The duality of the mass as a basis of the field-forces

Hans-Joerg Hochecker
Donaustr. 22, 30519 Hannover, Germany
E-mail: physics@hochecker.eu
Web-site: http://www.hochecker.eu

Abstract: The matter-waves, well-known from numerous experiments, can be described as beat waves of two counter-moving waves. Thus mass is oscillating space-time, which results from the superposition of two counter-moving space-time waves. The duality of this counter-motion derives the duality of the electric force. And the inertia of the mass arises from the frequency. The electric force arises from a space- or energy- shift. Gravitation arises from the change of the energy-density of the electric field (by which the gravitational acceleration is independent of the mass) and yields the same results as GR. And the magnetic field appears to be an angle between the direction in which the electric field propagates and the direction in which it exerts its force.
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1. Introduction

The essential aim of this work is to show that at least three of the fundamental field-forces [1,2], namely the electric force, the gravitational force and the magnetic force, are based on different qualities of the electric field. This succeeds by the *central* cognition, which is that the matter-waves, as already calculated by deBroglie [3, 4], can be described as beat waves of two counter-moving waves. This allows the conclusion that mass is a longitudinally oscillating space-time wave. Space-time waves are known e.g. from gravitational waves [5-7] though they oscillate transversally and usually have much smaller frequencies. The representation of the mass as a dual wave makes the uncertainty principle [8-10] as the corresponding quantum phenomena more understandably. In addition, it explains the origin of the sizes of and within the atoms, and it explains the atomic orbitals of the electrons, known e.g. from Bohr's atom model [11-14].
The duality of the electric force results from the duality of the mass. The equivalence of mass and energy [15-17] means here that the energy of the mass spreads out with r^{-2} into space. The electric force of a field on a charge is therefore an energy- or space-shift at the centre of the charge. The inertia of the mass arises directly from the frequency of the charge in which the Higgs-Boson [18-21] is probably an elementary mass. Gravitation is a result of the change of the energy-density of the energy-field of the mass with r^{-2}. This representation of gravitation as an electric quality provides the same results as the theory of general relativity (GRT) [22-24] particularly regarding the electromagnetic waves (EMW).
The magnetic field is an angle between the direction in which the electric field propagates and the direction in which it performs its force. This angle meets the requirements of the theory of special relativity (SRT) [25, 26]. The quantization of the EMW [27-30] is based on the wave-like interaction between the EMW and a mass particle.
We finally recognize that the constancy of the speed of light (LS) shows the fundamental connection between space and time.
The development of these ideas has taken me for several years [31-33].

2. The mass as a wave

To derive the wavelength of a mass in motion, deBroglie used $m\cdot c^2 = f_m \cdot h$ (2.1), in which m is the relativistic mass, c the LS, f the frequency, and h the Plank constant. Heisenberg derived his uncertainty principle from this equation. Both worked very well. It was more difficult though to explain how this wave of a mass in motion is made.
But the origin of the matter-waves deBroglies is actually much simpler and more obviously than previously suspected, what I will show now.
Just as for a mass in motion, a frequency can be calculated for a motionless mass, too: $m_0 \cdot c^2 = f_{m0} \cdot h$ (2.2), in which m_0 is the rest-mass.

This oscillation of a *resting* mass is a standing wave. A resting mass is same in all directions therefore it must be a longitudinal spherical wave (as a sound wave).
A standing wave *always* consists of two counter-moving waves. The standing spherical wave of a mass consists correspondingly of a wave which moves away from the centre (which I call normal-wave), and a wave which moves towards the centre (which I call counter-wave). Each of these waves has the frequency calculated with (2.2) and moves with LS.
If the mass has the velocity v_m, then the frequency of the normal-wave - in the same direction of the motion and under consideration of the relativistic time-dilatation - is: $f_1 = \frac{c \cdot f_0 \cdot \sqrt{1-\frac{v_m^2}{c^2}}}{c-v_m}$ (2.3). And in the opposite direction: $f_2 = \frac{c \cdot f_0 \cdot \sqrt{1-\frac{v_m^2}{c^2}}}{c+v_m}$ (2.4).
The counter-wave moves towards the centre. So the motion of the centre cannot change the frequency of the counter-wave. If the energy balance of the mass is to be correct, the frequency of the counter-wave must change exactly oppositely to the normal-wave, as it will be seen. So the change of the normal-wave also changes the counter-wave automatically, which is plausible since both waves are components of the same matter-wave which correspondingly changes as a whole. Ultimately, the normal and counter waves are two oscillations between which energy is exchanged.

If two different waves superimpose, then beat arises. The envelop frequency of the beat is half the magnitude of the difference of the original frequencies: $f_b = \frac{|f_1 - f_2|}{2} = \frac{v_m \cdot f_{m0}}{c} \cdot \frac{1}{\sqrt{1-\frac{v_m^2}{c^2}}}$. And for $v_m \ll c$ it is: $f_b = \frac{v_m \cdot f_{m0}}{c}$ (2.5). For the calculation of the wavelength the beat is set on LS. If λ_b is the distance between two nodal points of the envelop wave, then: $c = \lambda_b \cdot f_b$ (2.6). Inserting (2.6) and (2.2) into (2.5) yields: $\lambda_b = \frac{h}{m_0 \cdot v_m}$. This is exactly the deBroglie wavelength for matter-waves which is confirmed by numerous experiments (such as double-split experiments [34]). It is remarkable: Matter-waves can be represented as beat waves.
The carrier frequency of the superposition is the mean average value of the original frequencies: $f_m = \frac{f_1 + f_2}{2} = \frac{f_{m0}}{\sqrt{1-\frac{v_m^2}{c^2}}}$ (2.7). We can see that the carrier frequency meets the same relativistic equation as the mass. So for the energies it is: $m \cdot c^2 = f_m \cdot h \Rightarrow \frac{m_0}{\sqrt{1-\frac{v_m^2}{c^2}}} \cdot c^2 = \frac{f_{m0}}{\sqrt{1-\frac{v_m^2}{c^2}}} \cdot h \Rightarrow m_0 \cdot c^2 = f_{m0} \cdot h$. Thus the whole energy of the mass is in the carrier frequency. And for that reason the frequency of the counter-wave must change as described.

Let´s have a look at the size ratios: The wavelength of a proton ($m_{p+} \approx 1.672 \cdot 10^{-27} kg$) is calculated by $\lambda_{p+} = \frac{h}{m_{p+} \cdot c}$, and is $\lambda_{p+} \approx 1.321 \cdot 10^{-15} m$ ($h \approx 6.626 \cdot 10^{-34} Js$). The diameter of a proton is indicated in atom-physics with about $D_{p+} \approx 1.6 \cdot 10^{-15} m$. The similarity of these two values is too good to be coincidental.
The wavelength of an electron ($m_{e-} \approx 9.11 \cdot 10^{-31} kg$) is $\lambda_{e-} \approx 2.42 \cdot 10^{-12} m$. The covalent radius of the hydrogen atom (and also the one of the helium atom) is specified as $D_H \approx 3.2 \cdot 10^{-11} m$. We see that λ_{e-} is smaller than D_H. Here, it has to be taken into account that the electrons are in motion within the atomic shell. Therefore, the deBroglie wavelength of the electrons within the atomic shell must also be taken into account. The diameters of the atoms as well as the atomic orbitals of the electrons result by the wavelength

of the mass of the electrons and their deBroglie wavelengths. Additionally, the wave characteristic of the protons and neutrons of the atomic nucleus must be taken into account, too.
Of course, the structure of the atom is determined by the electric forces. But the mass isn't a negligibly small object in the centre of the charge. The mass is a spherical wave with a centre. At the hydrogen atom, the electron can hardly move for more than 10 of its wavelengths. A mass moves by its wave pattern changing, namely by the frequencies of the normal-wave and the counter-wave changing contrariwise in the direction of the motion. At that, the beat wave is made. At the speed which is assigned to the electrons of the hydrogen atom, the deBroglie wavelength would be even larger than the shell diameter.

