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The electromagnetic mass of the proton

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Abstract
In the proton, there is an energy equilibrium between the relativistic energy of its positron and the electromagnetic energy of its two magnetic poles. There is also an energy equilibrium between the rest energy of the proton and the electromagnetic energy of its three charges and an electromagnetic radiation component, which is interpreted as time radiation. The conclusions of the energy equilibrium are used to verify the structure of the proton [1].

Keywords: Proton, Proton structure, Electromagnetic mass

1. Introduction

The existence of magnetic monopoles in protons follows from the electromagnetic derivation of gravitation [2.] The structure of the proton was discovered, described and proven with the electromagnetic fundamental forces and symmetry conclusions [1.] With the proton structure, the known relationship between strong and electromagnetic force could be proven. If it were possible to explain the mass of the proton completely with electromagnetic energy components, an old dream of scientists would come true. James Clerk Maxwell, Wilhelm Wien, Max Abraham, Hendrik Lorentz and Henri Poincare had tried in vain with various theories to establish the mass of bodies and electrons completely electromagnetically. If this explanation were to succeed, quarks, gluons and the Higgs mechanism would no longer be needed to explain the observed phenomena.

2. The energy equilibrium in the proton

The proton consists of a positron with a positive electric charge, a magnetic north pole and a magnetic south pole. The positron and also the two magnetic charges move at approximately the speed of light on an orbital radius that corresponds to the proton radius [1]. The two magnetic monopoles therefore also have this high speed.

The relativistic energy of the positron is the sum of the electromagnetic energy of the two monopoles which are brought infinitely far apart, starting from the distance of the proton radius. This unique constellation, together with the proton's explosive components of matter and antimatter, ensures its incredible stability. It is incontrovertible proof that the discovered components of the proton [1.] exist, interact with each other and are in energy equilibrium.

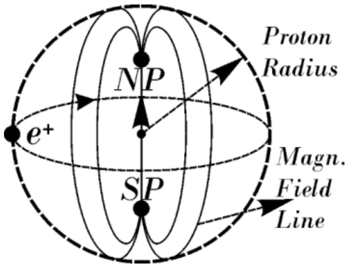

Figure 1: *Model of the proton, consisting of north pole NP, south pole SP and positron e+*

Equation (01) shows for the first time the following concise energy equilibrium of the positron in the proton. The relativistic energy of the positron E_{po} is as large as the electromagnetic energy E_{em1} and E_{em2} between the positron and the two magnetic poles:

$$E_{po} = \mu_r(E_{em1} + E_{em2}) = m_{po}c^2 \qquad m_{po} = \frac{m_{po0}}{\sqrt{1-\frac{v_{po}{}^2}{c^2}}} \qquad (01)$$

What electromagnetic energy is meant here? It is well known that the energy results from the integral of the force over the distance. For example, the electrical force between two charges at a distance r can be used to calculate the energy that results when the charges are brought infinitely far apart in a vacuum. The energy between two elementary charges with the initial distance of the proton radius r_p, which are brought infinitely far apart in a vacuum, is to be calculated:

$$E_{em} = \int_{r_p}^{\infty} F_{em}\,dr = \int_{r_p}^{\infty} \frac{e^2}{4\pi\varepsilon_0 r^2}\,dr = -\frac{e^2}{4\pi\varepsilon_0 r}\bigg|_{r_p}^{\infty} = \frac{e^2}{4\pi\varepsilon_0 r_p} \qquad (02)$$

$$E_{em} = \int_{r_p}^{r_{uni}} F_{em}\,dr = \int_{r_p}^{r_{uni}} \frac{e^2}{4\pi\varepsilon_0 r^2}\,dr = -\frac{e^2}{4\pi\varepsilon_0 r}\bigg|_{r_p}^{r_{uni}} = \frac{e^2}{4\pi\varepsilon_0 r_{uni}} + \frac{e^2}{4\pi\varepsilon_0 r_p} \qquad (02a)$$

Instead of infinity, the radius of the universe should be used: $r_{uni} = c\,t_{uni} = 1.305\;10^{26}\;m$ (see (02a)). Thus the entire electromagnetic space energy is located outside the proton, between the proton radius and the radius of the universe. As a result, in equation (02) a tiny energy component of $1.768\;10^{-54}\;Ws$ is added. ***It is shown below that electromagnetic space energy manifests itself in the rest energy of the proton. It therefore causes the rest mass of the proton***.

It is no coincidence that the ratio of the electromagnetic energy calculated for the radius of the universe to that calculated for the proton radius, multiplied by the Klitzing resistance/vacuum wave resistance ratio, leads to the fundamental interaction ratio gravitation/electromagnetics: $\alpha_{grav}/\alpha_{em} = 4.41\;10^{-40}$.

Those energies from elementary charges with the proton radius r_p are used in the following calculations.

The material-dependent permeability of the proton μ_r increases the magnetic field strength and the magnetic and electromagnetic energy by a factor of 68.5. This corresponds exactly to the ratio between the strong force and the electromagnetic force.

The calculation rules for the individual energies are used in equation (01):

$$E_{po} = m_{po}c^2 = \frac{m_p\,c^2}{4} = \mu_r(E_{em1} + E_{em2}) = \frac{R_{Kl}}{Z_0}\left(\frac{e^+ p_{NP}\,c}{4\pi r_p} + \frac{e^+ p_{SP}\,c}{4\pi r_p}\right) \qquad (03)$$

Compared to the vacuum, the material-dependent permeability prevails in the proton $\mu_r = R_{Kl}/Z_0$.

Equation (03) can be simplified and then leads directly to equation (43) from [1.]

