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The electromagnetic origin of gravity

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Abstract
Under the condition of the expansion of the universe and all masses with their charges in it, the electromagnetic origin of the gravitational force is determined with the help of the Lorentz force. Basicphysical relations to the interactions of the basic forces of nature are established. This includes calculation formulas for the gravitational constant, the proton radius and the age of the universe.

Keywords: Gravitation, Gravitational force, Fundamental forces, Fundamental interactions

1. Introduction

In the publication "The cause of gravity" [1.] the gravitational force between two masses was investigated with three methods independent of each other: 1. mechanically according to Newton with inclusion of entropy constancy and of time dilation, 2. electromagnetically according to the Coulomb law which follows from Maxwell's equations and 3. quantum-physically as radiation phenomenon which could be described with the one-dimensional Stefan-Boltzmann law.

In the publication "The Unification of the Fundamental Interactions" [2.] essential physical relations between the fundamental forces and their coupling constants were published. Strict mathematical relations between the microcosm and the macrocosm of nature were found.

In the publication "The Wave Resistance of the Vacuum" [3.] it could be shown by a simple theoretical experimental arrangement that between magnetic monopoles, if they could exist in space, the same force would prevail as between electric charges.

In this paper, the electromagnetic origin of gravity is to be demonstrated.

2. The displacement currents during the expansion of the universe

With the growth of the universe all masses grow spatial with their charges. This concerns both the electric and the magnetic charges. It is assumed here that there are not only electric but also magnetic elementary charges in the atoms. The magnetic elementary charges cannot exist in the space as free charges, since they presumably form the time and are thus in another dimension. The increase of all charges during the expansion of the universe causes both electric and magnetic displacement currents, because all charges are distributed to larger volumes. The displacement current is not a current in which a charge is transported. It corresponds to the change of the electric or magnetic flux. The calculations made here with their correct and observable results show that the displacement current, which is modelled in figures 1 and 2, always has a defined spatial direction. The current is perpendicular to the axis of motion of the two masses which fall on each other from assumed rest due to the gravitational effect. This uniform direction of the displacement current is directly related to the uniform direction of time, which is perpendicular to the three spatial dimensions and runs from the past into the future.

While the masses are only in their rest positions, they will move on their axis of motion and collide in the future. The displacement current is probably caused by the time which constantly releases information and which grows with the expansion of the universe. There always exists a pair of displacement currents with

defined direction each, which are perpendicular to each other, an electric and a magnetic one. During the expansion of the universe, the magnetic displacement current gives rise to the time $t = \vec{Q}_{mg}/\vec{I}_{v\,mg}$, while during the contraction of the universe, the electric displacement current gives rise to $t = \vec{Q}_{el}/\vec{I}_{v\,el}$. The displacement current generates the magnetic fluxes $\vec{B}_1$ and $\vec{B}_2$ during the expansion of the universe in the region of masses m_1 and m_2 (Figure1) and the electric fluxes $\vec{D}_1$ and $\vec{D}_2$ during the contraction of the universe in the region of masses m_1 and m_2 (Figure2). The fact that only closed magnetic field lines are observed in space is due to the fact that the magnetic charges form the time and thus the charges remain hidden as sources of the field. The time can be imagined during the expansion of the universe as magnetic elementary charges strung together and during the contraction as electric elementary charges strung together. The electric and magnetic charges are shifted, but they remain in the area of the masses. As a fourth dimension, time cannot be additionally represented in Figures 1 and 2, where 3-dimensional modeling has been done. The displacement currents $\vec{I}_{v\,el}$ and $\vec{I}_{v\,mg}$ are accompanied by a charge displacement of the charges $\vec{Q}_{el}$ and $\vec{Q}_{mg}$, respectively. These charges appear in equations (06), (07), (11) and (12) and are calculated.

The electric and magnetic flux densities shown in Fig. 1 and Fig. 2 are $\vec{D}$ and $\vec{B}$ do not result from electric or magnetic fields acting outwardly, but they result from the change in electric and magnetic flux due to the spatial magnifications of the charges. The displacement current flows even in vacuum when a field changes there. It can be expressed as a change in charge with time. For the electric displacement current, the relationship known according to Maxwell is valid:

$$\vec{I}_{v\,el} = \varepsilon \int_A \frac{\partial \vec{E}}{\partial t} d\vec{A} = \varepsilon_0 \varepsilon_r \int_A \frac{\partial \vec{E}}{\partial t} d\vec{A} = \varepsilon_r \int_A \frac{\partial \vec{D}}{\partial t} d\vec{A} = \frac{d\vec{Q}_{el}}{dt} \qquad (01)$$

Just as there is an electric displacement current, according to Maxwell's complete equations, if there are elementary magnetic charges in atoms, there should be a magnetic displacement current that flows as the charge increases:

$$\vec{I}_{v\,mg} = \mu \int_A \frac{\partial \vec{H}}{\partial t} d\vec{A} = \mu_0 \mu_r \int_A \frac{\partial \vec{H}}{\partial t} d\vec{A} = \mu_r \int_A \frac{\partial \vec{B}}{\partial t} d\vec{A} = \frac{d\vec{Q}_{mg}}{dt} \qquad (02)$$

The displacement currents at the masses m_1 and m_2 according to equations (01) and (02) are shown as models in figures 1 and 2.

