^2}{\partial t^2} \psi_x(x,t) \]  

(923)

the well known wave equation

### 25.3.2 The time independent differential equation.

Time independent differential equations are deduced derivating one time and two times the wave function \( \psi_x \).

**a)** We derivate the wave function \( \psi_x \) one time versus \( x \) and get the following time independent differential equation on the \( x \) coordinate

\[ \frac{\partial}{\partial x} \psi_x = \frac{i}{\hbar} \frac{E_{rel_x}}{c} \psi_x = \frac{i}{\hbar} \left( E_o + E_{kin_x} \right) \psi_x \]  

(924)

\( E_{kin_x} \) represents the kinetic energy for the whole range of speed, relativistic and non-relativistic.

**b)** We derivate the wave function \( \psi_x \) two times versus \( x \) and get the following time independent differential equation on the \( x \) coordinate

\[ \frac{\partial^2}{\partial x^2} \psi_x = -\frac{\hbar^2}{m_{rel_x}^2} \psi_x \]  

(925)

With

\[ m_{rel_x} = \frac{1}{c^2} \sqrt{E_o^2 + E_{px}^2} \]

\[ E_o = m_o c^2 \quad \text{and} \quad E_{px} = p_x c \]  

(926)

we get
\[
\frac{\partial^2}{\partial t^2} \psi_x = - \frac{1}{\hbar^2 c^2} (E_o^2 + E_{p_x}^2) \psi_x \quad (927)
\]

### 25.3.3 The space independent differential equation.

We derivate the wave function \( \psi_x \) two times versus \( t \)
\[
\frac{\partial^2}{\partial t^2} \psi_x = - \frac{c^2}{\hbar^2} p_x^2 \psi_x \quad (928)
\]

and with
\[
E_{p_x} = p_x c \quad \text{and} \quad E_p^2 = E_{p_x}^2 + E_{p_y}^2 + E_{p_z}^2 \quad (929)
\]
we get
\[
- \hbar^2 \frac{\partial^2}{\partial t^2} \psi_x = E_{p_x}^2 \psi_x \quad (930)
\]
and for the space
\[
- \hbar^2 \Delta_t \psi = E_p^2 \psi \quad (931)
\]

with the operator \( \Delta_t \) defined in sec. 25.6.

### 25.4 Non relativistic differential equations

For non relativistic speeds we have that \( v \ll c \) and that \( E_{\text{kin}} \approx p^2/(2m_o) \).

#### 25.4.1 General non relativistic differential equation.

The general non relativistic differential equation we obtain by deriving \( \psi_x \) two times versus \( t \) and one time versus \( x \). The results are then connected through \( E_{\text{rel}} - E_o = E_{\text{kin}} \approx p^2/(2m_o) \). We get

\[
- i \hbar c \frac{\partial}{\partial x} \psi_x(x,t) - E_o \psi_x(x,t) \approx - \frac{\hbar^2}{2m_o c^2} \frac{\partial^2}{\partial t^2} \psi_x(x,t) \quad \text{with} \quad E_o = m_o c^2 \quad (932)
\]

The differential equation with the constant energy \( E_o \) describes the movement of a non-accelerated particle in a zero potential energy field.

With \( E_{\text{tot}} \) the total energy, \( E_{\text{kin}} \) the kinetic energy, \( E_{\text{pot}} \) the potential energy and \( E_{\text{rel}} \) the relativistic energy, the above equation is equivalent to \( E_{\text{rel}} - E_o = E_{\text{kin}} \). If we add at to the kinetic energy \( E_{\text{kin}} \) the potential energy \( E_{\text{pot}} = U_x(x,t) \) we get the total energy \( E_{\text{tot}} \) for an accelerated movement. The result is

284
−iℏc∂∂xψ_x(x,t) - E_o ψ_x(x,t) + U_x(x,t)ψ_x(x,t) = E_{tot}ψ_x(x,t) \quad (933)

- \frac{\hbar^2}{2m_o c^2} \frac{\partial^2}{\partial t^2} ψ_x(x,t) + U_x(x,t)ψ_x(x,t) = E_{tot}ψ_x(x,t) \quad (934)

In a conservative system the total energy is time independent with \( E_{tot} = \text{constant} \).

Comparing equation (932) with the General Schrödinger differential equation, the main difference is that equation (932) derives one time versus space and two times versus time, in other words, time and space are interchanged.

### 25.4.2 The time independent non relativistic differential equation.

Differential equations are deduced in derivating one time or two times the wave function \( ψ_x \).

**a)** We derivate the wave function \( ψ_x \) one time versus \( x \)

\[ \frac{\partial}{\partial x} ψ_x = \frac{i}{\hbar} \quad E_{\text{rel}} \quad ψ_x = \frac{i}{\hbar} \quad (E_o + E_{\text{kin}}) \quad ψ_x \]  

(935)

For a conservative field \( U_x = q_e V_x \) with a total energy \( E_{tot_x} \) we have

\[ E_{tot_x} = E_{\text{kin}} + U_x \quad \text{and with} \quad E_{\text{kin}} \approx \frac{1}{2m_o} p_x^2 \quad (936) \]

we get

\[ \left\{-i\hbar c \frac{\partial}{\partial x} + U(x)\right\} ψ(x) \approx E_x \quad ψ(x) \]  

(937)

with

\[ E_x = E_{tot_x} + E_o \]  

(938)

the Eigenvalue.

**b)** For the time independent differential equation deduced derivating the wave function \( ψ_x \) two times versus \( x \) see sec. 25.7.

### 25.4.3 Space independent non relativistic differential equation.

We take two times the derivate of the wave function \( ψ_x \) versus \( t \)

\[ \frac{\partial^2}{\partial t^2} ψ_x = -\frac{c^2}{\hbar^2} p_x^2 \quad ψ_x \]  

(939)
and with eq. (931)

\[-\hbar^2 \Delta_t \psi = E_p^2 \psi\]  \hspace{1cm} (940)

and \(v \ll c\) and a conservative potential \(U\)

\[E_{\text{kin}} \approx \frac{1}{2} m_o \rho^2 = \frac{E_p^2}{2 E_o} \quad \text{and} \quad E_{\text{tot}} = E_{\text{kin}} + U\]  \hspace{1cm} (941)

we obtain the space independent non relativistic differential equation

\[\left\{ -\frac{\hbar^2}{2 E_o} \Delta_t + U \right\} \psi \approx E_{\text{tot}} \psi\]  \hspace{1cm} (942)

which is equivalent to the time independent equation from Schrödinger.

### 25.5 Uncertainty principle.

In the proposed model the pairs of canonical conjugated variables lead to the following uncertainty relations

\[(\Delta E) \cdot (\Delta x) \geq \frac{1}{2} \hbar c\]  \hspace{1cm} (943)

and

\[(\Delta p) \cdot (\Delta t) \geq \frac{1}{2} \frac{\hbar}{c}\]  \hspace{1cm} (944)

Noticeable at this point is the relation

\[E r_o = \hbar c\]  \hspace{1cm} (945)

for a particle, that connects the radius \(r_o\) and the relativistic energy \(E\) through \(\hbar c\).

### 25.6 Operators.

#### 25.6.1 Relativistic operator for the linear momentum.

The relativistic operator for the linear momentum of a particle is

\[\hat{p} = i \frac{\hbar}{c} \frac{\partial}{\partial t}\]  \hspace{1cm} (946)

The linear momentum we get with
\[ \tilde{p} \chi = i \frac{\hbar}{c} \nabla_t \chi \]  
(947)

where \( \chi \) is the total mass-probability function

\[ \chi = \psi_x \psi_y \psi_z \]  
(948)

and \( \nabla_t \)

\[ \nabla_t = \frac{\partial}{\partial t} |_x e_x + \frac{\partial}{\partial t} |_y e_y + \frac{\partial}{\partial t} |_z e_z \]  
(949)

### 25.6.2 Relativistic operators for the energy.

For the relativistic energy of a non-accelerated particle we obtain the operator

\[ \hat{E}_{rel} = -i \hbar c \frac{\partial}{\partial x} \]  
(950)

**Application example.**

If we apply the relativistic operators to the relativistic energy of a particle

\[ E_x^2 = m_o^2 c^4 + p_x^2 c^2 \]  
(951)

we get

\[ - \hbar^2 c^2 \frac{\partial^2}{\partial x^2} \psi_x = m_o^2 c^4 \psi_x - \hbar^2 \frac{\partial^2}{\partial t^2} \psi_x \]  
(952)

the **Klein-Gordon** equation.