So, while the electric forces are substantial for the energies within the atom, the wavelengths of the masses seem to determine the size ratios of the atoms.
The masses form stable wave patterns within the atomic shell from which the atomic orbitals of the electrons (of the centres of the masses) arise. Not every wave pattern can be stable, so there are only discreet stable wave patterns. This explains the quantization of the energy levels. The stable forms of the wave patterns of the shell could be calculated quite well with computer models.
I think that it has got clear that it makes sense to assign a frequency to the (rest-) mass.

So mass is a (spatial) spherical oscillation. The question is: What oscillates there? The most basic quantities of physics are space and time. Everything must therefore be explained by space and time in the end. The energy of the mass is present its spatial oscillation, which has an infinite extension in principle. I will point that this energy of the mass present in space causes the gravitation, the electric forces, and the magnetic force. Alone this already justifies the assumption that the spatial oscillation of the mass is based on the most basic quantities of physics: on space and time. Therefore, the spatial spherical oscillation of a mass is oscillating space-time. The GRT describes gravitation as a space-time phenomenon, according to which the mass curves the space-time. It is only consistent to assume that the mass itself is nothing else but space-time, namely oscillating space-time. Of the gravitational waves it is already known that oscillating space-time can in principle contain energy. Similarly, the energy of the mass is present in its spherical space-time wave. I can not say anything yet about the exact values of the space-time oscillation of a mass. Accordingly, I can not yet show how the oscillations of the individual elementary particles, of which larger masses consist, produce resulting the space-time values of the GRT. I am working on it currently.

The idea of oscillating space-time presupposes that a quality can be assigned to the space which corresponds to a density which changes oscillatingly. Time has here the meaning that it describes the temporal sequence of the spatial change.
The mass is a spherical oscillation. The surface of a sphere changes with r^{-2} . This results in the idea that the density of the space-time of a mass also changes with r^{-2} . (The space-time of the mass condenses towards the centre.) And this means that the amplitude of the oscillation of the mass changes with r^{-2} . This also explains the particle character of a mass: most of the energy is close to the centre.

Even if most of the energy of a mass is near the centre, the total energy of a mass is distributed over the entire space. Accordingly, the mass is an energy field consisting of the normal-field and the counter-field.

When a force F_m causes the acceleration a_m to a mass m , then the frequencies of the normal- and counter-waves of the mass change in the direction of the acceleration.

From (2.3) we get: $\dfrac{df_1}{dv_m} = \dfrac{d\left(\dfrac{f_0\cdot\sqrt{c^2-v_{m(t)}^2}}{c-v_{m(t)}}\right)}{dv_m} = \dfrac{f_0}{(c-v_{m(t)})\cdot\sqrt{1-\dfrac{v_{m(t)}^2}{c^2}}}$. And with

$a_{m(t)} = \dfrac{dv_m}{dt} \Rightarrow dv_m = a_{m(t)}\cdot dt$ it becomes:

$$\frac{df_1}{a_{m(t)}\cdot dt} = \frac{f_0}{(c-v_{m(t)})\cdot\sqrt{1-\frac{v_{m(t)}^2}{c^2}}} \Rightarrow \frac{df_1}{dt} = +\frac{a_{m(t)}\cdot f_0}{(c-v_{m(t)})\cdot\sqrt{1-\frac{v_{m(t)}^2}{c^2}}} \quad (2.8).$$

And from (2.4) we obtain in analogous manner: $\frac{df_2}{dt} = -\frac{a_{m(t)} \cdot f_0}{(c+v_{m(t)}) \cdot \sqrt{1-\frac{v_{m(t)}^2}{c^2}}}$ (2.9).

The (2.8) and (2.9) show the instantaneous rate of change of the f_1 and f_2 at a certain velocity $v_{m(t)}$ when the acceleration caused by the force is $a_{m(t)}$.
We see that f_1 and f_2 change differently, which means that the average frequency (as calculated by (2.7)) also changes (which must, of course, be the case because a_m changes the energy of m). Correspondingly, from (2.7) we obtain in analogy to (2.3) and (2.4): $\frac{df_m}{dv_m} = \frac{d\left(\frac{f_{m0}}{\sqrt{1-\frac{v_{m(t)}^2}{c^2}}}\right)}{dv_m} \Rightarrow \frac{df_m}{dt} = \frac{a_{m(t)} \cdot f_{m0} \cdot v_{m(t)}}{(c^2 - v_{m(t)}^2) \cdot \sqrt{1-\frac{v_{m(t)}^2}{c^2}}}$

(2.10).

The force F_m is: $F_m = m \cdot a_m$. And with $m = \frac{f_m \cdot h}{c^2} = \frac{f_{m0} \cdot h}{c^2 \cdot \sqrt{1-\frac{v_m^2}{c^2}}}$ we get: $a_m = \frac{F_m \cdot c^2 \cdot \sqrt{1-\frac{v_m^2}{c^2}}}{f_{m0} \cdot h}$. And so we get from (1.10): $\frac{df_m}{dt} = \frac{F_m}{h} \cdot \frac{v_{m(t)}}{\left(1-\frac{v_{m(t)}^2}{c^2}\right)}$ (2.11).

In (2.11) we see that the $\frac{df_m}{dt}$ is independent of f_{m0} for a given constant F_m . If the change of the frequency $\frac{df_m}{dt}$ is independent of the rest frequency f_{m0} , then, according to (2.10), the acceleration a_m is automatically inversely proportional to the rest frequency. The rest frequency f_{m0} corresponds to the rest mass m_0 . We thus see that the *inertia* of the mass is a direct consequence of the representation of the mass as a wave. Thus, the inertia is not an (almost mysterious) independent property of an otherwise hardly definable mass, but it is obtained automatically if the mass is understood as a superposition of the normal- and the counter-wave.
If the F_m is the gravitational force, then the magnitude of the force also changes with the rest mass, which corresponds to the often-mentioned equality of gravitational and inert mass. This connection is explained in the chapter on gravitation.

3. The electric force

When the velocity of a mass changes, the frequencies of the normal- and counter-wave change oppositely. These changes of the frequency correspond to changes in energy. The average frequency changes according to the energy change of the mass, which corresponds to the energy exchange of the mass with the environment. However, if one considers the changes of the energy of the normal- and the counter-field (for example, with (2.3) and (2.4)), it is found that the energies of the normal- and the counter-field change much more than the total energy of the mass. The reason for this is that the energy *is shifted between the normal- and the counter-field*, resulting in a small net change in the energy corresponding to the total energy change of the mass.
An electrical charge as a particle can not exist without mass, since this would otherwise have the speed of light automatically. When an electric force accelerates a charge, this means nothing else but that this force changes the frequencies of the mass of the electric charge. We know that the normal- and the counter-field of *one* mass influence each other in order to maintain the energy equilibrium. It is obvious to assume that the normal- and counter-fields of *different* masses also influence each other. This leads to the assumption that the cause of the electric force is also to be found in the interactions of the normal- and counter-fields of the masses. The electric force would therefore be an interaction between the energy fields of the masses, by

which energy is shifted between the normal- and the counter-field of a mass.

So what is the difference between a mass with a positive charge, a negative charge, and a neutral mass? A characteristic quality of the electric force is the duality: equal charges repel each other, opposite charges attract each other. This duality of the electrical force is reflected in the duality of the normal- and counter-fields of the masses.

We have seen that the normal- and the counter-field of a mass influence each other. Obeying this principle, also at the interactions between different masses always the normal- and the counter-field of the different masses interact with each other.

We have also seen that the normal- and the counter-field of a mass always change oppositely. Obeying this principle, the normal- and the counter-field of a mass cause in other masses always opposite changes. (How this looks exactly then is shown exemplarily below.)