3. The electromagnetic origin of the gravitational force

The well-known Lorentz force, which acts on a moving electric charge $\vec{Q}_{el}$ moving with the velocity $\vec{v}$ in an electromagnetic field is calculated as follows:

$$\vec{F}_{Lorentz} = \vec{Q}_{el}\vec{E} + \vec{Q}_{el}\left(\vec{v} \times \vec{B}_{mg}\right) \qquad (03)$$

If there is no external electric field for the electric charge of field strength $\vec{E}$ the equation (03) simplifies to the resulting force $\vec{F}_{res}$:

$$\vec{F}_{res} = \vec{Q}_{el}\left(\vec{v} \times \vec{B}_{mg}\right) \qquad (04)$$

If, as shown in Figure 1, the velocity of the electric charge is $\vec{Q}_{el}$ in the form of the electric displacement current $\vec{I}_{el}$ perpendicular to the field lines of the magnetic field with the flux density $\vec{B}_{mg}$ equation (04) can be further simplified by omitting the cross product:

$$\vec{F}_{res} = \vec{Q}_{el}\,\vec{v}\,\vec{B}_{mg} \qquad (05)$$

On the mass m_1 in figure 1 is affected by the electric displacement current $\vec{I}_{el\,1}$ in the magnetic field with the flux density $\vec{B}_2$which emanates from the mass m_2 has the following force:

$$\vec{F}_{grav} = \vec{Q}_{el\,1}\,\vec{v}_1\,\vec{B}_2 \tag{06}$$

On the mass m_2 in figure 1 is affected by the electric displacement current $\vec{I}_{el\,2}$ in the magnetic field with the flux density $\vec{B}_1$which emanates from the mass m_1 has the following force:

$$\vec{F}_{grav} = \vec{Q}_{el\,2}\,\vec{v}_2\,\vec{B}_1 \tag{07}$$

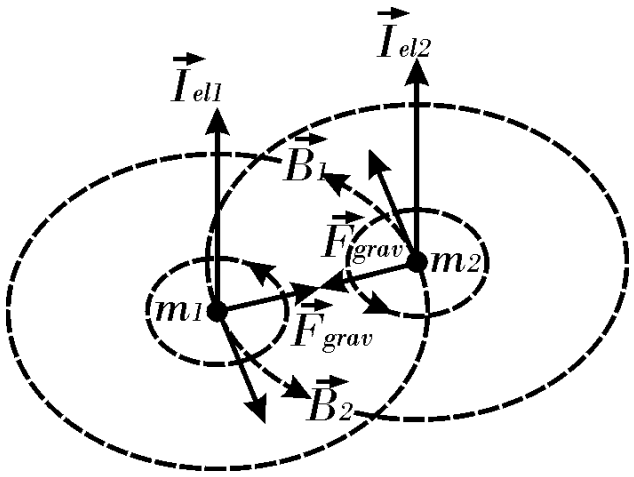

Figure 1: Electromagnetic origin of gravitational force by electric displacement current during the expansion of the universe

If there are magnetic monopole charges, starting from Maxwell's equations there should be a force on a moving magnetic charge comparable to the Lorentz force $\vec{Q}_{mg}$ which moves with the velocity $\vec{v}$ in an electromagnetic field:

$$\vec{F}_{res} = \vec{Q}_{mg}\vec{H} + \vec{Q}_{mg}\left(\vec{v} \times \vec{D}_{el}\right) \tag{08}$$

If there is no external magnetic field for the magnetic charge of the field strength $\vec{H}$ the equation (08) is simplified:

$$\vec{F}_{res} = \vec{Q}_{mg}\left(\vec{v} \times \vec{D}_{el}\right) \tag{09}$$

If, as shown in Figure 2, the velocity of the magnetic charge is $\vec{Q}_{mg}$ in the form of the magnetic displacement current $\vec{I}_{mg}$ is perpendicular to the field lines of the electric field with flux density $\vec{D}_{el}$ equation (09) can be further simplified by omitting the cross product:

$$\vec{F}_{res} = \vec{Q}_{mg}\,\vec{v}\,\vec{D}_{el} \tag{10}$$

On the mass m_1 in figure 2 is affected by the magnetic displacement current $\vec{I}_{mg\,1}$ in the electric field with flux density $\vec{D}_2$ which emanates from the mass m_2 has the following force:

$$\vec{F}_{grav} = \vec{Q}_{mg\,1}\,\vec{v}_1\,\vec{D}_2 \tag{11}$$

On the mass m_2 in figure 2 is affected by the magnetic displacement current $\vec{I}_{mg\,2}$ in the electric field with flux density $\vec{D}_1$ which emanates from the mass m_1 has the following force:

$$\vec{F}_{grav} = \vec{Q}_{mg\,2}\,\vec{v}_2\,\vec{D}_1 \qquad (12)$$

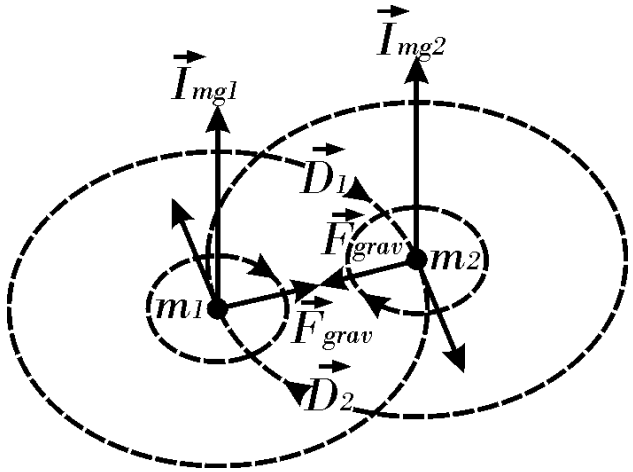

Figure 2: Electromagnetic origin of gravitational force by magnetic displacement current during the contraction oft he universe