With \( m_o = 0 \) we have

\[ \frac{\partial^2}{\partial x^2} \psi_x = \frac{1}{c^2} \frac{\partial^2}{\partial t^2} \psi_x \]  
(953)

### 25.6.3 Non-relativistic operator for the kinetic energy.

The non-relativistic operator for the kinetic energy on the \( x \) coordinate is

\[ \hat{E}_{kin} = - \frac{\hbar^2}{2 m_o c^2} \frac{\partial^2}{\partial t^2} |_x \]  
(954)

and the total kinetic energy \( E_{kin} \) in the three dimensional space

\[ E_{kin} = E_{kin_x} + E_{kin_y} + E_{kin_z} = - \frac{\hbar^2}{2 m_o c^2} \Delta t \chi \]  
(955)

with
\[ \Delta t = \frac{\partial^2}{\partial t^2} |_x + \frac{\partial^2}{\partial t^2} |_y + \frac{\partial^2}{\partial t^2} |_z \]  

(956)

### 25.6.4 Non-relativistic Hamilton operator.

The operator for the non-relativistic total energy on the \( x \) coordinate has the form

\[ \hat{E}_x = \frac{1}{2m_o} \left( i \frac{\hbar}{c} \frac{\partial}{\partial |_x} \right)^2 + \hat{U}_x \]  

(957)

or

\[ \hat{E}_x = \frac{\hat{p}_x^2}{2m_o} + \hat{U}_x \]  

(958)

which is equal to the Hamilton operator \( \hat{H}_x \).

The general non-relativistic differential equation thus takes the form

\[ i \hbar c \frac{\partial}{\partial x} \psi_x(x,t) = \hat{H}_x \psi_x(x,t) \]  

(959)

with

\[ \hat{H}_x = \frac{\hat{p}_x^2}{2m_o} + \hat{U}_x \]  

(960)

the non-relativistic Hamilton operator.

### 25.6.5 Non-relativistic operator for the orbital-angular-momentum.

The wave function for the three dimensional space is

\[ \psi_x(r,t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \chi(m_{rel}) \exp \left\{ \frac{i c}{\hbar} \left[ m_{rel} r - \mathbf{p}(m_{rel}) t \right] \right\} dm_{rel} \]  

(961)

with

\[ r = x \mathbf{e}_x + y \mathbf{e}_y + z \mathbf{e}_z \quad \text{and} \quad \mathbf{p} = p_x \mathbf{e}_x + p_y \mathbf{e}_y + p \mathbf{e}_z \]  

(962)

We define the linear momentum operator for the different coordinates as:

\[ \hat{p}_k = i \frac{\hbar}{c} \frac{\partial}{\partial t} |_k \]  

(963)

The orbital-angular-momentum-operator can be expressed as

\[ \mathbf{M} \left( r, \frac{i \hbar}{c} \nabla_\mathbf{t} \right) = \left( \mathbf{r} \times \frac{i \hbar}{c} \nabla_\mathbf{t} \right) \]  

(964)

with

288
\[ \nabla_t = \frac{\partial}{\partial t} |_{x} e_x + \frac{\partial}{\partial t} |_{y} e_y + \frac{\partial}{\partial t} |_{z} e_z \]  

(965)

The operators for the vector components are:

\[ \hat{M}_x = \hat{y} \hat{p}_z - \hat{z} \hat{p}_y \quad \hat{M}_y = \hat{z} \hat{p}_x - \hat{x} \hat{p}_z \quad \hat{M}_z = \hat{x} \hat{p}_y - \hat{y} \hat{p}_x \]  

(966)

The commutations are as known

\[ [\hat{M}_k, \hat{M}_{k+1}] \neq 0 \quad [\hat{M}_k, \hat{Q}] = 0 \quad \text{with} \quad \hat{Q} = \hat{M}_x^2 + \hat{M}_y^2 + \hat{M}_z^2 \]  

(967)

25.7 The proposed theory and the Correspondence Principle.

The present theory is based on the radius-energy relation that substitutes the de Broglie wavelength.

The accordance of the proposed theory with the correspondence principle of quantum mechanics is ensured, in that the time independent differential equation from Schrödinger, deduced from the wave package constructed with the de Broglie wavelength, can be derived from the wave package constructed with the radius-energy relation presented in this work.

We start derivating the wave function \( \psi_x \) two times versus space, to get the time independent differential equation

\[ \frac{\partial^2}{\partial x^2} \psi_x = - \frac{\hbar^2}{m_{rel}^2} \psi_x \]  

(968)

With

\[ m_{rel} = \frac{1}{\sqrt{2}} \sqrt{E_o^2 + E_{px}^2} \quad E_o = m_o c^2 \quad \text{and} \quad E_{px} = p_x c \]  

(969)

we get

\[ \frac{\partial^2}{\partial x^2} \psi_x = - \frac{1}{\hbar^2 c^2} (E_o^2 + E_{px}^2) \psi_x \]  

(970)

For non-relativistic velocities \( v \ll c \) we have that

\[ E_{kin} = \frac{p_x^2}{2 m_o} \quad \text{and} \quad E_{px}^2 = p_x^2 c^2 = 2 m_o c^2 E_{kin} \]  

(971)

and we get

\[ \frac{\partial^2}{\partial x^2} \psi_x = - \frac{2 m_o}{\hbar^2} \left[ \frac{1}{2} E_o + E_{kin} \right] \psi_x \]  

(972)
With a conservative potential \( E_{tot} = U_x + E_{kin} \), we get finally

\[
\left[ -\frac{\hbar^2}{2m_o} \frac{\partial^2}{\partial x^2} + U_x \right] \psi_x = E_x \psi_x \quad \text{with} \quad E_x = \frac{1}{2} \left[ E_o + 2 E_{tot} \right]
\]

(973)

For the three dimensional space we have

\[
\left[ -\frac{\hbar^2}{2m_o} \Delta_r + U \right] \chi = E \chi
\]

(974)

with \( \Delta_r \) the Laplace operator and

\[
E = \frac{1}{2} \left[ E_o + 2 E_{tot} \right]
\]

(975)

If we make \( E_o = 0 \) we get

\[
\left[ -\frac{\hbar^2}{2m_o} \Delta_r + U \right] \chi = E_{tot} \chi
\]

(976)

Eq. (976) is exactly the time independent differential equation constructed by Schrödinger with \( E_{tot} \) the Eigenvalue.

25.8 The mass conservation equation.

The mass conservation differential equation we obtain by derivating \( \psi_x \) one time versus \( t \) and one time versus \( x \). The results are then connected through

\[
p_x = \frac{v_x}{c^2} E_{rel}
\]

(977)

We get

\[
\frac{\partial}{\partial t} \psi_x(x, t) = -v_x \frac{\partial}{\partial x} \psi_x(x, t)
\]

(978)

We define the mass probability density as

\[
\rho_x(x, t) = \psi_x^*(x, t) \psi_x(x, t) \quad \text{or} \quad \rho(r, t) = \psi^*(r, t) \psi(r, t)
\]

(979)

We derive the mass probability density versus time

\[
\frac{\partial}{\partial t} \rho_x(x, t) = \frac{\partial}{\partial t} \left[ \psi_x^*(x, t) \psi_x(x, t) \right] = \frac{\partial}{\partial t} \psi_x^*(x, t) \psi_x(x, t) + \psi_x^*(x, t) \frac{\partial}{\partial t} \psi_x(x, t)
\]

(980)

With eq. (978) we get
\[
\frac{\partial}{\partial t} \rho_x(x, t) = -v_x \left[ \frac{\partial}{\partial x} \psi^*_x(x, t) \psi_x(x, t) + \psi^*_x(x, t) \frac{\partial}{\partial x} \psi_x(x, t) \right]
\] (981)

or

\[
\frac{\partial}{\partial t} \rho_x(x, t) = -v_x \frac{\partial}{\partial x} [\psi^*_x(x, t) \psi_x(x, t)] = -\frac{\partial}{\partial x} [v_x \rho_x(x, t)] = -\frac{\partial}{\partial x} j(x, t)
\] (982)

or

\[
\frac{\partial}{\partial t} \rho(r, t) = -\nabla_r j(r, t) \quad \text{with} \quad j(r, t) = v \psi^*(r, t) \psi(r, t)
\] (983)

where \( j(r, t) \) is the mass-current probability density.