The duality of the electric force is obtained when it is established that the normal- and counter-field are interchanged at opposite charges, which means that the properties of the normal- and the counter-field are interchanged in interactions. This means nothing else than that one field can be described as positive and the other as negative. Accordingly, the positive fields of both positive and negative charges are identical for the interactions of the masses, although they are a normal-field and a counter-field respectively. The analogous applies to the negative fields.

I use the following nomenclature: The normal-field of a positive charge is the positive field and its counter-field is the negative field. The normal-field of a negative charge is accordingly the negative field and its counter-field is the positive field.

So we see what constitutes a positive and a negative charge, which can also be called positive and negative mass. What then is a neutral mass?

In the case of a neutral mass, a positive mass is superimposed with a negative mass. In this case, the frequencies of the normal-waves of the two charges *add up* to a neutral wave or to a neutral field, *although* they have opposing properties as positive and negative fields. The same also applies to the counter-waves or fields.

In principle, it is self-evident that the frequencies must be added for the resulting mass. The frequency of the field has no significance for the electric force of a field on a charge. The frequency corresponds to the energy of the mass, that is to the energy-density of the space of the mass, which changes with r^{-2} . We know that opposite electric charges neutralize each other. Therefore, there must be assigned signs to the frequencies of the masses, according to the electrical qualities of the masses. If, in the addition of the frequencies of a positive and a negative mass, one of the masses is greater than the other, the difference of the masses remains as an electrical property, resulting in a net charge. And of course, this net charge also corresponds to an energy-density. We can conclude, therefore, that the electric force is independent of the frequency of the mass, but not of the energy-density of the net charge. And this energy-density then has either the properties of a positive or a negative charge.

In the case of a neutral mass, both the energy of the normal-field and that of the counter-field have half the properties of the positive field and half of the negative field.

For a positive charge, the normal field has an surplus of positive charge energy and the opposite field has an surplus of negative charge energy. And with a negative charge, of course, it is exactly the opposite.

To the nomenclature: I designate the charge on which a field exerts a force as the receiver R, and the charge that produces the field as the source S.

The fields of S thus cause an energy-shift between the normal- and the counter-field at R. The grater the net charges of S and R, the greater the energy-shift. In other words: the magnitude of the energy-shift at R depends on the magnitude of the surplus-energies of positive and negative charges at S and R. And these surplus-energies represent, in the fields of S, energy-densities with the properties of positive and negative charges. It can therefore be said that the energy-densities of the net charges are responsible for the electrical forces. Thus, it is imperative to conclude that every elementary charge must always have the same positive or negative mass, which I call elementary mass.

I do not know how big the smallest mass is, measured for elementary charges in atom-physics. But I assume that the elementary mass is very small. Possibly, the elementary mass is associated with the Higgs boson. Neutrinos can also be considered. These would then consist of two elementary masses. This would explain their frequent occurrence.

If elementary masses are indeed so small, even with the very small electrons, only a fraction of their mass would be responsible for the electrical forces. The bulk of the mass would be only for the inertia that may be necessary to form atomic structures.

The electric field is thus identical with the field of a positive or negative mass. Of course, one can also

assign an electrical energy to this field of a mass which results from the electrical forces.
The magnitude of the electric force, as already described, is, of course, proportional to the electrical (net) charges.
Summarized briefly: the space-time energy of the mass is distributed with r^{-2} in space, and is divided into the normal- and the counter-field, from which I deduce that there is a positive and a negative mass which produce the electric forces . The electrical forces cause energy-shifts at R, which are proportional to the net charges of S and R. And the superimposition of equal positive and negative fields yields a neutral field which does not cause any energy-shifts.

Let us now consider why the total energy of R changes in the energy-shifts at R.
A negative field of S changes by superposition the energy of the positive field of R. This energy-change depends on the relative direction of motion between the field of S and that of R. In the one case, R is supplied with energy, in the other case energy is withdrawn. The same holds true for the corresponding positive field of S and the negative field of R. This energy-changes cause the frequencies of the normal- field of R on opposite sides of R to change in the opposite direction. The same is for the counter-field of R. This automatically corresponds to a velocity of R, starting from the situation where R initially rested. However, a velocity of R means that the frequency in the direction of motion changes more strongly in relation to the rest frequency than the frequency in the opposite direction, so that the total energy of R changes inevitably. (Otherwise, the centre of R would have to oscillate at two different frequencies, one in and one opposite the direction of motion.)

The next example is the repulsion between two positive charges (S and R).
The following further nomenclature can be gathered from Figure 1 for the positive and negative waves:

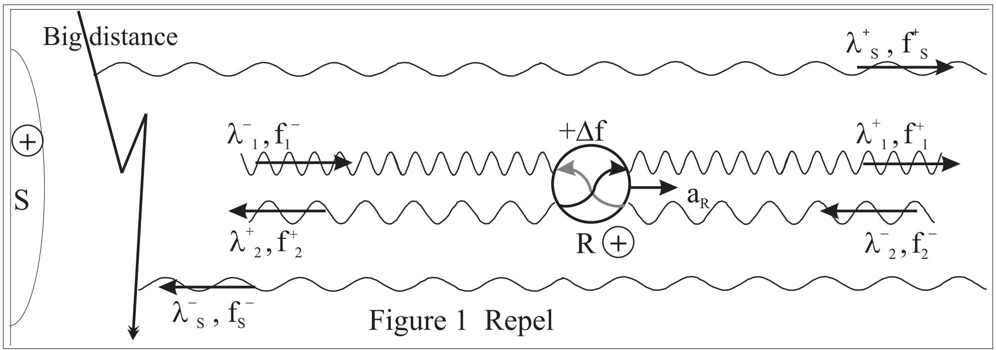

Figure 1 Repel

The field of a source S exerts a force on a charge, the receiver R. The waves of R which move away from S are marked with 1, and these which move towards S with 2. The distance between S and R shall be large enough, as the waves of S are approximately parallel. This means that the waves of R change only in a parallel direction to the waves of S. Of course, every wave of R can be decomposed into a component parallel and one perpendicular to the waves of S. Then, the parallel component has to be taken into account.

Let us now look exemplarily at the case of the repulsion between two positive charges (as in Figure 1). Instead of the wavelengths we look at the frequencies since, according to (2.1) or (2.2), the energy of a mass is directly proportional to the frequency.
The f^-_S will interact with f^+_1 and f^+_2 . At repulsion, f^+_1 gets greater and f^+_2 smaller. So the energy of f^+_1 increases and the one of f^+_2 decreases. So the f^-_S of S shifts energy at R contrary to its motion-direction. Here we already see the basic principle for these interactions (who wants can go through all possibilities for $S^\pm$ and $R^\pm$): The energies of the waves of R are always shifted contrary to the motion-direction of the waves of S. Correspondingly, due to f^+_S , the frequency of f^-_1 increases, and the one of f^-_2 decreases. At Figure 1, this is indicated by the corrugated arrows inside R.
The relative motion-direction is of decisive importance at this kind of interactions. So, the frequency of the normal-wave of R always increases when the $f^\pm_S$, with which the interaction takes place, moves in the opposite direction, and it decreases when the $f^\pm_S$ moves in the same direction. For the counter-wave of R it is exactly the opposite: it decreases at opposite motion-directions, and increases at the same directions.

The energy-shift at the normal-wave and at the counter-wave always happen *simultaneous*. This is as if the energy is directly shifted between the normal- and the counter-wave on each side of R (the side towards S and the opposite side). So the energy is shifted between f^-_1 and f^+_2 on the one side, and between f^+_1 and f^-_2 on the other side.
So, the frequency-shifts of R take place at the centre of R and spread from there with the normal-wave

(which has LS).

Together with the frequencies of R the wavelengths always also change. This corresponds to the fact that at the interaction of R with the field of S not only energies are shifted but also space is shifted in the same directions. (And, if we look only at the connecting line between S and R, the changes of the wavelength of R correspond to length-shifts.)

