Theory of Force between moving Charges

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Version No.14 dated 15 October 2020

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1 Introduction

Heinrich Hertz published in 1894 his book "Untersuchung Über Die Ausbreitung Der Elektrischen Kraft". Here he discussed several possible ways, how the electric force is acting. The first alternative, the direct immediate action, without any intermediate transmission was neglected, though there was no strong argument, no experiment was made, to exclude this possibility.
In the study of electromagnetic emission in the universe, especially from Neutron stars, one finds effects that can not be explained with today's physics. There seems to be a chance to come to sounding explanations, if one follows this first discussed path by Heinrich Hertz though it was dismissed.
This immediately has as consequence, that there is no velocity limit for particles or electromagnetic waves. Of course the emission velocity from the source is c (as in emission theory).

This paper is a test or an experiment,
how far can one get using this simple starting point

The result is in the eyes of the author amazing, it even leads to questions like:

Is the photon frequency exactly half of atom rotating frequency-difference ?
Can a photon model be created that consists of two rotating particles ?
Is gravity a consequence of the Lorentz Force ?

2 Math of the new theory

The force on charges is given by few equations. The formulas are taken from John David Jackson [JDJ]; Classical Electrodynamics; Third Edition.
The F numbers refer to the Formula No. (F n.m) in that book.

1. The Lorentz Force (Introduction F 1.3)

$$\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B}) \tag{1}$$

2. The Coulomb Formula gives the static force between two charges q_1 and q_2

$$\mathbf{F} = \frac{1}{(4\pi\epsilon)}(q_1 * q_2)\frac{\mathbf{r}}{|\mathbf{r}|^3} \tag{2}$$

as $c = (\mu_0 * \epsilon_0)^{-1/2}$ according JDJ page 3 and $\mu_0 = 4\pi 10^{-7}$ in SI units

the expression $1/(4\pi\epsilon)$ can and will be replaced in the following by $c^2/10^7$

so the Coulomb law has the following expression (Chapter 1 F 1.3)

$$\mathbf{E} = \frac{q_1 c^2}{10^7} \frac{\mathbf{x\text{-}x1}}{|\mathbf{x\text{-}x1}|^3} \tag{3}$$

3. The BIOT and Savart Formula (Chapter 5 F 5.5)
(By the way the same formula appears in chapter 11.10 in the Gauss unit system describing the B field of a passing charge.)

$$\mathbf{B} = kq \frac{\mathbf{v} \times \mathbf{x}}{|\mathbf{x}|^3} \tag{4}$$

The constant factor k is in SI $[10^{-7}]$ with the units $[N/A^2] = [kg * m/C^2]$

Here a warning is included in the book [1] consisting of three objections
"... But this expression is time dependent and furthermore is valid only for charges whose velocities are small compared to that of light and whose accelerations can be neglected . ..."

a) But this expression is time dependent is not valid for two charges circling around their center of mass.
Here one can derive the force without any time dependence, as it is shown later on in this New Theory.

b) In the New Theory the speed of light is no limit for particles, so that this limitation is not valid in the New Theory.

c) For the acceleration the present interpretation is also not sufficient, as it is known, that the rotation of electrons in atoms around the kernel cannot be correctly interpreted by the present theory. The electrons are accelerated continuously and should emit electromagnetic waves. They do not ! So the present very simple rule, that accelerated charges create electromagnetic waves needs a refinement.

With the replacement as before the Biot Savart formula becomes

$$\mathbf{B} = \frac{q}{10^7} \frac{\mathbf{v} \times \mathbf{x}}{|\mathbf{x}|^3} \tag{5}$$

The interpretation of (5) is:
a charge q generates a **B** field at the observation point, when it has the relative velocity **v** and its location is described by the distance vector **x**.

Now one can combine the Biot and Savart and Coulomb formula with the Lorentz Force.

$$\mathbf{F} = q(\mathbf{E} + \mathbf{v}\ \mathbf{x}(\frac{1}{10^7}\frac{\mathbf{v}\times\mathbf{x}}{|\mathbf{x}|^3})) \tag{6}$$

For better reading **x** will be replaced by **r** and the term for the static force included

$$\mathbf{F} = \frac{q_1 q_2}{10^7}(\frac{c^2\mathbf{r}}{|\mathbf{r}|^3} + \mathbf{v}\ \mathbf{x}(\frac{\mathbf{v}\times\mathbf{r}}{|\mathbf{r}|^3})) \tag{7}$$

This is equal to

$$\mathbf{F} = \frac{q_1 q_2}{10^7|\mathbf{r}|^3}(c^2\mathbf{r} + \mathbf{v}\ \mathbf{x}\ (\mathbf{v}\times\mathbf{r})) \tag{8}$$

or

$$\mathbf{F} = \frac{q_1 q_2 c^2}{10^7|\mathbf{r}|^3}(\mathbf{r} + \frac{1}{c^2}(\mathbf{v}\ \times(\mathbf{v}\times\mathbf{r})) \tag{9}$$

or

$$\mathbf{F} = \frac{q_1 q_2 c^2}{10^7|\mathbf{r}|^3}(\mathbf{r} + (\frac{\mathbf{v}}{c}\times(\frac{\mathbf{v}}{c}\times\mathbf{r})) \tag{10}$$