### 25.9 The wave equation for relativistic speeds.

We start with the wave eq. (914) from sec. 25.2

\[
\psi_x(x, t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \chi_x(m_{\text{rel}}) \exp \left[ i \frac{c}{\hbar} (m_{\text{rel}} x - p_x(m_{\text{rel}}) t) \right] dm_{\text{rel}}
\] (984)

and analyze the equation for relativistic speeds where \( \Delta v = c - v \ll c \). We get

\[
E_{\text{rel}} = E_p = p c = \frac{m v}{\beta} c \quad \beta = \sqrt{1 - \frac{v^2}{c^2}} \quad \lambda = \frac{\hbar}{p}
\] (985)

The resulting wave equation is

\[
\psi_x(x, t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \chi_x(m_{\text{rel}}) \exp \left[ i \frac{\hbar}{p} (p x - E_{pv} t) \right] dm_{\text{rel}}
\] (986)

where

\[
E_{pv} = p v = \frac{m v}{\beta} v
\] (987)

With \( E_{\text{rel}} = p c^2 / v \) and \( E_{\text{o}}^2 \ll E_p^2 \) we get

\[
E_{pv} = p v = \frac{p^2 c^2}{E_{\text{rel}}} = \frac{p^2 c^2}{\sqrt{E_o^2 + E_p^2}} \approx p c = E_p
\] (988)

We now derive the wave equation one time versus space and one time versus time and connect the results with \( E_{pv} = p c \). We get

\[
\frac{\partial}{\partial t} \psi_x = -c \frac{\partial}{\partial x} \psi_x
\] (989)
25.10 Applications of the non-relativistic differential equation

The solutions of the time independent non-relativistic differential equation (933) for a potential pot, the harmonic oscillator and the hydrogen atom are derived.

25.10.1 Potential pot

The non-relativistic time independent differential equation is

\[-i\hbar c \frac{\partial}{\partial x} \psi_x(x) + U_x(x) \psi_x(x) = [E_{\text{tot}} + E_o] \psi_x(x) = E \psi_x(x) \]  

(990)

With \( y = \psi_x(x) \) we can write

\[-i\hbar c \frac{dy}{y} = [E - U] dx \]  

(991)

After integration we get

\[-i\hbar c [\ln |y| + \ln C_y] = \int [E - U] dx \]  

(992)

resulting

\[|y| = \frac{1}{C_y} \exp \left\{ \frac{i \hbar c}{\hbar c} \int [E - U] dx \right\} \]  

(993)

Equation (993) is valid for all potential energies \( U \) and gives real values for \( y \) if

\[ \left\{ \frac{i \hbar c}{\hbar c} \int [E - U] dx \right\} = k \pi \quad \text{and} \quad k = 0, \pm 1, \pm 2, \pm 3, \cdots \]  

(994)

defining the quantization condition, which together with the normalization condition allows the calculation of the eigenfunctions.

The potential pot is defined as

\[ U = \begin{cases} \infty & \text{for } x \leq 0 \\ 0 & \text{for } 0 < x < a \\ \infty & \text{for } x \geq a \end{cases} \]

and we have for \( U = 0 \)

\[ \frac{1}{\hbar c} E x = k \pi \quad \text{resulting with } x = a \quad E_k = \pi \frac{\hbar c}{a} k \]  

(995)

with \( k = 0, \pm 1, \pm 2, \pm 3, \cdots \).

The total energy is with \( E_k = E_{\text{tot}} + E_o \)
\[ E_{\text{tot}} = E_k - E_o = \pi \frac{\hbar c}{a} k - E_o \]  

(996)

and for \( E_{\text{tot}} = 0 \) we get

\[ a_o = k \frac{\pi \hbar c}{E_o} = k \pi r_o \quad \text{with} \quad \frac{\hbar c}{E_o} = r_o \]

(997)

the radius of of a rest electron or positron.

The eigenfunction is

\[ y_k = \frac{1}{C_y} \exp \left\{ \frac{i}{\hbar c} E_k x \right\} \]

(998)

The integration constant \( C_y \) we get with the normalization condition

\[ \int_{-\infty}^{\infty} y_{k'}^* y_k \, dx = \delta_{(k', k)} \]

(999)

For \( k' = k \) we get

\[ \frac{1}{C_y^2} \int_0^a \exp \left\{ \frac{i}{\hbar c} [E_{k'} - E_k] x \right\} \, dx = 1 \]

(1000)

resulting

\[ \frac{1}{C_y^2} = a \quad \text{or} \quad C_y = \sqrt{a} \]

(1001)

The normalized eigenfunction is

\[ y_k = \frac{1}{\sqrt{a}} \exp \left\{ \frac{i}{\hbar c} E_k x \right\} \]

(1002)

The main differences compared with the solution obtained with the Schroedinger equation is that the quantization of the energy is proportional to \( k \) instead of \( k^2 \) and for defined values of \( a \) the total energy \( E_{\text{tot}} \) becomes zero.

25.10.2 Harmonic oscillator

The potential energy for the harmonic oscillator is

\[ U(x) = \frac{K}{2} x^2 = \frac{m \omega^2}{2} x^2 \quad \text{with} \quad \omega^2 = K/m \]

(1003)

With eq. (993) we get

\[ |y| = \frac{1}{C_y} \exp \left\{ \frac{i}{\hbar c} \int \left[ E - \frac{K}{2} x^2 \right] \, dx \right\} \]

(1004)

With the quantization condition we get
\[
\frac{1}{\hbar c} \int_0^a \left[ E - \frac{K}{2} x^2 \right] dx = \frac{1}{\hbar c} \left[ E a - \frac{K}{6} a^3 \right] = k \pi
\]
resulting for the quantized energy with \( E_{\text{tot}} = E_k - E_o \)

\[
E_{\text{tot}} = \pi \frac{\hbar c}{a} \left[ k + \frac{1}{6} \frac{m \omega^2}{\pi \hbar c} a^3 \right] - E_o = E_k - E_o
\]

The minimum quantum change between two adjacent energy levels is

\[
\Delta E_{\text{tot}} = \Delta E_k = \pi \frac{\hbar c}{a}
\]

For \( E_{\text{tot}} = 0 \) we get

\[
a \left[ E_o - \frac{1}{6} m \omega^2 a^2 \right] = k \pi \hbar c
\]

which for \( k = 0 \) gives

\[
a_1 = 0 \quad \text{or} \quad a_{2,3} = \pm \sqrt{\frac{6 E_o}{m \omega^2}} \quad \text{for} \quad k = 0
\]

We get for the minimum quantum change between two adjacent energy levels

\[
\Delta E_{\text{tot}} = \pm \frac{\pi}{\sqrt{6}} \hbar \omega
\]

The minimum quantum energy difference \( \Delta E_{\text{tot}} \) between two adjacent energy levels is proportional to \( \hbar \omega \).