Let us now look at the calculations for our example:

With the nomenclature used here, from (2.8) we get: $\frac{df_1^+}{dt} = +\frac{a_{R(t)} \cdot f_0}{(c - v_{R(t)}) \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}}$ (3.1). And from (2.9) we get: $\frac{df_2^+}{dt} = -\frac{a_{R(t)} \cdot f_0}{(c + v_{R(t)}) \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}}$ (3.2).

For the force on the mass (F_m) we insert the electric force, and so we get from (2.11):

$$\frac{df_R}{dt} = \frac{F_e}{h} \cdot \frac{v_{R(t)}}{\left(1 - \frac{v_{R(t)}^2}{c^2}\right)} \quad (3.3).$$

If we replace the $a_{R(t)}$ by $a_{R(t)} = \frac{F_e \cdot c^2 \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}}{f_{0R} \cdot h}$ (3.4) in the first two equations and move the h to the other side in each equation, we obtain the equation for the energies: $\frac{df_R}{dt} \cdot h = \frac{df_1^+}{dt} \cdot h - \frac{df_2^+}{dt} \cdot h$ (3.5).

Here we see the energy-shift from f_2^+ to f_1^+ at which a net change of the energy of R arises, which is made possible by the exchange of energy between R and the field of S. The energy-shift from f_2^+ to f_1^+ is, as we know, independent of f_{0R} , but it is proportional to F_e , what means that it is proportional to the strength of the field of S, which changes with r^{-2} . So the energy-shift from f_2^+ to f_1^+ is proportional to the quantity of energy which can be exchanged between the field of S and R.

So, the changes of the frequencies show us how the energies of R change.

Next, we consider the changes in the wavelengths of R belonging to the frequency-changes and thus also to the energy-shifts.

The changes of the wavelengths of R show us the meaning of f_{0R} .

It is: $\lambda_1^+ = \frac{\lambda_{0R} \cdot (c - v_{R(t)})}{c \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}} \Rightarrow \frac{d\lambda_1^+}{dt} = -\frac{\lambda_{0R} \cdot a_{(t)}}{(c + v_{R(t)}) \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}}$ (3.6), and

$$\lambda_2^+ = \frac{\lambda_{0R} \cdot (c + v_{R(t)})}{c \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}} \Rightarrow \frac{d\lambda_2^+}{dt} = +\frac{\lambda_{0R} \cdot a_{(t)}}{(c - v_{R(t)}) \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}} \quad (3.7).$$

We see here that the change rates of the wavelengths (which result from the gradient of $\lambda_{(v)}$) have the same functions as the change rates of the frequencies, if they are calculated relativistically. (If they are calculated non-relativistically, the middle frequency changes due to $v_{R(t)}$ but the middle wavelength doesn't change.)

Correspondingly it is: $\frac{d\lambda_R}{dt} = \frac{a_{R(t)} \cdot \lambda_{0R} \cdot v_{R(t)}}{(c^2 - v_{R(t)}^2) \cdot \sqrt{1 - \frac{v_{R(t)}^2}{c^2}}}$ (3.8).

By inserting (3.4) (that is $a_{R(t)}$) into (3.6), (3.7), and (3.8), and with $c = f_{0R} \cdot \lambda_{0R}$ we get:

$\frac{\frac{d\lambda_1^+}{\lambda_{0R}}}{dt} = -\frac{F_e \cdot c^2}{(c + v_{R(t)})} \cdot \frac{1}{f_{0R} \cdot h}$ (3.9), $\frac{\frac{d\lambda_2^+}{\lambda_{0R}}}{dt} = +\frac{F_e \cdot c^2}{(c - v_{R(t)})} \cdot \frac{1}{f_{0R} \cdot h}$ (3.10), and $\frac{\frac{d\lambda_R}{\lambda_{0R}}}{dt} = \frac{F_e \cdot c^2 \cdot v_{R(t)}}{(c^2 - v_{R(t)}^2)} \cdot \frac{1}{f_{0R} \cdot h}$ (3.11).

The $\frac{d\lambda}{\lambda_{0R}}$ are the relative wavelength-changes. This is nothing else but a length-change which is independent of the wavelength. So a length-shift from λ_2^+ to λ_1^+ takes place (due to the acceleration which the field of S causes at R). Of course this length-shift represents a space-shift since λ_2^+ and λ_1^+ are waves of space. The energy of the rest mass of R is given by $f_{0R} \cdot h$ and is stored in the space. So the $f_{0R} \cdot h$ shows the magnitude of the energy *density* of the space. (The grater f_{0R} is, the greater is the energy.) We see in (3.9), (3.10), and (3.11) that the length-shift is inversely proportional to $f_{0R} \cdot h$. So the length-shift, which represents a space-shift, is inversely proportional to the energy density which corresponds to the f_{0R}. This means that the *energy-shift is independent of* f_{0R}. A given field of S always shifts, at a certain place, the same quantity of energy independently of f_{0R}. This confirms the conclusions from (3.5). And, here too, there is a space-shift between the field of S and R which is seen in $\frac{d\lambda_R}{\lambda_{0R}}$.
It is particularly interesting that the space-shift from λ_2^+ to λ_1^+ corresponds to an energy-shift. Changes in energy are, after all, also in the case of electrical forces changes of mass. Thomson had already recognized (1881) the equivalence of electromagnetic energy and mass (but had calculated it non-relativistically) [35]. But Einstein recognized the general equivalence of energy and mass [36].

Let us now consider the importance of the fact that the normal- and the counter-field of S move with the speed of light for the energy-changes of R.
Due to the force of the field of S the energy of R changes. This happens by the exchange of energy between the field of S and R. This means that the energy of the field of S also changes. The changes of the energy of R *and* S are seen in the change of the common field of R and S, which corresponds to the motions of R and S.
The frequencies of the waves of S (these are the normal-wave (f_{NS}) and the counter-wave (f_{CS})) appear in none of the equations for the electric forces since at first they only have meaning for the gravitation and the inertia (which is natural since they are mass-frequencies).
The electric force on R consists of the forces which arise from the normal- and the counter-wave of S: $F_e = F_{Ne} + F_{Ce}$.
The exchange of energy, which happens due to these forces, takes place with each the normal- and the counter-wave of S.
Energy is a force multiplied by a displacement ($dE = F_{(r)} \cdot ds$). The displacement is that displacement which is covered in the direction of the force relatively to the field. The fields of the normal- and counter-wave of S propagate with LS. The displacement, which results from the LS (relative to R), must be counted at the exchange of energy (between the field and R) as a regular displacement.
With a charge resting in the field of S no (net-) exchange of energy takes place (the forces on this charge are in equilibrium). This is explained by the opposite directions, into which the normal- and counter-field propagate. When the direction in which the field propagates is oppositely to the direction of the force, then the field adds energy to the charge (that is R). When the field and the force have the same direction, then the field takes away energy from the charge. For $v_R = 0$ the relative velocity to each the normal- and counter-field is the LS. So the displacement which the normal- and the counter-field cover within the same time-period relative to R is equal. Therefore the sum of the added and the subtracted energy (for $v_R = 0$) is *always* zero. So: $F_{Ne} \cdot c_N \cdot \Delta t - F_{Ce} \cdot c_C \cdot \Delta t = F_e \cdot v_R \cdot \Delta t \Rightarrow F_{Ne} \cdot c_N - F_{Ce} \cdot c_C = 0$.
So we see that at the centre of R, this is M_R, an energy-shift takes place between the normal- and the counter-field of S. But at this the fields of S don't change since they immediately exchange their energies at M_R between each other again.
A velocity v_R of R can produce an additional displacement ΔS in a parallel direction to F_e. By this, the displacement which the one of the fields of S covers relatively to R increases by ΔS, and the displacement of the other field decreases by ΔS. So there is a difference of the displacements between the two fields of S of $2 \cdot \Delta S$ - with respect to the displacement relative to R.
The energy of a field corresponds to its force ($\frac{dE}{dS} = F \propto \frac{1}{r^2}$). For a motionless S, the force of the normal-field is *equal* to that of the counter-field, so each is half the electrostatic force ($1/2 \cdot F_e$.) Since the displacements of the normal- and the counter-field have opposite directions while the forces have the same directions, opposite signs must be assigned to the forces of the normal- and the counter-field. So, for the two