The individual coefficients of equations (06), (07), (11) and (12) are to be determined and assigned numbers for the gravitational system **Earth-Moon.**

About equation (06): The total electric charge $\vec{Q}_{el\,1}$ on the mass m_1 results from the number of individual charges. The number of single charges in turn is multiplied by the object mass m_1 as well as with the electron mass m_e and the proton mass m_p is calculated [1.]:

$$\vec{Q}_{el\,1} = N_{e1}e \qquad \text{with} \qquad N_{e1} = \frac{m_1}{\sqrt{m_e m_p}} \qquad (13)$$

For the earth with the mass m_1 result $N_{e1} = 1.531\,10^{53}$ electric elementary charges. The total electric charge according to (13) is accordingly $\vec{Q}_{el\,1} = 2.453\,10^{34}\,As$.

The velocity $\vec{v}_1$ of the displacement current $\vec{I}_{el1}$ at the charge increase with the expansion of the universe is extremely slow and corresponds to the ratio of proton radius r_p (see below) to the radius of the universe r_{uni} multiplied by the speed of light c.

$$\vec{v}_1 = \frac{r_p}{r_{uni}}c \quad \text{with} \quad r_{uni} = t_{uni}c \quad \text{and} \quad t_{uni} = 13.8\,10^9 a \qquad (14)$$

The velocity $\vec{v}_1$ of the displacement current $\vec{I}_{el1}$ is $1.933\,10^{-33}\,m/s$ and is equal on all masses. All objects in the universe expand with it.

The magnetic flux density $\vec{B}_2$ in equation (06) is caused by the mass m_2 caused by the mass. It results from the magnetic field strength. For a point-like magnetic charge in space, the magnetic field strength is equivalent to the known electric field strength at a distance of r:

$$\vec{H}_2 = \frac{\vec{Q}_{mg\,2}}{4\pi\mu_0\,r^2} \qquad (15)$$

In the Earth-Moon system and in many other gravitational systems, the masses can be considered as point-like with respect to their gravitational effect due to their large distance.

This results in the magnetic flux density $\vec{B}_2$ with the absolute permeability μ and the distance r between earth and moon:

$$\vec{B}_2 = \mu\vec{H}_2 = \mu_0\mu_r\vec{H}_2 = \mu_0\mu_r \frac{N_{p2}p}{4\pi\mu_0 r^2} = \mu_r \frac{N_{p2}p}{4\pi r^2} \qquad (16)$$

The number of magnetic charges N_{p2} is again related to the object mass m_2 as well as with the electron mass m_e and the proton mass m_p is calculated [1.] It corresponds to the number of electric charges on this mass:

$$N_{p2} = \frac{m_2}{\sqrt{m_e m_p}} \qquad (17)$$

This results for the mass m_2 of the moon $N_{p2} = 1.883\ 10^{51}$ magnetic elementary charges.

The substance-dependent permeability μ_r corresponds to the ratio of the Klitzing resistance to the wave resistance of the vacuum. It is very interesting to find here two essential natural constants from quantum physics.

$$\mu_r = \frac{R_{Kl}}{Z_0} \qquad (18)$$

The dimensionless substance-dependent permeability with these two natural constants is $\mu_r = 68.5$.

The magnetic flux density $\vec{B}_2$ according to equation (16) is then $\vec{B}_2 = 4.195\ 10^{18}\ Vs/m^2$.

The resulting gravitational force according to equation (06) by the electric displacement current $\vec{I}_{el\,1}$ in the magnetic field with the flux density $\vec{B}_2$ can then be written as follows:

$$\vec{F}_{grav} = \vec{Q}_{el\,1}\,\vec{v}_1\,\vec{B}_2 = N_{e1}e\frac{r_p}{r_{uni}}c\frac{R_{Kl}}{Z_0}\frac{N_{p2}}{4\pi r^2}p = \frac{m_1}{\sqrt{m_e m_p}}e\frac{r_p}{r_{uni}}c\frac{R_{Kl}}{Z_0}\frac{\frac{m_2}{\sqrt{m_e m_p}}}{4\pi r^2}p \qquad (19)$$

$$\boxed{\vec{F}_{grav} = \frac{m_1 m_2}{m_e m_p}\frac{r_p}{r_{uni}}\frac{R_{Kl}}{Z_0}\frac{epc}{4\pi r^2}} \qquad (20)$$

$$\vec{\boldsymbol{F}}_{\boldsymbol{grav}} = \vec{Q}_{el\,1}\,\vec{v}_1\,\vec{B}_2 = 2.453\ 10^{34} \times\ 1.933\ 10^{-33}\ \times 4.195\ 10^{18}\ N = \mathbf{1.989\ 10^{20} N}$$

About equation (07): The total electric charge $\vec{Q}_{el\,2}$ on the mass m_2 results from the number of individual charges. The number of single charges in turn is multiplied by the object mass m_2 as well as with the electron mass m_e and the proton mass m_p is calculated [1.]:

$$\vec{Q}_{el\,2} = N_{e2}e \qquad \text{with} \qquad N_{e2} = \frac{m_2}{\sqrt{m_e m_p}} \qquad (21)$$

For the moon with mass m_2 result $N_{e2} = 1.883\ 10^{51}$ electric elementary charges. The total electric charge according to (21) is accordingly $\vec{Q}_{el\,2} = 3.018\ 10^{32}\ As$.