With the normalization condition given by equation (999) we have that

\[
\int_{-\infty}^{\infty} y_{k'}^* y_k dx = \frac{1}{C_y} \int_{-\infty}^{\infty} \exp \left\{ \frac{i}{\hbar c} \left[ E_{k'} - E_k \right] x \right\} dx
\]

or

\[
\frac{\hbar c}{C_y} \int_{-\infty}^{\infty} \exp \left\{ i \left[ E_{k'} - E_k \right] \eta \right\} d\eta = \frac{\hbar c}{C_y} \delta_{(k',k)} \quad \text{with} \quad \eta = \frac{x}{\hbar c}
\]

With \( k' = k \) we get the integration constant \( C_y = \sqrt{\hbar c} \) resulting the normalized eigenfunctions

\[
y_k = \frac{1}{\sqrt{\hbar c}} \exp \left\{ \frac{i}{\hbar c} \left[ E_k x - \frac{K}{6} x^3 \right] \right\}
\]

25.10.3 Hydrogen atom

We start with the deduction of the quantization conditions with eq. (933)
\[-i\hbar c \frac{\partial}{\partial x} \psi_x(x) + U(x) \psi_x(x) = \left[ E_{\text{tot}} + E_0 \right] \psi_x(x) = E \psi_x(x) \tag{1014} \]

We define the operator
\[
\vec{\nabla} \cdot \vec{E} = \nabla E = \frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z} \quad \text{with} \quad \vec{E} = \vec{e}_x + \vec{e}_y + \vec{e}_z \tag{1015} \]

\[
\nabla E \psi(x,y,z) = \frac{\partial}{\partial x} \psi(x,y,z) + \frac{\partial}{\partial y} \psi(x,y,z) + \frac{\partial}{\partial z} \psi(x,y,z) \tag{1016} \]

For polar coordinates we write
\[
-i\hbar c \nabla \chi(r,\theta,\phi) + U \chi(r,\theta,\phi) = E \chi(r,\theta,\phi) \tag{1017} \]

with the \( \nabla \) operator expressed in polar coordinates
\[
\nabla = \frac{\partial}{\partial r} + \frac{2}{r} + \frac{1}{r \sin \theta} \frac{\partial}{\partial \phi} + \frac{1}{r} \frac{\partial}{\partial \theta} + \frac{1}{r} \cot \theta \tag{1018} \]

The differential equation has now the form
\[
\left[ \nabla + i\hbar c U \right] \chi = i\hbar c E \chi \tag{1019} \]

We now assume that the wave function \( \chi \) can be expressed as a product of a function exclusively of the distance \( r \) and a function of the angular variables \( \theta \) and \( \varphi \).
\[
\chi(r,\theta,\varphi) = R(r) Y(\theta,\varphi) \tag{1020} \]

We get
\[
\left[ \frac{d}{dr} + \frac{4}{r} \right] R \cdot Y + \frac{1}{r} \Lambda Y \cdot R + \frac{i}{\hbar c} U \cdot R \cdot Y = \frac{i}{\hbar c} E \cdot R \cdot Y \tag{1021} \]

with the operator \( \Lambda \)
\[
\Lambda = \frac{1}{\sin \theta} \frac{\partial}{\partial \varphi} + \frac{\partial}{\partial \theta} + 2 \cot \theta \tag{1022} \]

We now assume that
\[
\Lambda Y = -\lambda Y \tag{1023} \]

and get two separate differential equations for \( R(r) \) and \( Y(\theta,\varphi) \).
\[
\frac{d}{dr} R - \frac{i}{\hbar c} [E - U] R + \frac{1}{r} \left[ 4 - \lambda \right] R = 0 \tag{1024} \]
and
\[
\left[ \frac{1}{\sin \theta} \frac{\partial}{\partial \varphi} + \frac{\partial}{\partial \theta} + 2 \cot \theta \right] Y = -\lambda Y \tag{1025}
\]

Eq. (1024) gives
\[
\ln R = \frac{i}{\hbar \mathcal{C}} \int_{r_o}^r [E - U] dr - [4 - \lambda] \ln \frac{r}{r_o} + C_R \tag{1026}
\]

with \( C_R = C_r + i C_i \) a complex integration constant.

From the solution of eq. (1025) results that \( \lambda = i l \) with \( l = 0, \pm 1, \pm 2; \cdots \) as will be shown later on. We get
\[
R = \exp \left\{ -4 \ln \frac{r}{r_o} + C_r \right\} \exp \left\{ \frac{i}{\hbar \mathcal{C}} \left[ \int_{r_o}^r (E - U) dr + l \hbar \mathcal{C} \ln \frac{r}{r_o} + C_i \hbar \mathcal{C} \right] \right\} \tag{1027}
\]

The quantization condition requires that
\[
\frac{1}{\hbar \mathcal{C}} \left[ \int_{r_o}^r (E - U) dr + l \hbar \mathcal{C} \ln \frac{r}{r_o} + C_i \hbar \mathcal{C} \right] = k \pi \quad \text{with} \quad k = 0, \pm 1, \pm 2; \cdots \tag{1028}
\]

Equation (1028) is valid for all point symmetrical potentials \( U \). We now introduce the potential of an atomic nucleus
\[
U = -\frac{Ze^2}{4\pi \epsilon_o r} = -\frac{K_u}{r} \quad \text{with} \quad K_u = \frac{Ze^2}{4\pi \epsilon_o} \tag{1029}
\]

where \( Z \) is the atomic number, and get for the quantization condition with \( E = E_k \)
\[
E_k = \left[ k \pi \hbar \mathcal{C} - (K_u + l \hbar \mathcal{C}) \ln \frac{r}{r_o} - C_i \hbar \mathcal{C} \right] \frac{1}{r} \tag{1030}
\]

or
\[
\ln \frac{r}{r_o} = \left( k \pi - \frac{E_k r}{\hbar \mathcal{C} - C_i} \right) / \left( \frac{K_u}{\hbar \mathcal{C}} + l \right) \tag{1031}
\]

This equations must be solved numerically.

What follows is the intention of an approximation using expected results.

The energy \( E_k \) of eq. (1030) must be equal to one term of the series of the hydrogen spectrum empirically introduced by Ballmer, namely
\[
E_n = \hbar \mathcal{C} R_H \frac{1}{n^2} \quad \text{and} \quad \Delta E_n = \hbar \mathcal{C} R_H \left[ \frac{1}{n^2} - \frac{1}{(n+1)^2} \right] \tag{1032}
\]

with \( R_H \) the Rydberg constant and \( n = 1, 2, \ldots \).
This is only possible if the product $E_k r$ in eq. (1031) is quantized. We define that $E_k r = A_q(k, l)$ and get

$$E_k = \frac{A_q}{r_o} \exp \left\{ - \left( k \pi - \frac{A_q}{\hbar c} - C_i \right) / \left( \frac{K_u}{\hbar c} + l \right) \right\}$$ \hspace{1cm} (1033)

The problem reduces now to find the function $A_q(k, l)$ that makes $E_k = E_{tot} + E_0$ for the hydrogen spectrum, with $E_{tot} = E_n$.

Before we continue we will deduce the condition $\lambda = i l$ introduced previously. We assume that

$$Y(\theta, \phi) = \Theta(\theta) \Phi(\phi) \quad \text{and} \quad \frac{d}{d\varphi} \Phi = m \Phi \hspace{1cm} (1034)$$

and with $\Phi(\varphi) = \Phi(\varphi + 2\pi)$ we get

$$\Phi = \exp\{m \varphi\} \quad \text{with} \quad m = i m_l \quad \text{and} \quad m_l = \pm 0, \pm 1, \pm 2; \cdots$$ \hspace{1cm} (1035)

With eq. (1034) we have that eq. (1025) transforms to

$$\frac{m}{\sin \theta} \Theta + \frac{d}{d\theta} \Theta + 2 \cot \theta \Theta = - \lambda \Theta \hspace{1cm} (1036)$$

and

$$\frac{d \Theta}{\Theta} = - \left[ \frac{m}{\sin \theta} + 2 \cot \theta + \lambda \right] d\theta$$ \hspace{1cm} (1037)

which gives the solution

$$\Theta = \frac{1}{C_\Theta} \exp \left\{ - \int \left[ \frac{i m_l}{\sin \theta} + 2 \cot \theta + \lambda \right] d\theta \right\}$$ \hspace{1cm} (1038)

With $\Theta(\theta) = \Theta(\theta + 2\pi)$ we conclude that

$$\Theta = \frac{1}{C_\Theta} \exp \{-2 \ln \sin \theta\} \exp \{-i \left[ m_l \ln(\csc \theta - \cot \theta) + l \theta \right]\}$$ \hspace{1cm} (1039)

with $\lambda = i l$ and $l = \pm 0, \pm 1, \pm 2; \cdots$ what we have anticipated for eq. (1027).