fields of S, a difference of energy results - according to the difference of the displacements - of $\frac{1}{2}\cdot F_e\cdot\Delta S - \frac{1}{2}\cdot F_e\cdot\Delta S = F_e\cdot\Delta S$ (the signs are given from the signs of F_e and ΔS). This is the net energy which R exchanges with the total field of S (which is the sum of the normal- and the counter-field).
So we know the quantity of the energy which R exchanges altogether with the two fields of S. It results by the fact that the one field of S transmits more energy to R, than the other field can absorb. Only in the case that $v_R = 0$, and therefore $\Delta S = 0$, this equalizes to zero. Then the relative velocity between each field of S and R is LS. In case a ΔS arises from a v_R , a net energy results. But this net energy cannot simply be assigned half to the one field of S and half to the other. Rather the quantity of energy which the respective field of S exchanges with R arises from the relative velocity between the field and R. This means that the ratio of the energies corresponds to the ratio of the velocities. The ratio of the energies arises from the energy which a field of S exchanges with R to the energy which actually stays with R. So for the normal- field of S it is: $\frac{1/2\cdot F_e\cdot(\vec{c}_N - \vec{v}_R)\cdot\Delta t}{\vec{F}_{Ne}\cdot v_R\cdot\Delta t} = \frac{c_N}{v_R} \Rightarrow \vec{F}_{Ne} = \frac{1}{2}\cdot\frac{F_e}{c}\cdot(\vec{c}_N - \vec{v}_R)$ (3.12). And correspondingly for the counter-field: $\vec{F}_{Ce} = -\frac{1}{2}\cdot\frac{F_e}{c}\cdot(\vec{c}_C - \vec{v}_R)$ (3.13). And because for the normal- and counter-field always $\vec{c}_N = -\vec{c}_C$, it is:

$$F_e = F_{Ne} + F_{Ce} \Rightarrow F_e = \frac{1}{2}\cdot\frac{F_e}{c}\cdot(c - v_R) + \frac{1}{2}\cdot\frac{F_e}{c}\cdot(c + v_R) = \frac{1}{2}\cdot\frac{F_e}{c}\cdot 2\cdot c = F_e .$$

We recognize here that the force of the normal- and the counter-field of the S on the R depends on the velocity v_R of the R, while the resultant total force *isn't* velocity-dependent.

As I have already described, the energy which is exchanged between S and R causes a proportional energy-shift at R between f_2^+ and f_1^+ and between f_2^- and f_1^-. Due to the velocity-dependence of the F_{Ne} and F_{Ce} , the energy-shifts at R change correspondingly. The sum of all the energy-shifts at the normal- and counter-waves of R remains independent of v_R , which can be shown by (3.3). For the force which arises from the normal-field of S it is: $\frac{df_{RN}}{dt} = \frac{F_{Ne}}{h}\cdot\frac{v_R}{\left(1-\frac{v_R^2}{c^2}\right)}$. And for the counter-field of S it is:

$\frac{df_{RC}}{dt} = \frac{F_{Ce}}{h}\cdot\frac{v_R}{\left(1-\frac{v_R^2}{c^2}\right)}$. And the sum is: $\frac{df_{RN}}{dt} + \frac{df_{RC}}{dt} = \frac{F_e}{h}\cdot\frac{v_R}{\left(1-\frac{v_R^2}{c^2}\right)}$.

Of course the electric force is also proportional to the electric charge of R. Correspondingly, the quantity of energy which is shifted by the influence of S at R is also proportional to the electric charge of R.

The changes of the frequencies of R are independent of f_{0R} . And the frequency of S doesn't play a role either. It is as if the frequencies of the masses are insignificant. But, of course, the frequency corresponds to the energy of a mass, including the kinetic energy. In addition, the frequencies of the positive and negative waves of a mass correspond to the velocity of the mass.

4. Gravitation

According to (3.1) and (3.2) and to the nomenclature of the electric force we get for a wave of R which moves towards S: $\frac{df_2}{dt} = \pm\frac{a\cdot f_{0R}}{(c \mp v_R)\cdot\sqrt{1-\frac{v_R^2}{c^2}}}$ (4.1). And according to (3.6) and (3.7):

$\frac{d\lambda_2}{dt} = \pm\frac{a\cdot\lambda_{0R}}{(c \mp v_R)\cdot\sqrt{1-\frac{v_R^2}{c^2}}}$ (4.2). The same equations also apply to a wave of R which moves away of S (that is to $\frac{df_1}{dt}$ and $\frac{d\lambda_1}{dt}$).

At gravitation, a is the gravitational acceleration: $a = g = \frac{m_S\cdot G}{r^2}$. And: $m_S = \frac{f_{0S}\cdot h}{c^2\cdot\sqrt{1-\frac{v_S^2}{c^2}}}$. Therefore:

$g = \frac{f_{0S} \cdot h \cdot G}{c^2 \cdot r^2 \cdot \sqrt{1 - \frac{v_S^2}{c^2}}}$ (4.3). Inserting (4.3) into (4.1) and (4.2) yields:

$$\frac{df_2}{dt} = \pm f_{0R} \cdot f_{0S} \cdot \frac{h \cdot G}{(c \mp v_R) \cdot \sqrt{1 - \frac{v_R^2}{c^2}} \cdot c^2 \cdot \sqrt{1 - \frac{v_S^2}{c^2}} \cdot r^2} \Rightarrow \frac{df_2}{dt} = \pm f_{0R} \cdot f_{0S} \cdot K_v \text{ (4.4), and}$$

$$\frac{\frac{d\lambda_2}{\lambda_{0R}}}{dt} = f_{0S} \cdot \frac{h \cdot G}{(c \mp v_R) \cdot \sqrt{1 - \frac{v_R^2}{c^2}} \cdot c^2 \cdot \sqrt{1 - \frac{v_S^2}{c^2}} \cdot r^2} \Rightarrow \frac{\frac{d\lambda_2}{\lambda_{0R}}}{dt} = f_{0S} \cdot K_v \text{ (4.5).}$$

First we see that the $\frac{df_2}{dt}$ is proportional to f_{0R}, for a given v_R which is included in K_v. So the change of the frequency of a wave of R is proportional to the rest mass of R. This is so because the gravitational acceleration is independent of the mass.
We then see that the relative change of the wavelength $\frac{d\lambda_2}{\lambda_{0R}}$, which is the change of the length, is independent of λ_{0R}. This means that every wave always changes proportionally to its length. This manner of the change of the length is equivalent to a stretching or compression of the space of R in the direction of the change of the length.
At a stretching or compression of the length, the change of the frequency (that is $\frac{df_2}{dt}$) is automatically proportional to f_{0R}. Because, while the number of the waves remains the same for a certain section, the length of this section, which of course moves with LS, changes. This means that the time-period for these waves changes (therefore it also changes per wave) and therefore the frequency also changes. Thus the frequency changes proportionally to the number of the waves for a given section (a given length).