Now one can transform the two vector products according the mathematical identity

$$\mathbf{a}\ \times(\ \mathbf{b}\ \times\mathbf{c}\ ) = \ \mathbf{b}\ (\mathbf{a}\ \mathbf{c}\ ) - \mathbf{c}\ (\mathbf{a}\ \ \mathbf{b}\ ) \tag{11}$$

and gets

$$\mathbf{F} = \frac{q_1 q_2}{10^7|\mathbf{r}|^3}(c^2\mathbf{r} + \ \mathbf{v}\ (\mathbf{v}\ \mathbf{r}\ ) - \mathbf{r}\ (\mathbf{v}\ \ \mathbf{v}\ )) \tag{12}$$

From the formulas (7) to (10) follows
a) the force is always proportional to the product of the charges (for static and

dynamic forces)
b) the force decreases always with the square of the distance (for static and dynamic forces)
c) there are always several components included, the first expression $c^2\mathbf{r}$ in the brackets corresponds to the well known static force between the charges, the second expression represents the dynamic force, what usually is called the magnetic influence. This is velocity dependent.
d) the first cross product generates a force that is always perpendicular to the momentary speed. That is equal to the rule that a moving charge in a magnetic field does not gain any energy, it is only deflected perpendicular to its momentary velocity vector.

From the formula (12) follows
e) That the dynamic force is zero whenever the velocity $\mathbf{v}$ and radius vector $\mathbf{r}$ are parallel, and this can only be if they are on the same line to each other.

With that it is shown, that the forces between two charges moving relative to each other can be calculated with formula (12). The result is identical to a calculation where at first the B field is determined then the resulting force calculated. But this expression does not include anymore a B-field expression. The calculation of a B field is obsolete. It is replaced by the dynamical force between two charges. Also the use of the three finger rule to determin the resulting force direction is no longer needed. The resulting dynamical force is always in the plane given by the velocity vector and the distance vector. The direction is always the same as with the static force, two bodies with the same charge polarity repel each other (the static plus the dynamic force). If the charges have different polarities the particles attract each other more than only by the static force. This means that a B field is not existing, it is only a helpful description for many calculations, especially, when regarding the movement of a low mass single charged particle influenced by many other charges with higher mass, so that the backward interaction can be neglected.

One can write now the whole formula using vectors considering two charges
charge 0 and charge 1

$$\mathbf{F}_1 = \frac{c^2}{10^7}\frac{q_0 q_1}{|\mathbf{r}|^3} * \left\{ \begin{pmatrix} r_{1x}-r_{0x} \\ r_{1y}-r_{0y} \\ r_{1z}-r_{0z} \end{pmatrix} + \begin{pmatrix} (r_{1x}-r_{0x})\dfrac{\mathbf{v}^2}{c^2} \\ (r_{1y}-r_{0y})\dfrac{\mathbf{v}^2}{c^2} \\ (r_{1z}-r_{0z})\dfrac{\mathbf{v}^2}{c^2} \end{pmatrix} - \begin{pmatrix} (v_{1x}-v_{0x})\dfrac{\mathbf{v}*\mathbf{r}}{c^2} \\ (v_{1y}-v_{0y})\dfrac{\mathbf{v}*\mathbf{r}}{c^2} \\ (v_{1z}-v_{0z})\dfrac{\mathbf{v}*\mathbf{r}}{c^2} \end{pmatrix} \right\} \quad (13)$$

with

$$\mathbf{v}^2 = (v_{1x} - v_{0x})^2 + (v_{1y} - v_{0y})^2 + (v_{1z} - v_{0z})^2 \tag{14}$$

and

$$\mathbf{v*r} = (v_{1x} - v_{0x}) * (r_{1x} - r_{0x}) + (v_{1y} - v_{0y}) * (r_{1y} - r_{0y}) + (v_{1z} - z_{0z}) * (r_{1z} - r_{0z}) \tag{15}$$

and

$$|\mathbf{r}|^3 = ((r_{1x} - r_{0x})^2 + (r_{1y} - r_{0y})^2 + (r_{1z} - r_{0z})^2 \ \ )^{3/2} \tag{16}$$

If you select the coordinate system such that charge 0 is located at r=(0,0,0) with velocity v=(0,0,0)
you get a somewhat simpler form for the equation giving the momentary force acting on
charge 1.