Eq. (1036) we can now write as

$$\frac{d}{d\theta} \Theta + i \frac{m_l}{\sin \theta} \Theta = - 2 \cot \theta \Theta - i l \Theta \hspace{1cm} (1040)$$

In this equation the real and the imaginary terms must be equal, and we get from the imaginary terms that
With

\[
\frac{m_l}{l} = -\sin \theta \quad \text{with} \quad m_l = \pm 0, \pm 1, \pm 2; \cdots \quad \text{and} \quad l = \pm 0, \pm 1, \pm 2; \cdots
\]  

(1041)

We conclude, that the relation between the orbital quantum number \(l\) and the magnetic quantum number \(m_l\) is

\[
\left| \frac{m_l}{l} \right| \leq 1 \quad \text{or} \quad |m_l| \leq |l|
\]  

(1042)

Now we have to find \(A_q(k,l)\) that makes \(E_k = E_n + E_o\).

### 25.10.4 Calculations made for the Hydrogen atom

A numerical calculation is required to obtain \(E_k = A_q(k,l)\) from eq. (1033)

\[
E_k = \frac{A_q}{r_o} \exp \left\{ - \left( k \pi - \frac{A_q}{\hbar c} - C_i \right) / \left( \frac{K_u}{\hbar c} + l \right) \right\} \quad \text{with} \quad E_k = E_{tot} + E_o
\]  

(1043)

and the help of

\[
E_{tot} = E_n \quad \text{and} \quad E_k = -(\hbar c R_H \frac{1}{k^2} + E_o)
\]  

(1044)

where the sign for \(E_k\) was changed because eq. (1043) gives only acceptable results with \(r > 0\) if \(E_k r = A_q(k,l) < 0\). That is because the external potential \(U\) was defined negative with \(U \to 0\) for \(r \to \infty\). After obtaining \(A_q\) we can calculate the radius \(r = A_q/E_k\). The calculations were made with \(l = 1\) and with \(C_i = 500\).

If \(E_k r = A_q(k,l)\) could be express analytically it would be possible to calculate the differences \(\Delta E_n = \Delta E_k\) directly with

\[
E_k(r,k,l,C_i) = \left[ k \pi \hbar c - (K_u + l \hbar c) \ln \frac{r}{r_o} - C_i \hbar c \right] \frac{1}{r}
\]  

(1045)

end the help of

\[
r(k,l,C_i) = r_o \exp \left\{ \left( k \pi - \frac{A_q}{\hbar c} - C_i \right) / \left( \frac{K_u}{\hbar c} + l \right) \right\}
\]  

(1046)

which was derived from eq. (1031).

#### Results of calculations:

- The energy \(E_k\) tends to the negative Energy of a rest electron instead to zero for
$k \to \infty$ as it is for the Rydberg term (see Fig. 142). The energy-radius product $A_q$ is shown in Fig. 143.

![Graph showing Total energy $E_k(k,l)$](image)

**Figure 142: Energy $E_k$ of Hydrogen atom**
The radius of the Hydrogen atom decreases with increasing energy $E_k$ for constant orbital number $l$ (see Fig 144). This is because for a constant orbital number $l$ the energy can only increase by contracting the orbital radius $r$, increasing the tangential speed of the electron. The orbital radius $r$ is of the order of $10^{-10}m$ with $l = 1$, which is also the order of magnitude of the inter-atomic distances and the Bohr radius $a_o \approx 0.5 \, \text{Å}$.

The radius increases with constant energy $E_k$ or constant $n$ and increasing orbital quantum number $l$ (see Fig 145). The tangential speed of the electron decreases with the increasing radius $r$.

The energy eigenvalues don’t depend exclusively from the principal quantum number $n = k$. There is no degeneracy of the principal quantum state $n$, because the eigenvalues depend also from the orbital quantum number $l$. It is important to note, that the principal quantum state $n$ in the Hydrogen solution of the Schroedinger equation is also a function of the orbital quantum number $l$ because it was defined as $n = n_r + l + 1$. 

\[ E_k \cdot r = A_q(k, l) \]
\[ l = 1 \quad C_i = 500 \]
Figure 144: Orbital radius $r$ of Hydrogen atom for constant $l = 1$.

Figure 145: Orbital radius $r$ of Hydrogen atom for constant $k = 11$. 

Orbital radius $r = r(k,l)$

$\begin{align*} 
& \text{Principal quantum number } n = k \\
\text{Orbital radial } r = r(k,l) \\
& \text{Orbital quantum number } \ell = 1, \ 2, \ 3, \ \ldots \ (k-1) \\
& C \approx 500 \\
\end{align*}$

$\begin{align*} 
& \text{Orbital radius } r = r(k,l) \\
& \text{Orbital radial } r \text{ for } l = 1 \\
& \text{Orbital quantum number } \ell = 1, \ 2, \ 3, \ \ldots \ (k-1) \\
& C \approx 500 \\
\end{align*}$
25.11 Wave equations for free moving particles.

25.11.1 The relativistic wave equation for the free moving particle.

We start with the dispersion equations for the relativistic mass $m_{\text{rel}}$ of sec. 25.2. In what follows we omit the sub-index $x$ and write $m_{\text{rel}}$ instead of $m_{\text{rel},x}$.

\[
m_{\text{rel}} = \frac{E_{\text{rel}}}{c^2}, \quad m_{\text{rel}} = m_{\text{rel}}(p) = \frac{1}{c^2} \sqrt{E_o^2 + p^2 c^2} \quad \text{and} \quad E_o = m_o c^2 \quad (1047)
\]

which can be transformed to

\[
m_{\text{rel}} = \frac{1}{c} \left[ p^2 + \frac{E_o^2}{c^2} \right]^{1/2} = \frac{1}{c} \left[ p + p' \right] \quad (1048)
\]

with

\[
p_{1,2}' = -p \pm \sqrt{p^2 + \frac{E_o^2}{c^2}} \quad (1049)
\]

We also transform

\[
p(m_{\text{rel}}) = c \sqrt{m_{\text{rel}}^2 - m_o^2} \quad \text{and} \quad m_o = \frac{E_o}{c^2} \quad (1050)
\]

to

\[
p = \frac{1}{c} \left[ E_{\text{rel}}^2 - m_o^2 c^4 \right]^{1/2} \quad \text{with} \quad E_{\text{rel}} = E_o + E_{\text{kin}} \quad (1051)
\]

and

\[
p = \frac{1}{c} \left[ E_{\text{kin}}^2 + 2 E_o E_{\text{kin}} \right]^{1/2} = \frac{1}{c} \left[ E_{\text{kin}} + E' \right] \quad (1052)
\]

with

\[
E_{1,2}' = -E_{\text{kin}} \pm \sqrt{E_{\text{kin}}^2 + 2 E_o E_{\text{kin}}} \quad (1053)
\]

Note: In what follows we changed the symbol for the wave function from $\phi$ to $\Psi$ to follow the convention.