This type of the changes of the frequencies and the wavelengths of R can be explained plausible.
We have seen in the previous chapter on the electric force that mass is stored electric energy. So this energy is stored in the space. The space-density changes with r^{-2}. So for the *energy-density* (D_S) of the stored electric energy of the field of a source S it is: $D_S = \frac{K_{DS}}{r^2}$ (4.6), were K_{DS} is the density-coefficient for S.
The exact value for K_{DS} isn't clear yet. It is certain that K_{DS} is proportional to the mass therefore also to f_S of S ($K_{DS} \propto f_S$).
At the emergence of a wave of R at the place M_R this wave propagates with LS (c_R). This wave of R can move towards S or away from S.
When a wave of R moves towards S, then it moves into an area with a higher energy-density of S. At this the energy-density of the wave of R will also increase proportionally, which means that its frequency increases and its wavelength decreases, which corresponds to a *compression*.
But such a compression *doesn't* arise by the fact that e.g. the nodal points of a wave of R are shoved together. The wavelength of R rather changes by the *superposition* with the wave of S so that a *new* wave is made, with the *new* wavelength.
A wave of R which moves away from S is stretched correspondingly.
At this way of the change of the wavelength, which is a stretching or a compression, it does not matter at all whether a wave of R is positive or negative (according to the nomenclature of the previous chapter). Only and alone the relative direction of motion to S is relevant. This must be so since gravitation is always attractive while the electric force can be attractive or repulsive. And the change of the electric energy-density with r^{-2} satisfies exactly these conditions.

Equation (4.5) shows that the change of the length ($\frac{d\lambda_2}{\lambda_{0R}}$) of R is proportional to f_S. This is so because the energy-density of the field of S is proportional to f_S. And, of course, the *change* of the density is proportional to the density. And thus the change of the length of R is also proportional to the density, therefore to f_S.

We can assign a potential (Φ_{DS}) to the electric energy-density of the field of S: $\Phi_{DS}=\frac{K_{DS}}{r}$. The change of the length ($\frac{d\lambda_2}{\lambda_{0R}}$) of R is then calculated from the potential difference for the height H :

$\Delta\Phi_{DS}=\frac{K_{DS}\cdot H}{r^2\cdot\left(1+\frac{H}{r}\right)}=K_\lambda\cdot\frac{\Delta\lambda_2}{\lambda_{0R}}$ (4.7). K_λ is a proportionality constant, which would have to be found out in dependence of K_{DS} . And for $\frac{K_{DS}}{K_\lambda}=K_G$ (4.8) follows: $\frac{\frac{d\lambda_2}{\lambda_{0R}}}{H}=\frac{K_G}{r^2}\cdot\frac{1}{\left(1+\frac{H}{r}\right)}$. And for $H\rightarrow 0$ we get:

$\frac{\frac{d\lambda_2}{\lambda_{0R}}}{dr}=\frac{K_G}{r^2}=D_{GS}$ (4.9). The D_{GS} corresponds to the gravitational acceleration at a position in the field of S ($D_{GS}\propto g_S$).

So gravitation is an electric phenomenon, however, the emergence mechanism is a completely different one than at the electric force. We primarily see this at the differences of the $\frac{df}{dt}$ and $\frac{d\lambda}{dt}$ between the electric force and the gravitational force.

At the electric force, an energy-shift takes place between the waves of R - in which the interchange of energy with the field of S is proportional to the relative velocity between the field of S and R. So the motion of the field of S with LS (c_S) is of decisive importance.

The nature of gravitation is a completely different one. Gravitation arises due to the stretching and compression of the waves of R, therefore due to changes of the lengths. And these changes of the lengths arise from the motions of the waves of R with c_R relative to the change of the density of the field of S. So it is all about the motion of the waves of R with c_R .

Naturally, the gravitational acceleration also changes the frequencies of the waves of R in and opposite to the direction of motion in an opposite manner, which results in the same energy-shifts as in the case of the electric force. However, the energy-shifts of the electrical forces are not caused by density-changes, but by the superposition of the waves of S and R.

For the gravitation it makes sense to express the changes of the frequencies of R in reference to the gravitational potential.

For $v_R\ll c$ it is: $\frac{1}{2}\cdot m\cdot v_R^2=m\cdot g_S\cdot H\ \Rightarrow\ v_R=\sqrt{2\cdot g_S\cdot H}$ (4.10) (H = height difference).

Inserting (4.10) into (2.3) and (2.4) yields: $f_{1(H)}=f_{0R}\cdot\frac{\sqrt{c^2-2\cdot g_S\cdot H}}{(c-\sqrt{2\cdot g_S\cdot H})}$ and $f_{2(H)}=f_{0R}\cdot\frac{\sqrt{c^2-2\cdot g_S\cdot H}}{(c+\sqrt{2\cdot g_S\cdot H})}$.

The Taylor series yields: $f_{1(H)}=f_{0R}\cdot\left(1+\frac{\sqrt{2\cdot g_S\cdot H}}{c}+\frac{g_S\cdot H}{c^2}\ \cdots\right)$ and

$f_{2(H)}=f_{0R}\cdot\left(1-\frac{\sqrt{2\cdot g_S\cdot H}}{c}+\frac{g_S\cdot H}{c^2}\ \cdots\right)$.

Therefore: $\frac{f_{1(H)}+f_{2(H)}}{2}\approx f_{0R}+f_{0R}\cdot\frac{g_S\cdot H}{c^2}\ \Rightarrow\ \Delta f_{(H)}\approx f_{0R}\cdot\frac{g_S\cdot H}{c^2}$.

This corresponds to the value which the GRT delivers for EMW [23] (which shows that the considerations made here should be not quite wrong).

Of course, we can also directly develop (2.7) according to Taylor:

$$f_{(H)}=f_{0R}\cdot\frac{1}{\sqrt{1-\frac{2\cdot g_S\cdot H}{c^2}}}\ \Rightarrow\ f_{(H)}=f_{0R}\cdot\left(1+\frac{g_S\cdot H}{c^2}+\frac{3\cdot g_S^2\cdot H^2}{2\cdot c^4}\ \cdots\right)\ \Rightarrow\ \Delta f_{(H)}\approx f_{0R}\cdot\frac{g_S\cdot H}{c^2} .$$

So the middle frequency of mass-particles changes due to gravitation exactly as the EMW change in accordance with the GRT. This means that the EMW consist of the same counter-moving space-time waves as the mass-particles. But in difference to the mass-particles, the EMW and also the photons don't have any centre at which the energy-shifts of the electric force could take place so that there are no electric forces on EMW.

A photon arises from the relatively complex superposition of the different space-time waves of the positive and negative electric charges. The harmonic components of a photon can be calculated by a Fourier analysis. At a laser, many single photons overlap to an EMW. This EMW is homogeneous (in the context of the technical possibilities) and it doesn't make sense to imagine that it consists of single photons. Also e.g. a radio wave doesn't consist of single photons. The maximum quantity of energy which an EMW can pass on to a mass-particle rather corresponds to the quantity of energy of a mass-particle which has the same middle frequency as the EMW. So a quantum of an EMW corresponds to the energy of a mass-particle which has the same middle frequency as the EMW.

The reason for this behaviour of an EMW is that an EMW causes at a mass-particle the same oscillations as (another) mass-particle by a collision (I cannot prove this yet, though). In this context, we shall not forget that a collision between mass-particles, which are by nature space-time waves, proceeds considerably more complicated than between two firm objects (such as billiard balls).

The maximum shock of an EMW corresponds to a mass-particle with the same middle frequency (which is velocity-dependent) loosing its complete energy, including its rest energy.

In the chapter "Mass as a wave" we see how a particle behaves as a wave. Here we see how a wave behaves as a particle.

So gravitation results from the change of the density of the mass-energy of the field of a neutral mass (the source). And the changes of the frequencies which arise if a mass (this is then R) is moved by gravitation match the GRT.

A task for future works will be to find the connection between the space-time values of the waves of the masses (from which the density of the stored electric-energy arises) and the space-time values of the GRT (the so-called curved space-time).

5. The magnetic force

On the one hand, we see the duality of the electric field, which consists of the normal- and counter-field. In addition, we see at the energy considerations to the electric force that the force of the normal- and counter-field depends on the velocity v_R of R. In this chapter I show how the magnetic force results from these two qualities of the electric field.