$$\mathbf{F}_1 = \frac{c^2}{10^7} \frac{q_0 q_1}{|\mathbf{r}|^3} * \left\{ \begin{pmatrix} r_{1x} \\ r_{1y} \\ r_{1z} \end{pmatrix} + \begin{pmatrix} r_{1x} \frac{v_1^2}{c^2} \\ r_{1y} \frac{v_1^2}{c^2} \\ r_{1z} \frac{v_1^2}{c^2} \end{pmatrix} - \begin{pmatrix} v_{1x} \frac{v_1 * r_1}{c^2} \\ v_{1y} \frac{v_1 * r_1}{c^2} \\ v_{1z} \frac{v_1 * r_1}{c^2} \end{pmatrix} \right\} \tag{17}$$

Now lets look at some more details. As there is no absolute velocity, and no limit in the velocity, one can use a coordinate system where the charge q_0 is at $r_0 = (0, 0,)$ with a velocity $v_0 = (0, 0, 0)$. Additionally the coordinate system will be chosen such that all elements are in the x-y plane, then no component is created in direction of the z-axis. The resulting forces are all in the x-y plane.

The vector formula with q1 at
r_{x1}; r_{y1}; and $v_1 = v_{x1}$; $v_{y1} = v_{z1} = 0$
reduces to

$$\mathbf{F}_1 = \frac{c^2}{10^7} \frac{q_0 q_1}{|\mathbf{r}|^3} * \left\{ \begin{pmatrix} r_{1x} \\ r_{1y} \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ r_{1y} \frac{v_{1x}^2}{c^2} \\ 0 \end{pmatrix} \right\} \tag{18}$$

This is the momentary force on q_1.

And just for repetition:

$$\frac{c^2}{10^7} = \frac{1}{4\pi\epsilon_0} \tag{19}$$

The force F_0 on q_0 is the negative from F_1 acting on charge 0.

The force on q_0 has the same magnitude but opposite direction. One can see that the first vector term is a central force between the two charges. The second term creates a moment (torque) on the two charges, and with that does not add kinetic energy to the charges. The dynamic forces are opposite in direction but no central forces, except in the case when r_{1x} is also zero (0). That is the case if charge 1 is circling around charge 0 with constant radius. In such a case the dynamic force is also acting like a central force and simply adds to the static force.

With that the third Axiom from Newton has to be modified for electric charges. Each force creates immediately the same counterforce in exactly the same opposite direction. This is valid for all central forces, like static electric forces, and gravitational forces. This is as before, new is now: For charges there is a dynamic force that creates a rotational moment. The dynamic forces on the charges have the same amount, opposite direction, the moment arm is the distance of the two lines that are perpendicular to the velocity vectors This distance is zero (0), when the charges are circling around each other, or when a passing charged particle reaches its closest point to the other.

At the point of closest approach in the formula 18 for $r_x = 0$ the moment arm is zero (0). This is always the case, if charge 2 is circling around charge 1. Then no moment is created, remaining is the dynamic force that adds to the central force of the static electric field. According to the previous formula the total force that acts against the radial rotation force is just double of the static force, when the relative speed is c.

3 Numeric evaluations

3.1 Electron beam deflection

A comparison of electron beam deflection was calculated, where the beam passes through opposite charged fixed spheres. The result is, that the x-y path is basically identical

a) calculated with the new theory using the Lorentz-force and
b) calculated according Special Relativity.
It was found by numerical simulations that a maximum deviation between the two theories of 12,5% appeared when the kinetic energies are in the range of their rest mass $2 * m * c^2$. If you go to lower or higher kinetic energies, then the two path calcuculations are (nearly) identical. Of course the calculated needed time for an electron to run along a given path, due to the time dilation in SR, is different. The time in SR is longer according the Gamma factor, thus allowing the static electric force alone to bend the beam accordingly. This time dilation is not given in the new theory. The stronger bending (compared with the classical calculation considering only the static Coulomb force) is due to the dynamic force or one even could say due to the "magnetic" interaction of the charges due to the Lorentz Force.

3.2 Bohr model extended with dynamic Lorentz Force

A further simulation calculation was done to expand the Bohr Atom Model with these dynamic forces.

If you take formula (18) and let the coordinate system rotate with q_1, so that r_{1x} is always zero you have the attracting force of charge q_1 to q_0. (assuming $q_1<0$; $q_0>0$). Adding now the radial acceleration v^2/r you come to an extended Atom-Model that additionally to the Bohr-Atom model not only considers the static force and radial acceleration with its resulting force but also the dynamic force. Replace q_0 by $n_p * (-q_e)$ i.e. the charge of a proton multiplied the number (n_p) of protons in one atom kernel and q_1 by q_e (the charge of one electron) leads to the following equation that must be zero (=0).

$$\mathbf{F}_1 = \frac{c^2}{10^7} \frac{q_e * n_p * (-q_e)}{r^3} * \left\{ \begin{pmatrix} 0 \\ r \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ r\dfrac{v^2}{c^2} \\ 0 \end{pmatrix} \right\} + m_e * \begin{pmatrix} 0 \\ \dfrac{v^2}{r} \\ 0 \end{pmatrix} = 0 \qquad (20)$$

or

$$\mathbf{F}_1 = \frac{c^2}{10^7} \frac{q_e * n_p * (-q_e)}{r^2} * \left\{ \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ \dfrac{v^2}{c^2} \\ 0 \end{pmatrix} \right\} + m_e * \begin{pmatrix} 0 \\ \dfrac{v^2}{r} \\ 0 \end{pmatrix} = 0 \qquad (21)$$