The velocity $\vec{v}_2$ of the displacement current $\vec{I}_{el2}$ at the charge increase with the expansion of the universe is extremely slow and corresponds to the ratio of proton radius r_p (see below) to the radius of the universe r_{uni} multiplied by the speed of light c.

$$\vec{v}_2 = \frac{r_p}{r_{uni}} c \qquad \text{with} \qquad r_{uni} = t_{uni} c \tag{22}$$

The velocity $\vec{v}_2$ of the displacement current $\vec{I}_{el2}$ is $1.933\ 10^{-33}\ m/s$ and is equal on all masses. All objects in the universe expand with it.

The magnetic flux density $\vec{B}_1$ in equation (07) is caused by the mass m_1 caused by the mass. It results from the magnetic field strength. For a point-like magnetic charge in space, the magnetic field strength is equivalent to the known electric field strength at a distance of r:

$$\vec{H}_1 = \frac{\vec{Q}_{mg\,1}}{4\pi\mu_0\, r^2} \tag{23}$$

In the gravitational system Earth-Moon, the masses can be considered as point-like with respect to their gravitational effect due to their large distance.

This results in the magnetic flux density $\vec{B}_1$ with the absolute permeability μ and the distance r between earth and moon:

$$\vec{B}_1 = \mu\vec{H}_1 = \mu_0\mu_r\vec{H}_1 = \mu_0\mu_r \frac{N_{p1}}{4\pi\mu_0\, r^2} p = \mu_r \frac{N_{p1}}{4\pi\, r^2} p \tag{24}$$

The number of magnetic charges N_{p1} is again related to the object mass m_1 as well as with the electron mass m_e and the proton mass m_p is calculated [1.] It corresponds to the number of electric charges on this mass:

$$N_{p1} = \frac{m_1}{\sqrt{m_e m_p}} \tag{25}$$

The following results for the mass m_1 of the earth $N_{p1} = 1.531\ 10^{53}$ magnetic elementary charges.

The substance-dependent permeability μ_r corresponds to the ratio of the Klitzing resistance to the wave resistance of the vacuum.

$$\mu_r = \frac{R_{Kl}}{Z_0} \tag{26}$$

The dimensionless substance-dependent permeability with these two natural constants is $\mu_r = 68.5$.

The magnetic flux density $\vec{B}_1$ according to equation (24) is then $\vec{B}_1 = 3.410\ 10^{20}\ Vs/m^2$.

The resulting gravitational force according to equation (07) by the electric displacement current $\vec{I}_{el\,2}$ in the magnetic field with the flux density $\vec{B}_1$ can then be written as follows:

$$\vec{F}_{grav} = \vec{Q}_{el\,2}\, \vec{v}_2\, \vec{B}_1 = N_{e2} e \frac{r_p}{r_{uni}} c \frac{R_{Kl}}{Z_0} \frac{N_{p1}}{4\pi\, r^2} p = \frac{m_2}{\sqrt{m_e m_p}} e \frac{r_p}{r_{uni}} c \frac{R_{Kl}}{Z_0} \frac{\frac{m_1}{\sqrt{m_e m_p}}}{4\pi\, r^2} p \tag{27}$$

$$\vec{F}_{grav} = \frac{m_1 m_2}{m_e m_p} \frac{r_p}{r_{uni}} \frac{R_{Kl}}{Z_0} \frac{epc}{4\pi\, r^2} \tag{28}$$

$$\vec{\boldsymbol{F}}_{\boldsymbol{grav}} = \vec{Q}_{el\,2}\, \vec{v}_2\, \vec{B}_1 = 3.018\ 10^{32} \times\ 1.933\ 10^{-33}\ \times 3.410\ 10^{20}\ N = \mathbf{1.989\ 10^{20} N}$$

Concerning equation (11): The total magnetic charge $\vec{Q}_{mg\,1}$ on the mass m_1 results from the number of individual charges. The number of single charges in turn is multiplied by the object mass m_1 as well as with the electron mass m_e and the proton mass m_p is calculated [1.]:

$$\vec{Q}_{mg\,1} = N_{p1}p \qquad \text{with} \qquad N_{p1} = \frac{m_1}{\sqrt{m_e m_p}} \tag{29}$$

For the earth with the mass m_1 result $N_{p1} = 1.531\ 10^{53}$ electric elementary charges. The total electric charge according to (29) is accordingly $\vec{Q}_{mg\,1} = 9.242\ 10^{36}\ Vs$.

The velocity $\vec{v}_1$ of the displacement current $\vec{I}_{mg1}$ at the charge reduction with the contraction of the universe is extremely slow and corresponds to the ratio of proton radius r_p (see below) to the radius of the universe r_{uni} multiplied by the speed of light c.

$$\vec{v}_1 = \frac{r_p}{r_{uni}} c \qquad \text{with} \qquad r_{uni} = t_{uni} c \tag{30}$$

The velocity $\vec{v}_1$ of the displacement current $\vec{I}_{mg1}$ is $1.933\ 10^{-33}\ m/s$ and is equal on all masses. All objects in the universe contract with it.

The electric flux density $\vec{D}_2$ in equation (11) is caused by the mass m_2 caused by the mass. It results from the electric field strength. For a point electric charge in space, the electric field strength at a distance is given by r:

$$\vec{E}_2 = \frac{\vec{Q}_{el\,2}}{4\pi\varepsilon_0\, r^2} \tag{31}$$

In the gravitational system Earth-Moon, the masses can be considered as point-like with respect to their gravitational effect due to their large distance.