If we now introduce (1048) and (1052) in eq. (911)

\[
\Psi(x, t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \kappa_x(p_x) \exp \left\{ \frac{i}{\hbar} [m_{\text{rel}}(p_x) x - p_x t] \right\} dp_x \quad (1054)
\]

we get

\[
\Psi(x, t) \propto \exp \left\{ \frac{i}{\hbar} \left[ [p + p']x - [E_{\text{kin}} + E']t \right] \right\} \quad (1055)
\]
what we can write in the form

$$\Psi(x, t) \propto \exp \left\{ \frac{i}{\hbar} \left[ p' x - E' t \right] \right\} \cdot \exp \left\{ \frac{i}{\hbar} \left[ p x - E_{\text{kin}} t \right] \right\}$$

(1056)

We know that

$$E_{\text{rel}} = E_o + E_{\text{kin}} = E_s + E_n$$

(1057)

with

$$E_s = \frac{E_o^2}{\sqrt{E_o^2 + E_p^2}} \quad E_n = \frac{E_p^2}{\sqrt{E_o^2 + E_p^2}} \quad E_p = p c$$

(1058)

For relativistic speeds \( v > 0.95c \) we have that

$$E_s << E_n \quad E_{\text{rel}} \approx E_n \quad E_{\text{kin}} \approx E_n - E_o$$

(1059)

and

$$p_1' = 0 \quad p_2' = -2p \quad E_1' = 0 \quad E_2' = -2E_{\text{kin}}$$

(1060)

and get

$$\Psi(x, t) \propto \exp \left\{ \pm \frac{i}{\hbar} \left[ p x - E_{\text{kin}} t \right] \right\} = \exp \left\{ \pm \frac{i}{\hbar} \left[ p x - (E_n - E_o) t \right] \right\}$$

(1061)

25.11.2 The slightly relativistic wave equation for the free moving particle.

For \( v << c \) we have that \( p \approx mv \)

$$E_s \approx E_o \quad \text{and} \quad E_n \approx E_{\text{rel}} - E_o = E_{\text{kin}}$$

(1062)

Also for \( v \to 0 \) we get that

$$E_{\text{kin}} \to 0 \quad \text{and} \quad E' \to 0 \quad \text{for} \quad v \to 0$$

(1063)

and

$$p \to 0 \quad \text{and} \quad p' \to mc \quad \text{for} \quad v \to 0$$

(1064)

From (1056) we get
\[ \Psi(x, t) \propto \exp \left\{ \frac{i}{\hbar} [mc x] \right\} \cdot \exp \left\{ \frac{i}{\hbar} [p x - E_{\text{kin}} t] \right\} \] (1065)

where we have that the first exponent is not a function of \( p \) and \( E_{\text{kin}} \). As \( p = mv \) from the second exponent is much smaller than \( mc \) from the first exponent, the first exponent oscillates along the \( x - \text{axis} \) between plus and minus of its absolute value which is one. The frequency of the oscillation of the first factor is very high compared with the second, and the first factor can be made equal to one for all \( x \).

\[ \Psi(x, t) \propto \exp \left\{ \frac{i}{\hbar} [p x - E_{\text{kin}} t] \right\} \] (1066)

With \( p \approx mv \) we also can write

\[ E_{\text{kin}} \approx -\frac{c^2}{2E_0} p^2 + \frac{1 \cdot 3}{2 \cdot 4} \frac{c^4}{E_0^3} p^4 - \frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \frac{c^6}{E_0^5} p^6 + \cdots \] (1067)

and arrive to the relativistic wave equation for a free moving particle

\[ i \hbar \frac{\partial}{\partial t} \Psi = \left[ \frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + \frac{1 \cdot 3}{2 \cdot 4} \frac{\hbar^4}{m^3 c^2} \frac{\partial^4}{\partial x^4} \cdots \right] \Psi \] (1068)

If we take into consideration only the first two terms of \( E_{\text{kin}} \) and introduce an external potential \( U(x) \), we get the following time independent wave equation for a slightly relativistic moving charged particle in an external potential.

\[ \left[ \frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + \frac{1 \cdot 3}{2 \cdot 4} \frac{\hbar^4}{m^3 c^2} \frac{\partial^4}{\partial x^4} + U(x) \right] \Psi = E \Psi \] (1069)

To calculate the maximum velocity \( v_{\text{max}} \) for this case we make the third term of eq. (1067) ten times smaller than the second term and get \( v_{\text{max}} = 0.346 \ c \). It is not recommended to use more than two terms of eq. 1067 because of the approximations made for the deduction.

**Note:** Eq. 1069 allows to calculate the solutions for QM systems which are slightly relativistic instead of using the strong relativistic Dirac formulation.

### 25.11.3 The non-relativistic wave equation for the free moving particle

If we make \( E_0 = 0 \) because we want an equation that describes only the kinetic energy we get \( p' = 0 \) and \( E' = 0 \), and if we reduce our observation to non-relativistic speeds with \( v << c \) we have from eq. (1056)

\[ \Psi(x, t) \propto \exp \left\{ \frac{i}{\hbar} [p x - E_{\text{kin}} t] \right\} \quad \text{with} \quad E_{\text{kin}} = \frac{1}{2} \frac{p^2}{m} = E_{\text{kin}}(p) \] (1070)
\[ \Psi(x, t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \kappa_x(p_x) \exp \left\{ \frac{i}{\hbar} \left[ p_x x - E_{\text{kin}}(p) t \right] \right\} dp_x \]  

(1071)

The wave function derived two times versus \( x \) and one time versus \( t \) gives the differential equation of the free moving particle of mass \( m \). If we introduce an external potential \( U \) we have the Schrödinger equation for an accelerated particle.

\[ i \hbar \frac{\partial}{\partial t} \Psi(x, t) \approx \left[ -\frac{\hbar^2}{2 m_o} \frac{\partial^2}{\partial x^2} + U \right] \Psi(x, t) \]  

(1072)

25.12 Stable and unstable particles.

Particles in the SM are classified as Gauge Bosons, Leptons, Quarks, Baryons and Mesons. The classification makes no difference between stable and unstable particles. Unstable particles with energies much greater than the energies of the stable electron (0.511 MeV/c²), positron or neutrino are defined as Basic Subatomic Particles (BSPs), violating the concept of basic particles which must be the constituents of all not basic particles. The result is the search for basic particles like the unstable Quarks with energies above 0.35 GeV/c².

The approach “Emission and Regeneration” UFT

1. defines as BSPs the electron, positron and the neutrino which are stable particles, and defines all particles with higher energies, stable or unstable, as Composed Subatomic Particles (CSPs) which are integrated by BSPs.

2. defines electrons and positrons as focal points of rays of Fundamental Particles (FPs) which go from infinite to infinite and have longitudinal and transversal angular momenta. Interactions between electrons and positrons are the result of the interactions of the angular momenta of their FPs. No carrier bosons are required to describe interactions between subatomic particles.

3. defines neutrinos as pairs of FPs with opposed angular momenta which generate linear momenta, and photons as a sequence of pairs of FPs with opposed angular momenta that generate a sequence of opposed linear momenta.

4. shows that no strong forces are required to hold electrons and positrons together, which are the constituents of protons and neutrons. The forces between the constituents electrons and positrons tend to zero for the distance between them tending to zero.

5. shows that weak forces which are responsible for the decay of atomic nuclei are electromagnetic forces.
6. shows that gravitation forces are also electromagnetic forces.

The conclusion is, that all interactions between subatomic particles are electromagnetic interactions and described by QED. Interactions as described by QCD and Gauge/Gravity Duality are simply the product of the deficiencies of the SM and not required.

25.12.1 The potentials of the four interactions.

Our SM differentiates between the following potentials to explain interactions between particles.

- Strong
- Weak
- Gravitation
- Electromagnetic

In sec. 3.1 the momentum curve between two static charged BSAs (electron/positron) was derived resulting Fig. 63 (Fig. 146) and the following regions were defined:

1. From $0 \ll \gamma \ll 0.1$ where $p_{stat} = 0$
2. From $0.1 \ll \gamma \ll 1.8$ where $p_{stat} \propto d^2$
3. From $1.8 \ll \gamma \ll 2.1$ where $p_{stat} \approx constant$
4. From $2.1 \ll \gamma \ll 518$ where $p_{stat} \propto \frac{1}{\gamma}$
5. From $518 \ll \gamma \ll \infty$ where $p_{stat} \propto \frac{1}{\gamma^2}$ (Coulomb)

The static momentum curve of Fig. 146 is part of the potential well of an atomic nucleus as shown in Fig. 147, which can be approximated by a piecewise constant potential for the analytical analysis in quantum mechanics.