(m_e is the mass of an electron; q_e the charge of an electron; n_p is the number of protons in the kernel)

3.3 A limiting radius r_g

One first result from this extended Atom Model seems interesting. In the new model, due to the Lorentz Force, appears a special radius r_g. The model shows a value of $r_g = q_1 * q_2/(10^7 * m_1)$.
This is for the Hydrogen atom $2,8180 * 10^{-15}$ m and is about 18.000 times smaller than the rotation radius of the electron. This radius r_g can never be achieved, as then the kinectic energy would go to infinity. So there is a range around r_g that is not achieveable, the kinetic energy would be higher than the maximum of contained potential energy of two charged particles that are separated at infinite large distance .

3.4 Adding magnetic dipol to magnetic dipol force

Looking at the forces between two oppositly charged particles there is one force missing. Additionally to the static force and Lorentz Force one has to consider the magnetic force, as the electron and the proton/kernel of an atom have a magnetic moment. They behave like small magnets and can be described by their magnetic dipol moment. Assuming that
a) the size of electron and proton are much smaller than 1e-15m and
b) the orientation of the magnetic moments line up to a straight line (as regular bar magnets would do). So in a system where an electron and proton circling around the center of mass, the magnetic moments are always perpendicular to the rotation axis. In regular cases the two magnetic moments have the same orientation. In special cases it is possible that they are antiparallel as e.g. in the spin flip of the Hydrogen atom, where a transition from antiparallel orientation to parallel orientation takes place.
The force between magnetic dipols that are oriented on the same line is

$$F = \frac{6 * mm_1 * mm_2}{10^7 * r_1^4 * (1 + m_1/m_2)^4} \tag{22}$$

If the magnetic moments mm_1 and mm_2 are parallel on the same line they are attracting each other, if antiparallel distracting each other.

4 The complete force equation for two oppositly charged particles rotating around their center of mass

Now we have all forces that are acting on two opposit charged particles.
The radial velocity dependent centrifugal force is compensated by
a) the static force
b) the dynamic velocity dependent Lorentz Force
c) the magnetic dipol to dipol force (positive if the dipol orientations are parallel, negative if they are antiparallel)

Using only positive absolute values for the charges the formula is

$$m_1 * \frac{v_1^2}{r_1} = \frac{c^2 * q_1 * q_2}{10^7 * (1 + \frac{m_1}{m_2})^2 * r_1^2} + \frac{q_1 * q_2 * v_1^2}{10^7 * r_1^2} + \frac{6 * mm_1 * mm_2}{10^7 * (1 + \frac{m_1}{m_2})^4 * r_1^4} \tag{23}$$

This formula describes the forces on two opposit charged particles on circled path around the center of mass.

For a rotating two perticle system the following condition exists using the center of mass as reference point

$$\frac{r_1}{r_2} = \frac{v_1}{v_2} = \frac{m_2}{m_1} \tag{24}$$

With the help of these conditions and the generel force formula one can derive the total rotation energy, the total angular moment and the rotation frequency of the two particle system.

Furtheron the following abbreviation is used

$$r_g = \frac{q_1 * q_2}{10^7 * m_1} \tag{25}$$

With these basic equations it is possible to derive the kinetic energy, angular moment, and rotation frequency, all only dependent on the radius r_1.

4.1 Kinetic rotation energy

The kinetic rotation energy for a two particle system is

$$E_{kin} = \frac{m_1 * c^2}{2 * (1 + \frac{m_1}{m_2}) * |(\frac{r_1}{r_g} - 1)|} * (1 + \frac{6 * mm_1 * mm_2}{c^2 * q_1 * q_2 * (1 + \frac{m_1}{m_2})^2 * r_1^2}) \tag{26}$$

If one sets
$m_1 << m_2$, and mm_1 or $mm_2 = 0$, and use (r_1/r_g) instead of $(r_1/r_g - 1)$
then one arrives at the kinetic energy known from the Bohr model.

$$E_{kin}(Bohr) = \frac{m_1 * c^2}{2 * (\frac{r_1}{r_g})} = \frac{m_1 * c^2 * r_g}{2 * r_1} = \frac{m_1 * c^2 * e^2}{2 * 10^7 * m_1 * r_1} = \frac{e^2}{8 * \pi * \epsilon_0 * r_1} \tag{27}$$

4.2 Angular moment

The angular moment for a two particle system amounts to

$$L = \frac{m_1 * r_1 * c}{\sqrt{|(\frac{r_1}{r_g} - 1)|}} * \sqrt{1 + \frac{6 * mm_1 * mm_2}{c^2 * q_1 * q_2 * (1 + \frac{m_1}{m_2})^2 * r_1^2}} \tag{28}$$

4.3 Rotation frequency

The frequency is given by

$$2 * \pi * f = \frac{c}{(1 + \frac{m_1}{m_2}) * r_1 * \sqrt{|(\frac{r_1}{r_g} - 1)|}} * \sqrt{1 + \frac{6 * mm_1 * mm_2}{c^2 * q_1 * q_2 * (1 + \frac{m_1}{m_2})^2 * r_1^2}} \tag{29}$$

This last equation is dependent on the former two as

$$\omega = 2 * \pi * f = \frac{2 * E_{kin}}{L} \tag{30}$$

So we have now for a given pair of opposit charged particles equations that are

only dependent on the rotation radius r_1.