This results in the electric flux density $\vec{D}_2$ with the absolute permittivity ε and the distance r between earth and moon:

$$\vec{D}_2 = \varepsilon \vec{E}_2 = \varepsilon_0 \varepsilon_r \vec{E}_2 = \varepsilon_0 \varepsilon_r \frac{N_{e2} e}{4\pi\varepsilon_0\, r^2} = \varepsilon_r \frac{N_{e2} e}{4\pi\, r^2} \tag{32}$$

The number of electric charges N_{e2} is again related to the object mass m_2 as well as with the positron mass m_e and the antiproton mass m_p is calculated [1.] It corresponds to the number of magnetic charges on this mass:

$$N_{e2} = \frac{m_2}{\sqrt{m_e m_p}} \tag{33}$$

This results for the mass m_2 of the moon $N_{e2} = 1.883\ 10^{51}$ electric elementary charges.

The substance-dependent permittivity ε_r corresponds exactly to the substance-dependent permeability μ_r the ratio of the Klitzing resistance to the characteristic impedance of the vacuum:

$$\varepsilon_r = \frac{R_{Kl}}{Z_0} \tag{34}$$

The dimensionless substance-dependent permittivity with these two natural constants is $\varepsilon_r = 68.5$.

The electric flux density $\vec{D}_2$ according to equation (32) is then $\vec{D}_2 = 1.113\ 10^{16}\ As/m^2$.

The resulting gravitational force according to equation (11) by the magnetic displacement current $\vec{I}_{mg\,1}$ in the electric field with the flux density $\vec{D}_2$ can then be written as follows:

$$\vec{F}_{grav} = \vec{Q}_{mg\,1}\, \vec{v}_1\, \vec{D}_2 = N_{p1} p \frac{r_p}{r_{uni}} c \frac{R_{Kl}}{Z_0} \frac{N_{e2}}{4\pi\, r^2} e = \frac{m_1}{\sqrt{m_e m_p}} p \frac{r_p}{r_{uni}} c \frac{R_{Kl}}{Z_0} \frac{\frac{m_2}{\sqrt{m_e m_p}}}{4\pi\, r^2} e \tag{35}$$

$$\vec{F}_{grav} = \frac{m_1\ m_2}{m_e m_p}\frac{r_p}{r_{uni}}\frac{R_{Kl}}{Z_0}\frac{epc}{4\pi\ r^2} \tag{36}$$

$$\vec{\boldsymbol{F}}_{\boldsymbol{grav}} = \vec{Q}_{mg\ 1}\ \vec{v}_1\ \vec{D}_2 = 9.242\ 10^{36} \times\ 1.933\ 10^{-33}\ \times 1.113\ 10^{16}\ N = \mathbf{1.989\ 10^{20} N}$$

Concerning equation (12): The total magnetic charge $\vec{Q}_{mg\ 2}$ on the mass m_2 results from the number of individual charges. The number of single charges in turn is multiplied by the object mass $m_2$as well as with the electron mass m_e and the proton mass m_p is calculated [1.]:

$$\vec{Q}_{mg\ 2} = N_{p2}p \qquad \text{with} \qquad N_{p2} = \frac{m_2}{\sqrt{m_e m_p}} \tag{37}$$

For the moon with mass m_2 result $N_{p2} = 1.883\ 10^{51}$ electric elementary charges. The total electric charge according to (37) is accordingly $\vec{Q}_{mg\ 2} = 1.137\ 10^{35}\ Vs$.

The velocity $\vec{v}_2$ of the displacement current $\vec{I}_{mg2}$ at the charge reduction with the contraction of the universe is extremely slow and corresponds to the ratio of proton radius r_p (see below) to the radius of the universe r_{uni} multiplied by the speed of light c.

$$\vec{v}_2 = \frac{r_p}{r_{uni}}c \qquad \text{with} \qquad r_{uni} = t_{uni}c \tag{38}$$

The velocity $\vec{v}_2$ of the displacement current $\vec{I}_{mg2}$ is $1.933\ 10^{-33}\ m/s$ and is equal on all masses. All objects in the universe contract with it.

The electric flux density $\vec{D}_1$ in equation (12) is caused by the mass m_1 caused by the mass. It results from the electric field strength. For a point electric charge in space, the electric field strength at a distance is given by r:

$$\vec{E}_1 = \frac{\vec{Q}_{el\ 1}}{4\pi\varepsilon_0\ r^2} \tag{39}$$

In the gravitational system Earth-Moon, the masses can be considered as point-like with respect to their gravitational effect due to their large distance.

This results in the electric flux density $\vec{D}_1$ with the absolute permittivity ε and the distance r between earth and moon:

$$\vec{D}_1 = \varepsilon\vec{E}_1 = \varepsilon_0\varepsilon_r\vec{E}_1 = \varepsilon_0\varepsilon_r\frac{N_{e1}}{4\pi\varepsilon_0\ r^2}e = \varepsilon_r\frac{N_{e1}}{4\pi\ r^2}e \tag{40}$$

The number of electric charges N_{e1} is again related to the object mass m_1 as well as with the positron mass m_e and the antiproton mass m_p is calculated [1.]. It corresponds to the number of magnetic charges on this mass:

$$N_{e1} = \frac{m_1}{\sqrt{m_e m_p}} \tag{41}$$

The following results for the mass m_1 of the earth $N_{e1} = 1.531\ 10^{53}$ magnetic elementary charges.