For a resting R, the force of the respective field of S on R results from the LS of this field. For a R, which has a v_R in a parallel direction to the force, the force changes by the magnitude of the v_R. So the force is proportional to the relative velocity (v_{rel}) between R and the respective field of S. This statement shall be generally valid now: Every v_R of R always produces *independently of its direction* its own force. The magnitude of this force is calculated according to the equations (3.12) and (3.13) for the normal- and counter-field: $+\frac{1}{2}\cdot F_e\cdot\frac{v_R}{c}$ and $-\frac{1}{2}\cdot F_e\cdot\frac{v_R}{c}$. For a motionless S, the sum of the forces which arise from the normal- and counter-field is zero.

So the v_{relR} between the field of S and R determines the force on the R. In the same way the v_{relS} between the field of S and the centre of S determines the strength of the field of S. The grater the v_{relS} is, all the stronger the field is. So, for a velocity v_S of S, the strength of the normal- and counter-field results each from: $+\frac{1}{2}\cdot\frac{q_S}{r^2}\cdot(\vec{c}_N-\vec{v}_S)$ and $-\frac{1}{2}\cdot\frac{q_S}{r^2}\cdot(\vec{c}_C-\vec{v}_S)$, were q_S is the charge of S, and $\vec{c}_N$ and $\vec{c}_C$ are the LS of the respective field.

By the component of the v_S which is parallel to the $\vec{c}_N$ and $\vec{c}_C$ (this is $v_{S\parallel}$), the normal- and counter-field are changed exactly oppositely so that the corresponding (additional) forces on R cancel each other exactly. So the $v_{S\parallel}$ doesn't has to be further taken into account.

From the component of the v_S which is vertical to the $\vec{c}_N$ and $\vec{c}_C$ (this is $v_{S\perp}$), an angle φ_S results between the propagation direction of the field and the direction in which the field exerts its force. This angle is calculated by: $\tan(\varphi_S)=\frac{v_{S\perp}}{c_{N,C}}$. In Figure 2, the force on a motionless R is represented, if a $v_{S\perp}$ is given ($v_{S\parallel}$ is left out, as said).

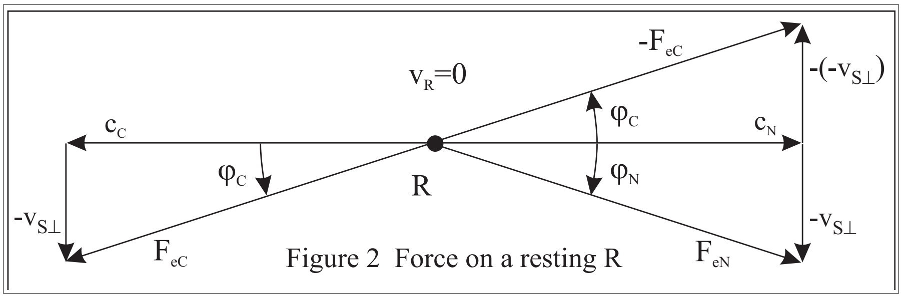

Figure 2 Force on a resting R

The F_{eN} and F_{eC} are the forces which arise from the normal- and counter-field, and φ_N and φ_C are the angles by which the F_{eN} or F_{eC} are turned around starting at $\vec{c}_N$ or $\vec{c}_C$. The additional forces, which arise from the $v_{S\perp}$, cancel each other out (as in the previous case), so that the sum of the forces on R is F_e.

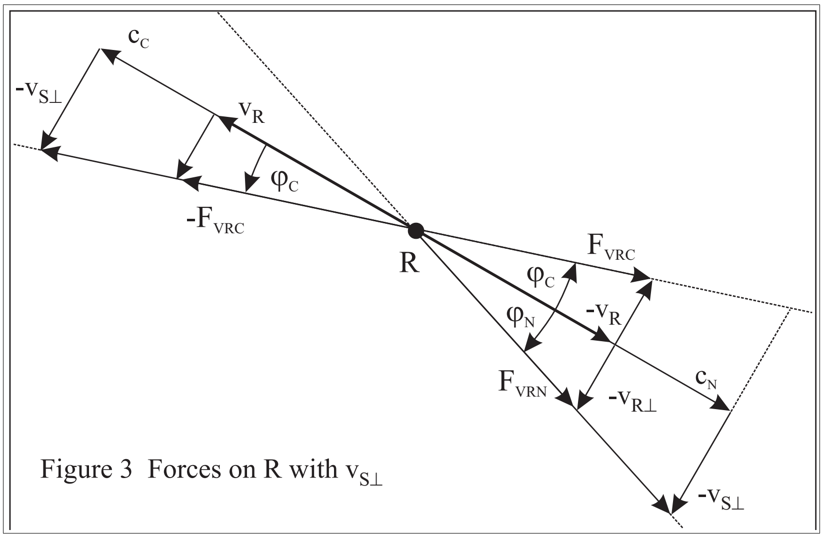

Figure 3 Forces on R with $v_{S\perp}$

We see that the force, which the normal- and counter-field exert on a resting R, changes due to the $v_{S\perp}$, with respect to the direction and the magnitude. Exactly the same change also happens to the force which arises from the v_R. The force F_{VR}, which arises from the v_R, is in addition to the force on a resting R, and this additional F_{VR} behaves exactly proportional to the force on the resting R. The change of the normal- and counter-field by the $v_{S\perp}$ also changes the F_{VR} exactly proportional.

In (3.12) and (3.13), we see that the F_{VR} has the direction of the $-\vec{v}_R$. In addition, the force which the v_R produces due to the normal-field (F_{VRN}) is turned around by the angle φ_N starting at $-\vec{v}_R$, and the force which arises due to the counter-field (F_{VRC}) is turned around by φ_C starting at $-\vec{v}_R$, in which, of course, the actual force due to the counter-field is $-F_{VRC}$, as represented in Figure 3.

The $-v_S$ produces a force in addition to the force which arises from c_N or c_C. The $-v_{S\perp}$ produces an additional force which is perpendicular to c_N or c_C. Correspondingly, the F_{VRN}, too, consists of one component which corresponds to the $-\vec{v}_R$, and one component which is vertical to $-\vec{v}_R$, which therefore corresponds to $-v_{R\perp}$ (see Figure 3). According to the proportionality, the magnitude of the vertical component can be calculated: $\frac{1}{2}\cdot\frac{F_e}{c}\cdot\frac{v_{R\perp}}{v_R}=\frac{1}{2}\cdot\frac{F_e}{c}\cdot\frac{v_{S\perp}}{c} \Rightarrow v_{R\perp}=\frac{v_R\cdot v_{S\perp}}{c}$.

The forces which correspond to the $-v_R$ are exactly equally opposing forces at the normal- and counter-field, and so they cancel each other out.

The fact, that the normal- and the counter-field produce due to the v_R opposite forces corresponds to a multiplication by -1. With respect to the angle φ_C the multiplication by -1 corresponds to a turn by 180°. This means, that the forces which are vertical to $\vec{v}_R$ and which arise from the normal- and counter-field have the same direction. So their magnitudes add up to the total force:

$\frac{1}{2}\cdot\frac{F_e}{c}\cdot\frac{v_R\cdot v_{S\perp}}{c}+\frac{1}{2}\cdot\frac{F_e}{c}\cdot\frac{v_R\cdot v_{S\perp}}{c}=\frac{F_e}{c}\cdot\frac{v_R\cdot v_{S\perp}}{c}$. The direction of this force results from the angle φ_N between the $-\vec{v}_R$ and $\vec{F}_{VRN}$, or from the angle φ_C between the $+\vec{v}_R$ and $-\vec{F}_{VRC}$. In addition, F_e is negative at opposite charges (of S and R).