5 Connection to photon and spectral lines

Apply the formulas to atoms with their known and measured spectral lines.

5.1 Rotation frequency and photon frequency

Looking at an electron coming from infinity to the stable ground state radius a photon is created. This photon has a frequency f_p that is exact half the rotating frequency of the atom f_a atom (electron and proton).

$$f_p = 1/2 * f_a \tag{31}$$

This is corresponding to the reverse of ionization, starting from infinite radius. For other transitions f_a is accordingly only the difference between the two states.

Using this condition it is possible to calculate the radius in ground state of various atoms circled by one electron using the spectral lines (e.g. from NIST). From the calculated radius one can then calculate the kinetic rotation energy of the atom E_{akin} and also the angular L_a moment.

5.2 Angular moment

From the conservation of angular moment it follows that the created photon must have an angular moment L_p of the same amount. (vector sum of angular moments must be zero). For the absolute values we have

$$L_p = L_a \tag{32}$$

This is corresponding to the ionization, starting from infinite radius. For other transitions L_a is accordingly only the difference between the two states.

5.3 Energy

Two masses with opposit charges have a fixed potential energy E_0 when they are infinitely far apart from each other. In the Bohr model this energy potential is set to zero, as the real absolute value is not known. With reducing the distance between the particles the Bohr energy is negative by that reducing the potential

enrgy E_0. With setting the total energy at infinity to E_0 the energy remains positive. It is reduced when the radius gets smaller, the pair looses potential energy that is converted into

a) kinetic rotation energy $E_{apot}(r)$ of the atom and
b) photon energy E_p

So one can write

$$E_0 = E_{apot}(r) + E_{akin}(r) + E_p \tag{33}$$

All these energies are positive or zero, never negative.
Up to now $E_{apot}(r)$ and E_p is not known. But there are paths that could be checked.

Potential energy of atom:
For the potential energy one can make the assumption that for an atom in ground state with one electron in the shell, the kinetic energy is identical with the absolute potential energy. $E_{apot} = E_{akin}$ That is most probably the reason, as no other reason seems to be imaginable why the electron in ground state reaches exact the radius to form stable atoms.

Photon energy:
The emitted photon will get exactly half the kinetic energy the atom got. This follows immediately from the condition that f_p is half of f_a, and the absolute values of the angular moments are identical.

6 Calculation results from using spectral lines

With numerical calculations one can get from the spectral lines the radius of the electron. All other values Ekin, L can then be determined.
Also other transitions from shell n to m can be calculated if there is only one electron circling around the kernel.
If one looks at the transition for an ion, e.g. an atom that has already n electrons and the n+1th electron makes a transition form shell n+2 to n+1, the mass of the kernel has to be adjusted (add the mass of the electrons) with the mass of the already rotating electrons.
This calculation delivers exact frequency values compared with spectral lines.
The photons have always half the frequency of the atom rotation frequency difference.

H spin flip
With the knowledge of the base rotating frequency of the Hydrogen atom and the spin flip frequency it is possible to calculate the difference of the kinetic energy and the difference of the angular moment. Half of the kinetic energy difference is then given to the created photon.

All calculations are based a circled paths around the kernel, so the whole consideration is based on that the electrons are in the s-shell. Other trajectories are not yet considered.

7 Energy minimum link to Neutron

With the help of the new theory it is possible to calculate the total energy contained in an electron proton pair. The reference potential energy was selected such, that the potential energy equals the kinetic energy in ground state. The result is shown in Fig.1.

The graphic shows that the energy would grow to infinity at r_g, but also shows that there is a minimum at a radius smaller than r_g. The radius of this minimum is not influenced by the reference potential energy, it stays the same for any constant added to the potential energy.
Of interest is now the value of the radius, where one finds this minimum. It is at r $= 1,87..*10^{-15}$ m, close to the expected radius of a neutron. Here it is known from scattering experiments, that the radius is in a range of about 1,5 to $1,7*10^{-15}$ m.

There is a second fact. Looking at the energy it is possible with this new theory to differentiate between the kinetic energy caused by the magnetic dipol moments E_m and the kinetic energy caused by the static and Lorentz Force E_L.