The substance-dependent permittivity ε_r corresponds to the ratio of the Klitzing resistance to the wave resistance of the vacuum.

$$\varepsilon_r = \frac{R_{Kl}}{Z_0} \tag{42}$$

The dimensionless substance-dependent permittivity with these two natural constants is $\varepsilon_r = 68.5$.

The electric flux density $\vec{D}_1$ according to equation (40) is then $\vec{D}_1 = 9.053\ 10^{17}\ As/m^2$.

The resulting gravitational force according to equation (12) by the electric displacement current $\vec{I}_{el\,2}$ in the magnetic field with the flux density $\vec{B}_1$ can then be written as follows:

$$\vec{F}_{grav} = \vec{Q}_{mg\,2}\ \vec{v}_2\ \vec{D}_1 = N_{e2} p \frac{r_p}{r_{uni}} c \frac{R_{Kl}}{Z_0} \frac{N_{e1}}{4\pi\, r^2} e = \frac{m_2}{\sqrt{m_e m_p}} p \frac{r_p}{r_{uni}} c \frac{R_{Kl}}{Z_0} \frac{\frac{m_1}{\sqrt{m_e m_p}}}{4\pi\, r^2} e \qquad (43)$$

$$\vec{F}_{grav} = \frac{m_1\ m_2}{m_e m_p} \frac{r_p}{r_{uni}} \frac{R_{Kl}}{Z_0} \frac{epc}{4\pi\, r^2} \qquad (44)$$

$$\vec{\boldsymbol{F}}_{\boldsymbol{grav}} = \vec{Q}_{mg\,2}\ \vec{v}_2\ \vec{D}_1 = 1.137\ 10^{35} \times\ 1.933\ 10^{-33}\ \times 9.053\ 10^{17}\ N = \mathbf{1.989\ 10^{20} N}$$

All 4 considerations for the gravitational force according to equations (06), (07), (11) and (12) lead to equation (20) and thus to the same result. Equation (20) contains magnetic elementary charges, which are indispensable for the present description of gravitation. The obvious conclusion is: They exist in the atoms.

For the gravitational system earth-moon with the center distance r between both celestial bodies the determined gravitational force amounts to $1.989\ 10^{20} N$. It is left here to the reader to determine this gravitational force according to Newton.

The usual negative sign of the gravitational force results from the definition that repulsive forces are positive and is not considered here.

The slowed down time flow in the gravitational field is an indication that the caused force inhibits its cause, namely time as a displacement current.

4. Basic physical equations in connection with gravitation

The gravitational force between two masses has also been described as a force between two charges with both the electric $N_{e1}\ und\ N_{e2}$ as well as the magnetic elementary charge number $N_{p1}\ oder\ N_{p2}$ of the charges and the quotient of the coupling constants $\alpha_{grav}/\alpha_{em}$ written [1.]. The square of elementary magnetic charge is $p^2 = 4\pi\alpha_{em} c \mu_0 \hbar$ with $p = 6.036\ 10^{-17}\ Vs$ [3.]:

$$F_{grav} = -\gamma \frac{m_1 m_2}{r^2} = \frac{N_{e1} N_{e2}\ e^2}{4\pi\varepsilon_0 r^2} \frac{\alpha_{grav}}{\alpha_{em}} = -\frac{N_{p1} N_{p2}\ p^2}{4\pi\mu_0 r^2} \frac{\alpha_{grav}}{\alpha_{em}} = -\frac{N_{p1} N_{p2}\ p^2}{4\pi\mu_0 r^2} \frac{r_p}{2\alpha_{em} r_{uni}} \qquad (45)$$

This relationship can be easily verified. Here, as in chapter 3, the number of electric or magnetic elementary charges $N_{ex}\ oder\ N_{px}$ of any mass m_x with the electron mass m_e and the proton mass m_p is calculated [1.]:

$$N_{ex} = N_{px} = N_x = \frac{m_x}{\sqrt{m_e m_p}} \qquad (46)$$

The assumption that the masses have as many magnetic as electric elementary charges is astonishing, because up to now any reference to it is missing. However, the calculations in chapter 3 confirm this assumption. In the further text, therefore, with the number of charges N the indices e and $p$which thus describe the type of charge, are omitted.

The following simple form of gravity as a magnetic force which would assume the existence of monopoles in space is not applicable as equation (03) shows:

$$\left|F_{grav}\right| \neq F_{mg} = \frac{N_1 N_2\ p^2}{4\pi\mu_0 r^2} \qquad (47)$$

The magnitude of the gravitational force F_{grav} is just not equal to that of the magnetic force F_{mg}. The gravitational force occurs in space, as equation (45) shows, weakened by the factor $\alpha_{grav}/\alpha_{em}$ factor.

The coupling constant of the gravitational interaction α_{grav} has a value of $3.2\ 10^{-42}$ and the coupling constant of the electromagnetic interaction α_{em} has a value of $7.3\ 10^{-3}$. Thus the attenuation factor $\alpha_{grav}/\alpha_{em}$ has the extremely small value of $4.4\ 10^{-40}$. The following relationship was established between the characteristic impedance of the vacuum and the Klitzing resistance [3.]:

$$2\alpha_{em} = \frac{Z_0}{R_{Kl}} \tag{48}$$

This relationship is introduced in equation (45) and shows the gravitational force in another concise notation:

$$\boxed{F_{grav} = -\frac{N_1 N_2\, p^2}{4\pi\mu_0 r^2}\frac{R_{Kl}}{Z_0}\frac{r_p}{r_{uni}} = -\frac{N_1 N_2\, e^2}{4\pi\varepsilon_0 r^2}\frac{R_{Kl}}{Z_0}\frac{r_p}{r_{uni}} = -F_{mg}\frac{R_{Kl}}{Z_0}\frac{r_p}{r_{uni}} = -\frac{N_1\, N_2}{r^2}c\hbar\alpha_{grav}} \tag{49}$$