The force on electrons or positrons that move in the defined regions of the potential well is given by the following equations derived in sec. 6.2:

$$d\vec{F}_{in} = \frac{1}{8 \pi} \sqrt{m_p r_{op} r_{rot}} \frac{d}{dt} \int_{r_r}^{\infty} dH_n \quad \text{with} \quad (1073)$$

$$\frac{d}{dt} \int_{r_r}^{\infty} dH_n = \frac{1}{2} \frac{d}{dt} [H_n] \frac{r_{o}}{r_{r}} \sin \varphi \ d\varphi \ \bar{s}_r - H_n \ v \ \frac{r_{o}}{r_{r}^2} \sin \varphi \ \cos \varphi \ d\varphi \ \bar{s}_r \quad (1074)$$
Figure 146: Linear momentum $p_{\text{stat}}$ as function of $\gamma = d/r_o$ between two static BSPs with equal radii $r_{o1} = r_{o2}$.

\[
+ \frac{1}{2} H_n \frac{1}{r_r} \sin \varphi \, d\varphi \, \frac{dr_\varphi}{dt} \, \mathbf{s}_\gamma
\]

For the regions we have that:

- BSPs that are in region 1 don’t attract nor repel each other. The static force is zero and no binding Gluons nor strong forces to hold them together are needed.

- BSPs that have migrated slowly from region 1 to region 2 where the potential groves approximately with $d^2$, are accelerated to or away from the potential wall by the static force according the charge of the particle and the charge of the remaining particles in region 1. The force on these moving particles is given by eq. (401). We can differentiate between:

  - BSPs that are accelerated away from the potential wall (region 3) induce on BSPs of other atoms the gravitation force. The accelerated BSPs transmit their acquired momentum to BSPs of other atoms (induction) and stop their movement immediately according the conservation law of momentum. The force on accelerated BSPs is given by the first term of the right side of eq. (374) with $\frac{d}{dt}[H_n] = \sqrt{m \frac{dv}{dt}}$. 

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BSPs that are accelerated to the potential wall may tunnel the wall what results in the decay of the atom with the corresponding radiations. No special weak force is required.

- BSPs in the region 5 where the Coulomb force exists, orbit around the atom nucleus. This is called in the SM the electromagnetic force.

The “Emission & Regeneration” UFT approach shows that all forces are derived from one Field, the $dH$ field. It also shows that all interactions are of electromagnetic type and described by QEDs (Quantum Electrodynamics) and that no other type of interactions are required. It shows that all particles are composed of electrons, positrons and neutrinos and that particles of very short lifetime are composed particles.
25.13 Compatibility of gravitation with Quantum mechanics.

The potential in which an orbital electron in an Hydrogen atom with $Z = 1$ moves is

$$U(r)_{\text{Coul}} = - \frac{Z e^2}{4\pi\varepsilon_0} \frac{1}{r} = 2.3072 \cdot 10^{-28} \frac{1}{r} \text{ J with } Z = 1 \quad (1075)$$

We know from [5] page 178 that the discrete energy levels for the orbital electron of the H-atom is

$$E_{n_{\text{Coul}}} = - \frac{m}{2\hbar^2} \left( \frac{Z e^2}{4\pi\varepsilon_0} \right)^2 \frac{1}{n^2} = 2.1819 \cdot 10^{-18} \frac{1}{n^2} \text{ J} \quad (1076)$$

The difference between the energy levels is

$$\Delta E_{n_{\text{Coul}}} = 2.1819 \cdot 10^{-18} \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ J} \quad (1077)$$

25.13.1 Quantized gravitation.

In the present approach of “Emission & Regeneration” UFT gravitation is presented based on the reintegretion of migrated electrons and positrons to their nuclei. According to that model the force on one electron/positron of a mass $M_1$ due to the reintegretion of an electron/positron to an atomic nucleus of a mass $M_2$ is given by (746)

$$F_i = \frac{dp}{\Delta t} = \frac{k c \sqrt{m} \sqrt{m_p}}{4K d^2} \int \int_{\text{Induction}} \text{ with } \int \int_{\text{Induction}} = 2.4662 \quad (1078)$$

and the corresponding potential is

$$U(r)_{\text{Grav}} = \left( 2.4662 \frac{k c \sqrt{m} \sqrt{m_p}}{4K} \right) \frac{1}{r} = 2.3071 \cdot 10^{-28} \frac{1}{r} \text{ J} \quad (1079)$$

If we write the Schroedinger equation with the gravitation potential instead of the Coulomb potential for the H-atom, we get discrete energy levels simply in replacing the expression in brackets of eq.(1076) with the expression in brackets of eq. (1079)

$$E_{n_{\text{Grav}}} = - \frac{m}{2\hbar^2} \left( 2.4662 \frac{k c \sqrt{m} \sqrt{m_p}}{4K} \right) \frac{1}{n^2} = 2.1816 \cdot 10^{-18} \frac{1}{n^2} \text{ J} \quad (1080)$$

In the same model of gravitation the number of reintegrating electrons/positrons for a mass $M$ is derived as $\Delta G = \gamma_G \cdot M$ with $\gamma_G = 5.3779 \cdot 10^8 \text{ kg}^{-1}$. The resulting energy level due to all reintegrating electrons/positrons of $M_1$ and $M_2$ is
\[ E_{n\text{Grav\_tot}} = 2.1816 \cdot 10^{-18} \Delta G_1 \Delta G_2 \frac{1}{n_2^2} \text{ J} \quad (1081) \]

For the H-Atom \( M_2 \) is formed by one proton composed of 918 electrons and 919 positrons and \( M_1 \) is the mass of the electron. The mass of a proton is \( M_2 = m_{\text{prot}} = 1.6726 \cdot 10^{-27} \text{ kg} \) and the mass of the electron \( M_1 = m_{\text{elec}} = 9.1094 \cdot 10^{-31} \text{ kg} \). We get \( \Delta G_2 = 8.9951 \cdot 10^{-19} \) and \( \Delta G_1 = 4.8989 \cdot 10^{-22} \). We get for the energy difference for orbital electrons at the H-Atom due to gravitation potential

\[ \Delta E_{n\text{Proton}} = 9.6134 \cdot 10^{-58} \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ J} \quad (1082) \]

If we compare the factors of the brackets for the energy difference due to the Coulomb potential of eq. (1077) and the gravitational potential of eq. (1082), we see that even between very different energy levels \( n_1 \) and \( n_2 \) of the gravitational levels the energy differences of the gravitation are neglectible compared with the Coulomb.

For the energy difference between two levels \( n_1 \) and \( n_2 \) of an atom we can write:

\[ \Delta E_{n\text{Coul}} \pm \Delta E_{n\text{Grav}} = h(\nu \pm \Delta \nu) = 2.1819 \cdot 10^{-18} \left[ 1 \pm \Delta G_1 \Delta G_2 \right] \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ J} \quad (1083) \]

with \( \Delta G = \gamma_G M \) where \( \gamma_G = 5.3779 \cdot 10^8 \text{ kg}^{-1} \).

Now we make the same calculations for the difference between the energy levels due to the gravitation potential of the sun with \( M_2 = M_\odot = 1.9891 \cdot 10^{30} \text{ kg} \) and the earth with \( M_1 = M_\oplus = 5.9736 \cdot 10^{24} \text{ kg} \). We get \( \Delta G_\odot = 1.0697 \cdot 10^{39} \) and \( \Delta G_\oplus = 3.2125 \cdot 10^{33} \) resulting

\[ \Delta E_{n\odot \uparrow} = 7.4968 \cdot 10^{54} \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ J} \quad (1084) \]

As the earth shows no quantization in its orbit around the sun, two adjacent levels \( n_1 \) and \( n_2 \) must be very large outer levels so that \( \Delta E_{n\odot \uparrow} \approx 0 \), similar to the large outer levels of the conducting electrons of conducting materials. Mathematically we can write with \( n_2 = n_1 + 1 \)

\[ \lim_{n_1 \to \infty} \Delta E_{n\odot \uparrow} = 7.4968 \cdot 10^{54} \left[ \frac{1}{n_1^2} - \frac{1}{(n_1 + 1)^2} \right] = 0 \text{ J} \quad (1085) \]

25.13.2 Relation between energy levels and space.

The compatibility of gravitation as the reintegration of migrated electrons/positrons to their nuclei is also shown by the following calculations. From eq. (1081) we get the energy difference between two gravitation levels

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\[ \Delta E_{nGrav} = 2.1816 \cdot 10^{-18} \Delta G_1 \Delta G_2 \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] J \] (1086)

and with the difference between two gravitation potentials at different distances

\[ \Delta U_{Grav} = G M_1 M_2 \left[ \frac{1}{r_1} - \frac{1}{r_2} \right] J \] (1087)

we can write that \( \Delta E_{nGrav} = \Delta U_{Grav} \) what gives with \( r_1 r_2 \approx r^2 \)

\[ \frac{\Delta r}{r^2} = \frac{2.1816 \cdot 10^{-18} \gamma^2 G}{2} \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \] (1088)

For the H-atom with \( r \approx 10^{-13} \text{ m} \) we get for the difference between the two first energy levels \( n_1 = 1 \) and \( n_2 = 2 \)

\[ \Delta r = \frac{2.1816 \cdot 10^{-18} \gamma^2 G}{3} \left[ \frac{3}{4} \right] = 7.0926 \cdot 10^{-17} \text{ m} \] (1089)

what is a reasonable result because \( \Delta r << r \).