Calculating the mass difference m(neutron) - m(electron) - m(proton) you arrive at $1,39422E-30$ kg. Converting this into mass energy according $E = m*c^2$, one gets $0,78210$ MeV.
Determining numerically with the new theory at the energy minimum the energy caused by static and Lorentz Force one arrives at E_L=$0,76087$ MeV.
This is only 2,7 % smaller than the calculated value from the mass difference. Now one can ask:
Is the energy caused by static and Lorentz Force underlying garavity ?
Is this mass ?
Is the Lorentz Force one major reason for creating mass and gravity ?

The kinetic energy caused by the dipol force cannot underly gravitation, as its value is much too big. E_m is about 97 times larger than E_L.

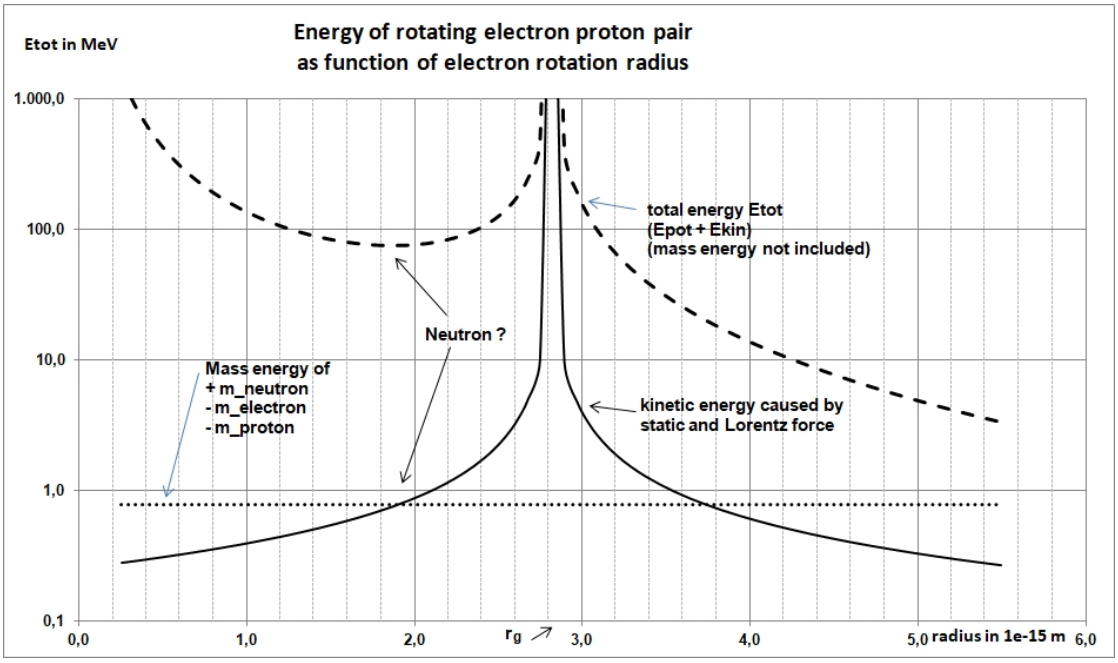
Energy of rotating electron proton pair
as function of electron rotation radius
Etot in MeV
1.000,0
100,0
10,0
1,0
0,1
0,0
1,0
2,0
rg
3,0
4,0
5,0
radius in 1e-15 m
6,0
total energy Etot
(Epot + Ekin)
(mass energy not included)
Neutron ?
Mass energy of
+ m_neutron
- m_electron
- m_proton
kinetic energy caused by
static and Lorentz force

Figure 1:

8 Consequences of the new theory

Starting point for this new theory was

- **c as the velocity of emitting photons from their source**
- **no limiting velocity for particles and photons**
- **the electric static force**
  the dynamic (Lorentz) force and
  the magnetic dipol force
  are acting immediately, without any retardation,

In this new theory follows

- **the Lorentz Force is a cause for gravity**
- **then gravity is also acting immediately without any retardation.**

9 The Photon model

Using exact the same basic equations as for the atom with one electron one can set up a photon model consisting of:

1. two rotating particles with mass $m_{p1} = m_{p2}$
2. both have the same amount of charge
that is exact the elementary charge e, so $q_1 = -q_2 = e$
3. both have the same amount of magnetic dipol moment
$mm_{p1} = mm_{p2}$ that are oriented parallel on the same line. So the magentic moments rotate together with the particles always staying on one line.
4. The velocity of the two particles is

$$v_p = 2 * \pi * c \tag{34}$$

so that their relative speed is

$$v_{prel} = 4 * \pi * c \tag{35}$$

It follows that

$$f_p = c/r_{p1} \tag{36}$$

With these assumptions we get the following
using $r_g = e^2/(10^7 * m_{p1})$
and r1 as rotation radius of the particles to the center of mass.
Their distance is $2 * r_{p1}$.