Equation (49) now shows a simple relation between the gravitational force F_{grav} and the magnetic force F_{mg}which contains two dimensionless coefficients: 1. the ratio of the Klitzing resistance to the characteristic impedance of the vacuum $R_{Kl}/Z_0 = 68.5$ and 2. the ratio of the proton radius to the radius of the universe. $r_p/r_{uni} = 6.4\ 10^{-42}$. The characteristic impedance of the vacuum Z_0 is approx. 377 Ω. The radius of the universe can be easily calculated with the age of the universe: $r_{uni} = c\ t_{uni}$ [4.]. The gravitational force is slightly larger than according to (47) because the Klitzing resistance is larger than the characteristic impedance of the vacuum and it is therefore extremely much smaller than according to (47) because the proton radius is much smaller than the radius of the universe. The well-known Klitzing resistance shows up in the quantum Hall effect: If a current flows at low temperatures and perpendicular to a strong magnetic field through a thin metal film as a 2-dimensional electron system, the Hall voltage is formed. It does not grow linearly with the magnetic field, but in steps. The Hall resistance is the quotient between the Hall voltage and the current. The Klitzing resistance $R_{Kl} = U_H/I = h/e^2 = 25{,}813\ \Omega$ is the largest Hall resistance. The electrons in the metal film are deflected by the Lorentz force.

They always move with the same energy on a discrete circular path, which corresponds to a certain energy level. The vacuum characteristic impedance Z_0 opposes the propagation of electromagnetic waves in vacuum. As an impedance of space, it causes electromagnetic waves to propagate in vacuum only at the speed of light. The coupling constant of the strong interaction is $\alpha_{st} = 0.5$. In quantum physics, this value represents a maximum value, which is about 0.5 femtometers quark distance. The coupling constant does not grow further at larger distances. This leads at atomic distances to the cohesion of quarks and also of protons. At higher energies and smaller distances, the quarks behave like free particles. So, in a sense, they are confined in a region of space. Within this area they can move freely. For the coupling constant α_{st} the following relation was given for the first time [2.]:

$$\alpha_{st} = \sqrt{\frac{\hbar}{m_p\, r_p\, c}} = 0.5 \tag{50}$$

Equation (50) can be introduced into (45) for a different notation of the gravitational force:

$$F_{grav} = -\gamma\frac{m_1 m_2}{r^2} = -\frac{N_1 N_2\, p^2}{4\pi\mu_0 r^2}\frac{r_p}{2\alpha_{em} r_{uni}} = -F_{mg}\frac{r_p}{2\alpha_{em} r_{uni}} = -F_{mg}\frac{\alpha_{st}}{\alpha_{em}}\frac{r_p}{r_{uni}} \tag{51}$$

The equality of the ratios of fundamental forces and their coupling constants [2.] is valid:

$$\frac{\alpha_{st}}{\alpha_{em}} = \frac{F_{st}}{F_{mg}} \tag{52}$$

Therefore, equations (51) and (52) can be used to write for the gravitational force:

$$\boxed{F_{grav} = -F_{st}\,\frac{r_p}{r_{uni}}} \tag{53}$$

If now the ratio r_p/r_{uni} from equation (51) is introduced into (53), the result is:

$$F_{grav} = -\gamma\,\frac{m_1 m_2}{r^2} = -F_{st}\,\frac{r_p}{r_{uni}} = F_{st}\,\frac{F_{grav}}{F_{mg}}\,\frac{Z_0}{R_{Kl}} \tag{54}$$

From this follows for the strong force F_{st}:

$$\boxed{F_{st} = F_m\,\frac{R_{Kl}}{Z_0}} \tag{55}$$

Equation (55) shows that the strong force follows from the magnetic force and equation (53) shows that the gravitational force follows from the strong force. This is another indication that there are not only electric but also magnetic charges in the elementary particles.

The strong force could originate from the magnetic field of magnetic monopoles.

Using equation (46), it follows for the gravitational force between two objects with masses of proton and electron:

$$F_{grav} = -\gamma\,\frac{N_1\sqrt{m_e m_p}\;N_2\sqrt{m_e m_p}}{r^2} = -\gamma\,\frac{N_1\,N_2 m_e m_p}{r^2} \tag{56}$$

The simplification of equation (49) leads to a novel calculation rule for the Newtonian gravitational value γ:

$$\boxed{\gamma = \frac{1}{m_e m_p}\,\frac{r_p}{r_{uni}}\,\frac{R_{Kl}}{Z_0}\,\frac{e^2}{4\pi\varepsilon_0} = \frac{1}{m_e m_p}\,\frac{r_p}{r_{uni}}\,\frac{R_{Kl}}{Z_0}\,\frac{p^2}{4\pi\mu_0} = \frac{1}{m_e m_p}\,\frac{r_p}{r_{uni}}\,\frac{R_{Kl}}{Z_0}\,\frac{epc}{4\pi}} \tag{57}$$

The correctness of equation (57) can be easily checked. The gravitational value γ is then $6.7\;10^{-11}\;m^3/(kg\;s^2)$. With this concatenation of numerous elementary quantities with the necessity that the correct unit for γ must come out, it is extremely improbable that the equation (57) is not correct.