The force determined here corresponds exactly to the magnetic force F_M. Therefore: $F_M = F_e \cdot \frac{v_R \cdot v_{S\perp}}{c^2}$.
So the F_M can be calculated directly by the F_e and the velocities of the S and R. It is not necessary to calculate the magnetic field or the cross product from v_R and the strength of the magnetic field.
For the calculation of the magnetic force of e.g. a straight, current-carrying conductor with the homogeneous charge density λ on a point charge q_R, the electric force is calculated under consideration of $\frac{v_R \cdot v_{S\perp}}{c^2}$. The $v_{S\perp}$ results from the v_S so that the integration yields: $F_M = q_R \cdot \frac{v_R \cdot v_S}{c^2} \cdot \frac{\lambda}{8 \cdot \varepsilon_0 \cdot R_p}$, were R_p is the plumb line from q_R to the conductor.

We see here *what* the magnetic field is: it is the angle φ_N of the normal-field in combination with the angle φ_C of the counter-field. So we gain a better understanding of the magnetic force. Of course, all previous cognitions on the magnetic force remain unchanged. This also applies to the SRT. The angles φ_N and φ_C depend on the observer in accordance with the SRT, which includes the constancy of the LS. So, e.g., for an observer, for whom S rests, $\varphi_N = \varphi_C = 0$.
The magnetic fields of the EMW also have the angles φ_N and φ_C. EMW are complex superpositions of normal- and counter-waves. But always when the electric field is the smallest, the speeds of the charges, which produce the EMW, are the highest so that the φ_N and φ_C are the greatest. And, always when the electric field is the greatest, the speeds of the charges and therefore also φ_N and φ_C are the smallest. From this finally the motto of the electrodynamics results: a changing electric field produces a magnetic field and vice versa. Maxwell's equations [37-39], which remain untouched of the cognitions of this work, are based on this motto. Maxwell's equations describe charge-shifts in a general (and mathematically elegant) way. Due to charge-shifts the electric fields change and from the motions of the charges connected with that the angles φ_N and φ_C are made, that is, magnetic fields are made.
In short: the magnetic field is no field of its own but a quality of the electric field.

6. Space and time

The SRT and the GRT show us that space and time are not absolute. From the GRT, space-time waves can be derived. And the matter-waves show us now that mass consists of counter-moving space-time waves.
Thus, mass and force fields consist of changing space-time. Therefore, in the end, the complete reality of physics is made of changing space-time.
Space and time are the most basic elements of physics. The space itself doesn't exist, though. A completely homogeneous space doesn't have any reality in our perception. Only the changes of the space cause reality, such as an oscillation. Time is the comparison of changes. Thus, time arises together with the changes of the space.
The space-time waves of a mass correspond to an energy - this means that the space-time of an object can change the space-time of another object. The superposition of a space-time with another space-time yields a new space-time with new parameters. However, a simple additivity cannot be presupposed at the superpositions of the space-time (it may be more complex). The exact space-time values of various objects and their changes must be determined in future works. I did a first attempt in this direction with the "Objects of Space" [33] long time ago, but still a long way has to be gone.

The constancy of the LS arises because time is the comparison of the changes of space. At a wave, the change of the space corresponds to the wavelength. The larger the wavelength is, all the slower the change is, all the smaller the related time is. The quotient is constant and corresponds to the LS. Thus the constancy of the LS results because the changes of the space define the time itself.
So the constancy of the LS is a very special phenomenon since it is directly connected to the space-time. The LS changes by the gravitation (in dependence of the observation location), which shows that the gravitation changes the space-time.

The emergence of photons and EMW generally requires a complicated superposition, so the question arises, why EMW are ubiquitous. Partly, this can be explained from the ability of photons to excite the emergence of other photons, as it is known from lasers. On the other hand, there are superpositions of space-time of every kind that take place incessantly. So the space around us should be filled up with space-time patterns of every kind in an inconceivable extent. But we cannot be aware of this grate variety since all this space-time patterns do not interact with the matter perceptible to us. In this context, the so-called dark energy could be the view through a keyhole into a reality till now unknown to us, or it is only the echo of a loud roaring. Here then, photons would be relatively rare. (The idea that there could be connections between the realities is breathtaking.)

Due to the continuing superpositions of the space-time the complexity of the space-time structures may increase continuously. This increase of the complexity can be equivalent to a continuing new creation of space. But this newly created space does not expand outward (as a gas), the expansion takes place on-site. This means that the space of a space area expands into itself, while, seen from outside, it keeps its size. In this way the observable universe can expand into itself. So the enlargement of the universe doesn't take place only by an outward expansion but perhaps also by an expansion into itself. For the famous Hubble redshift [40] of the light of the stars this is all the same.

The cognition that mass is a space-time wave provides a surprisingly simple but also daring explanation for the *entanglement* of photons and mass particles [41-46]. Till now, I thought that the changes of the frequency of a mass spread with LS, starting of its centre. However, a space-time wave can, in principle, change in its entire length *simultaneously*. In this way the frequency of the wave of a mass can change in its entire extension simultaneously, just in the moment when the frequency changes in the centre of the mass. Such a behaviour would not influence the speed of the centre in any way so that the constancy of the LS would remain true. There are no contradictions to the other contents of this work either.
Furthermore, it is possible that one and the same wave has not only one but two (or more) centres. For photons, these would be two (or more) locations with maximum amplitude. By modifying *one* of the locations with the maximum amplitude, the other location would *simultaneously* change as described above. However, the amplitude decreases very rapidly as the distance increases. The energy at the counterpart can therefore only change very little (practically not at all). But energy-independent properties may change at the counterpart (such as the polarization). Here, the almost mysterious phenomenon of entanglement is surprisingly plausible.

Protons can combine to form an atomic nucleus. I have described that protons as well as electrons and neutrons consist of very many positive and negative elementary charges which form the neutral mass. When two protons get very close, the neutral mass between them forms two negative charges, producing a neutral structure which is a neutral mass. At the same time, a place with two positive net charges is formed in the area of the now double neutral proton mass. Obviously, the neutral mass must only be grate enough to allow the existence of two net charges in a particle. Accordingly, in the case of larger atomic nuclei, the neutrons provide a sufficiently large neutral mass. Electrons, on the other hand, are very difficult to combine because their neutral mass is much smaller.
Presumably the atomic nucleus is a very dynamic place, where complex wave patterns are continuously changing in continuing motion. In the collisions in particle physics, the most diverse fragments of the positive, negative, and neutral mass can arise, and the resulting wave patterns are often very short-lived. Nevertheless, the particle physicists repeatedly find the same components, which shows that the collisions are based on regularities.

7. Conclusion

The electric force, the gravitational force and the magnetic force follow all three the inverse-square law (r^{-2}). This suggests a common emergence mechanism. But, we've seen that all three forces have different causes. The electric force is a space-shift caused by a field at a charge, the gravitational force is a result of the change in the density of the energy of the electric field, and the magnetic field is the angle between the direction in which the electric field propagates and the direction in which it exerts its force.
We see that all three forces result from different qualities of the energy field of the mass. The basis for this is the representation of the mass as the superposition of two counter-moving space-time waves, whereby the mater waves, as already recognized by DeBroglie, and the inertia of the mass are automatically explained. But above all, we now understand the nature of the three forces and the connections between them better. This will surely help us to find new phenomena. So, e.g., it has to be expected that the effects of the velocities of the masses on their frequencies will also have effects on gravitation. It will also soon be possible to calculate superpositions and superposition patterns of space-time waves. This could be interesting for particle physics and for quantum phenomena, but also for the EMW, which are known to yield virtual electron–positron pairs in the presence of strong magnetic fields [47, 48]. On the other hand, we now also understand why the search for anti-gravitation has yielded no results so far.
Of course, it will be necessary to find the space-time parameters of the space-time waves. I am already working on this, but that is still a long way to go.

I find it specially interesting, even if it is perhaps only philosophical, to realize that everything around us *consists only of space*, and also we ourselves are only made up of space. And our existence, the divine spark, if we will, arises by the differences in the length- and time-parameters of the space, which also result in the space-time waves.

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