9.1 The force equations for a photon

Centrifugal force

$$F_c = (2 * \pi * c)^2 * m_{p1}/r_{p1} \tag{37}$$

The Coulomb force

$$F_q = \frac{c^2 * e^2}{10^7 * 2^2 * r_{p1}^2} \tag{38}$$

The Lorentz Force

$$F_L = \frac{e^2 * (v_1 - v_2)^2}{10^7 * 2^2 * r_{p1}^2} = \frac{(2 * \pi * e * c)^2}{10^7 * r_{p1}^2} \tag{39}$$

The magnetic force (from magnetic moments mm)

$$F_m = \frac{6 * mm_{p1}^2}{10^7 * 2^4 * r_{p1}^4} \tag{40}$$

With the given assumptions for the photon and these formulas one can derive all following relations

9.2 Kinetic energy of a photon

The kinetic rotation energy is

$$E_{pkin} = \frac{m_{p1} * c^2}{4 * |(\frac{r_{p1}}{r_g} - 1)|} * (1 + \frac{6 * mm_{p1}^2}{c^2 * e^2 * 4 * r_{p1}^2}) \tag{41}$$

and due to the expected constant rotation velocity

$$E_{pkin} = 2 * 1/2 * m_{p1}(2 * \pi * c)^2 \tag{42}$$

so it follows immediately

$$m_{p1} = \frac{E_{pkin}}{(2 * \pi * c)^2} \tag{43}$$

so the total particle mass of the photon is twice this value

$$m_p = \frac{E_{pkin}}{2 * (\pi * c)^2} \tag{44}$$

The total force equation can be written as

$$(2 * \pi * c)^2 * m_{p1}/r_{p1} = \frac{c^2 * e^2}{10^7} + \frac{(2 * \pi * e * c)^2}{10^7 * r_{p1}^2} + \frac{6 * mm_{p1}^2}{10^7 * 2^4 * r_{p1}^4} \tag{45}$$

Using $r_{p1} = c/f_p$ leads to

$$E_{pkin} = \frac{c * e^2 * f_p}{10^7} * (\frac{1}{4} + 8 * \pi^2 + \frac{3 * mm_{p1}^2 * f_p^2}{8 * c^4 * e^2}) \tag{46}$$

Here one can see the different influences of the three forces. The kinetic energy caused by the Lorentz Force is always $(4*\pi)^2$ larger than the kinetic energy caused by the static Coulomb force. The kinetic energy caused by the magnetic moments is dependent on the magnetic moments itself and the frequency.

9.3 Angular moment of a photon

The angular moment amounts to

$$L_p = \frac{m_{p1} * r_{p1} * c}{\sqrt{|(\frac{r_{p1}}{r_g} - 1)|}} * \sqrt{1 + \frac{6 * mm_{p1}^2}{c^2 * e^2 * 4 * r_{p1}^2}} \tag{47}$$

With the kowledge of the photon mass the angular moment can also be calculated by

$$L_p = 2 * m_{p1} r_{p1} * v_{p1} = \tag{48}$$

or

$$L_p = 4 * \pi * m_{p1} * c^2/f_p \tag{49}$$

9.4 Rotation frequency of a photon

The frequency is given by

$$2 * \pi * f_p = \frac{c}{2 * r_{p1} * \sqrt{|(\frac{r_{p1}}{r_g} - 1)|}} * \sqrt{1 + \frac{6 * mm_{p1}^2}{c^2 * e^2 * 4 * r_{p1}^2}} \tag{50}$$

This last equation is dependent on the former two as

$$\omega_p = 2 * \pi * f_p = \frac{2 * E_{pkin}}{L_p} \tag{51}$$

For the frequency also the following can be derived

$$f_p^3 = \frac{2 * c^4}{3 * mm_{p1}} * ((4 * \pi)^2 * c * 10^7 * m_{p1} - e^2 * (1 + (4 * \pi)^2) * f_p) \tag{52}$$

Knowing the frequency the magnetic moment can be determined

$$mm_{p1}^2 = \frac{2 * c^4}{3 * f_p^3} * ((4 * \pi)^2 * c * 10^7 * m_{p1} - f_p * e^2 * (1 + (4 * \pi)^2) \tag{53}$$

10 Translational energy with considering Lorentz mass

Up to now only rotational energies were considered. Now one can look at the translational energy, as it is considered that the photon will be ejected from its source (the atom) with light speed c.
The additional translational energy of the photon is then $2 * 1/2 * m_{p1} * c^2$. If one now considers as shown from the neutron, that the Lorentz energy is also underlying gravitational forces, then the Lorentz energy can be considered to act as further additional mass. The amount of this mass can be derived from the energy formula taking only the portion that is caused by the Lorentz Force.