In the publication [1.] another formula for the gravitational value was found:

$$\gamma = \frac{2\hbar^2}{c\;t_{uni}\;m_e {m_p}^2} \tag{58}$$

Hereby it becomes quite clear that the gravity value must change with the age of the universe. However, one must also consider the mass reductions of electron and proton with the time.

With the equations (57), (58) and (48) and the known relationship $e^2 = 4\pi\alpha_{em}c\varepsilon_0\hbar$ the following calculation rule follows for the proton radius:

$$\boxed{r_p = \frac{\hbar}{{\alpha_{em}}^2 c\;m_p}\,\frac{{Z_0}^2}{{R_{Kl}}^2}} \tag{59}$$

Only the time-variable proton mass m_p thus also determines the time-varying proton radius. All other quantities in equation (59) are real invariant natural constants. The calculated proton radius is 0.84 femtometers and agrees exactly with the actual measured radius [5.].

It is very advantageous that such essential quantities as the gravitational value and the proton radius can be described physically and calculated mathematically exactly.

Alan Guth describes in [6.], that a massed, compressible spherical shell, which contracts under its own gravity, produces an external gravitational field, which was not present before in the same space area within

the spherical shell. He deduced from it that thereby energy is released and the gravitational energy must be negative accordingly.

With the expansion of the universe an opposite process could take place in principle. The outer gravitational field of the universe is erased and for this energy is needed. The energy could come from the masses. These would have to become smaller with the age of the universe. With it would be also explicable that for the universe the amount of the mass energy corresponds exactly to the gravitational energy [7.]:

$$-\gamma \frac{{m_{uni}}^2}{r_{uni}} + m_{uni}\, c^2 = 0 \qquad \text{with} \quad r_{uni} = c\, t_{uni} \tag{60}$$

While the mass m_{uni} falls during the expansion of the universe, the amount of gravitational energy also falls to the same extent, because r_{uni} increases and γ rises even quadratically.

Equation (60) is formally correct, but does not establish the existence of everything from nothing. The explanation of the gravitational force as Lorentz force with electromagnetic origin has far-reaching consequences. Many attempts of explanation of gravitation also some of my own, are hereby falsified. It is no longer surprising that masses with so-called positive gravitational charge attract each other, although otherwise charges of the same polarity repel each other. The masses themselves have a neutral charge towards the outside and they move towards each other only due to the effect of the Lorentz force. Thus, gravity does not need any interacting particles, because the Lorentz force is caused by the electric and magnetic displacement current and the change of the magnetic and electric flux during the expansion of the universe. This also means that there can be no gravitational waves.

The negative sign of the gravitational energy does not surprise any more and also not the fact that in the universe the amount of the sum of all mass energies corresponds to that of the gravitational energy. Because it does not exist as independent energy actually at all, it is an energy which exists in the charges and in the form of electromagnetic field energy. This energy becomes free in consequence of the effect of the Lorentz force with the distance reduction between objects. The mass energy can also be understood as energy of charges and atomic fields. Charge displacement can lead either to energy release, as in free fall, or to energy absorption, as in the separation of masses. Because this process of mass separation requires energy, the masses must become smaller as the universe expands. It is believed by some scientists that the universe pulsates and contracts after an expansion phase. With the explanation of the gravitational force as a Lorentz force, this is obvious: The gravity would remain attractive also with continued time direction from the past into the future with matter. The time during the contraction of the universe would originate from the electric displacement current.

For the constant number of effects of the universe the following formula was given in [1.]:

$$N_{uni} = \sqrt{\frac{2\, {m_{uni}}^3}{m_e {m_p}^2}} = \frac{m_{uni}\, t_{uni}\, c^2}{\hbar} \tag{61}$$

From this, a new formula for the age of the universe can be derived:

$$t_{uni} = \sqrt{\frac{2\, m_{uni}}{m_e}}\, \frac{\hbar}{m_p c} \tag{62}$$

The constant number of effects $N_{uni}\hbar = m_{uni}\, t_{uni}\, c^2$ of the universe is a measure for its entropy. For the age of the universe can also be written:

$$t_{uni} = \frac{N_e\, e\, N_p\, p}{4\pi}\, \frac{r_p}{r_{uni}}\, \frac{R_{Kl}}{Z_0}\, \frac{1}{m_{uni}\, c^2} \tag{63}$$

In equation (63) the gravitational value γ can be introduced and it can be brought into another form by subsequent elimination of γ with (57) into another form:

$$t_{uni} = \sqrt{\frac{m_{uni}}{4\pi}\frac{R_{Kl}}{Z_0}\frac{r_p}{c^3}\frac{ep}{m_e m_p}} \quad (64)$$

Equations (62) and (64) can be equated. From this follows the relation already published in [8.] for the proton:

$$\frac{r_p m_p c}{\hbar} = 4 \quad (65)$$

5. Summary

Starting from Maxwell's equations, the electromagnetic origin of gravity could be derived. Gravitation follows from the displacement currents and the flux changes which occur at the enlargement of charges due to the expansion of the universe. To describe gravity with general relativity as a curvature of space-time must be rejected. The present publication justifies why the earth and the moon remain on their orbits and in the end the universe maintains cohesion during its expansion. It could be confirmed here that with the expansion of the universe all objects must grow along. New formulas for the gravitational constant, the proton radius and the age of the universe were given.

It is interesting that the formulas (01) to (12) keep hre validity also with antimatter.

The realization that all masses fall with the expansion of the universe and all objects expand with it, which I represent and publish since approx. 10 years, could be verified.

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