Now we make the same calculations for the earth and the sun with \( r_{\odot,\dagger} \approx 150.00 \cdot 10^9 \text{ m} \). We get

\[ \Delta r_{\odot,\dagger} = 2.1164 \cdot 10^{32} \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \] (1090)

As the earth shows no quantization in its orbit around the sun, two adjacent levels \( n_1 \) and \( n_2 \) must be very large outer levels so that \( \Delta r_{\odot,\dagger} \approx 0 \), similar to the large outer levels of the conducting electrons of conducting materials.

### 25.13.3 Superposition of gravitation and Coulomb forces.

The “Emission & Regeneration” UFT shows that the Coulomb and the Ampere forces tend to zero for the distance between electrons/positrons tending to zero. The behaviour is explained with the cross product of the angular momenta of the regenerating rays of FPs that tends to zero.

The induction force is not a function of the cross product but simply the product between angular momenta of the regenerating rays of FPs. The result is that the induction force does not tend to zero with the distance between inducing particles tending to zero. As the gravitation was defined as the reintegration of migrated electrons/positrons to their nuclei and as a induction force, the gravitation force prevails over the Coulomb or Ampere forces for the distance tending to zero.

Fig. 148 shows qualitatively the resulting momentum due to Coulomb/Ampere and Gravitation momenta between an atomic nucleus of a target and a He nucleus.
Figure 148: Resulting linear momentum $p$ due to Coulomb/Ampere and Gravitation momenta.

**Note:** The gravitation model of “Emission & Regeneration” UFT is based on a physical approach of reintegration of migrated electrons/positrons to their nuclei and compatible with quantum mechanics, while General Relativity, the gravitation model of the SM, based on a mathematical-geometric approach is not compatible with quantum mechanics.

25.14 Table comparing the SM and the ’E & R’ model.
Fig. 149 shows the SM and the 'E & R' model subdivided in classical physics and QM. The classic part of the SM with its point-like representation of particles has four force-carriers, four fields and four interactions. QM based on the classical physics of the SM has correspondingly four gauge theories.

The classic part of the 'E & R' model with its focal-point representation of particles has only one type of force-carrier, only one field and only one type of interaction. QM based on the classical physics of the 'E & R' model has correspondingly only one type of gauge theory, namely QED.

The SM has four fields one for each type of force while the 'E & R' model has only one field for all forces and is therefore a UFT.

The SM is a poly-particle model while the 'E & R' model is a mono-particle model.
26 Summery of main characteristics of the proposed model.

The following abbreviations are used:

1. Basic Subatomic Particles (BSPs) are electrons, positrons and neutrinos.
2. Subatomic Particles (SPs)
3. Fundamental Particles (FPs)

The main characteristics of the proposed model are:

- Subatomic particles (SPs) are represented as focal points of rays of Fundamental Particles (FPs) that go from infinite to infinite. FPs store the energy of the SPs as rotation defining longitudinal and transversal angular momenta.

- FPs are emitted at the focal point and regenerate the focal point. Regenerating FPs are the FPs that were emitted by other focal points in space.

- The charge of a SP is defined by the rotation sense of the longitudinal angular momenta of the emitted FPs.

- The interacting particles for all types of interactions (electromagnetic, strong, weak, gravitation) are the FPs with their longitudinal and transversal angular momenta.

- All known forces are derived from one vector field generated by the longitudinal and transversal angular momenta of fundamental particles.

- All the basic laws of physics (Coulomb, Ampere, Lorentz, Maxwell, Gravitation, bending of particles and interference of photons, Bragg, Schroedinger) are mathematically derived from the proposed model, making sure that the approach is in accordance with experimental data.

- Electrons and positrons neither attract nor repel each other for the distance between them tending to zero. Nucleons are interpreted as swarms of electrons and positrons.

- The coexistence of protons in the atomic nucleus does not require the definition of a special strong force nor additional mediating particles (gluons).

- Quarks are composed of electrons and positrons and the charge Q is the relation between the difference of positrons and electrons of the quark and the total number of electrons and positrons. Q is the relative charge of the quark.
• The emission of particles from a heavy atomic nucleus does not require the definition of a special weak force nor additional mediating particles.

• Gravitation has its origin in the linear momenta induced by the reintegation of migrated electrons and positrons to their nuclei. No special mediating particles are required (gravitons).

• The gravitation force is composed of an induced Newton component and an Ampere component due to parallel currents of reintegrating electrons and positrons. For galactic distances the induced component can be neglected. A positive Ampere component explains the flattening of galaxies’ rotation curve (no dark matter is required) and a negative Ampere component explains the expansion of galaxies (no dark energy is required).

• The inertia of particles is explained with the time delay between the emission and the regeneration of FPs. No special mediating particles are required.

• Permanent magnets are explained with the synchronization along a closed path of reintegrating BSPs to their nuclei.

• The two possible states (spins) in one energy level of orbiting electrons are replaced by the two types of electrons defined in the present theory, namely the accelerating and decelerating electrons.

• The splitting of the atomic beam in the Stern-Gerlach experiment is explained with the magnetic field generated by the parallel currents composed of the orbital electron and the current induced in the atomic nucleus. The magnetic spin is not an intrinsic characteristic of the electron.

• Relativity based on speed variables instead of space-time variables give Galilean relativity multiplied with the gamma factor. Neither time dilatation nor length contraction is required.

• The wave character of the photon is defined as a sequence of FPs with opposed transversal angular momenta which carry potential opposed transversal linear momenta.

• Light that moves through a gravitation field can only lose energy, what explains the red shift of light from far galaxies (no expansion of the universe is required).

• Diffraction of particles such as the Bragg diffraction of electrons is now the result of the quantized interaction of parallel currents.
• As the model relies on BSPs permitting the transmission of linear momenta at
infinite speed via FPs, it is possible to explain that entangled photons show no
time delay when they change their state.

• The addition of a wave to a particle (de Broglie) is effectively replaced by a
relation between the particles radius and its energy.

• The Schroedinger equation is replaced by an equation where the wave function is
derived one time versus space and two times versus time in analogy to Newton’s
second law.

• The uncertainty relation of quantum mechanics derived with the new wave func-
tion form pairs of canonical conjugated variables between ”energy and space”
and ”momentum and time”.

• The time independent Schroedinger equation results deriving the new wave func-
tion two times versus space, the same as for the established wave function.

• The new quantum mechanics theory, based on wave functions derived from the
radius-energy relation, is in accordance with the quantum mechanics based on
the correspondence principle.

• All interactions are of electromagnetic type and described by QEDs (Quantum
Electrodynamics) and no other type of interactions are required.

• The gravitation of the present approach “Emission & Regeneration” UFT is com-
patible with quantum mechanics, what is not the case with General Relativity,
which is the gravitation model of the SM.

• Finally the hypothesis is made that the apparent CMB radiation is a gravitational
effect between the mass of the satellite and the signal evaluating part of the
satellite, what would explaining the isotropy of the radiation.
Bibliography

Note: The present approach is based on the concept that fundamental particles are constantly emitted by electrons and positrons and constantly regenerate them. As the concept is not found in mainstream theory, no existing paper can be used as reference.