$$E_{pkin}(Lorentz) = 4 * \pi^2 * f_p * c * e^2/10^7 \tag{54}$$

and with that the additional Lorentz mass m_L is

$$m_L = \frac{4 * \pi^2 * e^2 * f_p}{c * 10^7} \tag{55}$$

11 Summary

This new theory combines the generation of photons with the electron transitions of an atom as long as the electrons are on a circled path (in the s-shell).
This theory allows to describe and calculate the physical parameters of an electron kernel pair if there is one electron circling around a positivle charged kernel only derived from measured atomic spectra. The Planck constant is not used in the whole theory. From the measurable frequency of atomic spectra one can conclude back to the radius of an electron around the center of mass, and can calculate with that the kinetic energy, the angular moment and verify the frequency. Not achievable from this is the potential energy that is contained in two opposite

charged particles. First, when one calculates the resulting photon of an electron transition form one track to another, the total contained energy can be determined. So the sum of all energy contained in a pair of oppositly charged masses can be calculated. In the ground state of an atom the kinetic energy equals the potential energy. Also for all photons the contained potential energy has exactly the same amount as the kinetic energy. The total energy is the sum of the following energy portions:

1. The kinetic rotation energy of the two particles in ground state
2. the potential energy of the two particles in ground state equals the kinetic energy
3. the kinetic photon rotation energy is exactly half of the atom kinetic rotation energy
4. the potential photon energy equals the kinetic rotation energy of the photon
5. the translational energy of the photon masses, as they are accelerated to light speed c
6. the translational energy of the photon Lorentz mass, as this is also accelerated to c

This complete summation gives the total energy contained in two oppositly charged masses far apart from each other.
In the Bohr model this was simply set to zero(0) as reference point.

12 Discussion and Outlook

12.1 Mass equivalence of Energy and Mass

In todays theory it is assumed that each energy content is equivalent to mass and is with that mass underlying gravity. In this New Theory rotational energy that is caused by static forces (resulting from potential energy) and rotational energy caused by magnetic dipol moments are not underlying gravitation. Only the rotational energy portion that is caused by the Lorentz Force is acting as mass, underlies gravitation, and creates gravitational forces. This does not say that there is no equivalence between mass and energy, it only says that not all energy types are underlying gravity and act as gravitation.

12.2 The Lorentz Force as a source for gravitation

Now a mathematical problem can be set up.
Looking at two systems each containing two oppositly charged masses rotating

around their center of mass with radius r. The two systems are far apart from each other (distance = d), with d »r . It is now interesting to calculate the average Lorentz Force between the two systems. For this calculation the average has to be taken for all possible rotation orientations of the two systems and also for all phase differences of the two rotating sytsems.
Due to the dependence of the squared relative velocity of the Lorentz Force there might be a resulting attracting force between the two systems. If that can be shown, it could prove that the Lorentz Force is a reason for gravitation.

12.3 Prove that photons consist of charged masses

Use a single slit setup.
Use a slit that is smaller than than the wavelength of the photons.
Apply a magnetic field parallel to the slit behind the slit.
Use conductive material for the screen plane and divide this plane in half, exactly in the middle parallel to the slit.
Isolate the two planes electrically.
Measure the voltage between the plates.
Create a photon beam hitting the slit.
Measure the created voltage between the isolated planes dependent on the applied magnetic field.
If one changes the orientation of the magnetic field by 180 degrees, then the voltage should change the polaritiy .

This would prove that photons consist of oppositly charged masses rotating around each other.

12.4 The problem to find the correct potential energy

The whole new theory presently is based on a combination of three electrical forces. The force from the electric potential, the force from the Lorentz force, the force from magnetic moment. For an atom the potential enrgy-difference is calculated in the same way as in the Bohr model. But this can only be an approximation valid for large distances of the rotation radius larger than r_g. If the radius gets smaller, the error gets bigger, as for r=0 the potential energy would go to infinity, what cannot be. This is due to the fact that the atom kernel and the electron are assumed to be dimensionless point charges. So in reality one can expect a further force that causes the electric force to vanishes to zero (0) at $r_g > r > 0$. So also the potential energy can be expected to go to zero (0) at a radius larger than zero (0). The same is true for the magnetic dipol force, also this math expression assumes a radius for the magnetic dipol of 0, what also cannot be. So the whole model gets inaccurate the closer it gets to small radii. An idication might be that for

the Hydrogen atom the radius is about 18.000 time larger then r_g, very accurate results can be expected, much better than for the Neutron, where the rotation radius is slightly below r_g.

12.5 Is there a link to unstable orbits for all radioactive atoms ?

If one calculates with the given approximation theory the radii of atoms, one sees that all radiactive elements have a radius for the first electron in ground state r_1 that are smaller than r_g. This leads to the negative value in the expression of $(r_1/r_g - 1)$, that appears in the energy, the angular moment , and frequency formulas. As there are also some elements that are stable, according this approximation, one could check with a refined force formula, that uses no point charges and no idealized forces between magnets, if this condition could be the raeson, for atoms to be unstable, to be redioactive. There might be a chance to find a relation between the location of the force below r_g and the life time of radioactive elements. So one main question arises: Are atom orbits with $r_1 < r_g$ generally unstable and with that the reason why those elements are radioactive ?

References

[1] Classical Electrodynamics, 3rd Edition, John David Jackson