For electromagnetic energies E_{em} of elementary charges at the initial distance r_p determined using the relationship (02) applies in a vacuum:

$$E_{em} = \frac{epc}{4\pi r_p} = \frac{e^2}{4\pi\varepsilon_0 r_p} = \frac{p^2}{4\pi\mu_0 r_p} \qquad (04)$$

Equation (03) should now be extended. To express the rest energy of the proton $E_{p\,rest}$ with electromagnetic components, the following can be written instead of (03):

$$E_{p\,rest} = m_p\,c^2 = 4\frac{R_{Kl}}{Z_0}\left(\frac{e^+ p_{NP}\,c}{4\pi r_p} + \frac{e^+ p_{SP}\,c}{4\pi r_p}\right) \qquad (05)$$

Equation (06) shows a different notation for (05) when (04) is included:

$$E_{p\,rest} = m_p\, c^2 = 2\frac{R_{Kl}}{Z_0}\left(\frac{p^2}{4\pi\mu_0 r_p} + \frac{p^2}{4\pi\mu_0 r_p} + \frac{e^+ p_{NP}\, c}{4\pi r_p} + \frac{e^+ p_{SP}\, c}{4\pi r_p}\right) \quad (06)$$

Furthermore, according to the publication [1.], the relativistic kinetic energy of the positron is E_{po}:

$$E_{po} = m_{po}\, c^2 = hf_{po} = \frac{R_{Kl}}{Z_0}\left(\frac{e^+ p_{NP}\, c}{4\pi r_p} + \frac{e^+ p_{SP}\, c}{4\pi r_p}\right) = 2\frac{R_{Kl}}{Z_0}\frac{e\, p\, c}{4\pi r_p} \quad (07)$$

Equation (07) is inserted into (06) to obtain the electromagnetic energy $E_{em\,p}$ of the proton, taking into account the radiation of electromagnetic energy with the frequency f_p:

$$E_{p\,em} = m_p\, c^2 - hf_p = 2\frac{R_{Kl}}{Z_0}\left(\frac{p^2}{4\pi\mu_0 r_p} + \frac{e^+ p_{NP}\, c}{4\pi r_p} + \frac{e^+ p_{SP}\, c}{4\pi r_p}\right) \quad (08)$$

If equation (08) is related to the wavelength of the radiation of the proton $\lambda_p = 2\pi\, r_p$ with the frequency f_p the factor 2 is omitted:

$$E_{p\,em} = m_p\, c^2 - hf_p = \frac{R_{Kl}}{Z_0}\left(\frac{p^2}{\lambda_p \mu_0} + \frac{e^+ p_{NP}\, c}{\lambda_p} + \frac{e^+ p_{SP}\, c}{\lambda_p}\right) \quad (08a)$$

Equation (08) shows the three charge interactions of the three proton components in the brackets. According to equation (03), the relativistic energy of the positron is in equilibrium with the electromagnetic energy between each monopole and the positron. According to equations (08) and (08a), the rest energy of the proton minus a radiation component is in equilibrium with the electromagnetic energy components of all three charges it contains.

Equation (09) shows another notation for (08):

$$E_{p\,rest} = m_p\, c^2 = \frac{1}{\alpha}\left(\frac{p^2}{4\pi\mu_0 r_p} + \frac{e^+ p_{NP}\, c}{4\pi r_p} + \frac{e^+ p_{SP}\, c}{4\pi r_p}\right) + hf_p \quad (09)$$

The term responsible for the electromagnetic energy of the radiation makes up exactly one quarter of the rest energy of the proton, three quarters are claimed by the electromagnetic energy between the charges. ***The rest energy of the proton is caused entirely by the electromagnetic space energy, which exists between the boundaries "proton radius" and "universe radius" and contains a radiation component. The proton's radiation couples to space in the form of time and creates space-time.***

The speed of the positron, which corresponds to the speeds of the magnetic poles, is to be calculated exactly. Equation (08) can be written using (04):

$$E_{p\,em} = m_p\, c^2 - m_{po}\, c^2 = \frac{1}{\alpha}\frac{3e^2}{4\pi\varepsilon_0 r_p} \quad (10)$$

$$E_{po} = m_{po}\, c^2 = \frac{m_{po0}}{\sqrt{1-\frac{v_{po}^2}{c^2}}}\, c^2 = \frac{m_e}{\sqrt{1-\frac{v_{po}}{c^2}}}\, c^2 = m_p\, c^2 - \frac{3}{4} m_p\, c^2 = m_p\, c^2 - \frac{1}{\alpha}\frac{3e^2}{4\pi\varepsilon_0 r_p} \quad (11)$$

Equation (12) shows a simple relationship between the electron and proton mass if the velocity of the positron v_{po} is known.

$$m_e = \sqrt{1 - \frac{v_{po}^2}{c^2}}\left(m_p - \frac{1}{\alpha\, c^2}\frac{3e^2}{4\pi\varepsilon_0 r_p}\right) = \sqrt{1 - \frac{v_{po}^2}{c^2}}\left(m_p - \frac{3\hbar}{c\, r_p}\right) \quad (12)$$

To obtain the speed v_{po} equation (12) can be rearranged:

$$v_{po} = v_{NP} = v_{SP} = c\sqrt{1 - \frac{m_e^2}{\left(m_p - \frac{3\hbar}{c\, r_p}\right)^2}} \quad (13)$$

This speed of the positron v_{po} also applies to the north pole v_{NP} and the South Pole v_{SP}.

Poincare, for example, believed as early as 1905 that the rest energy of the electron corresponds to three quarters of its electromagnetic energy. The fourth quarter should be the energy of the so-called Poincare tension [3]. Even Einstein later failed to explain the missing quarter. ***For the proton,*** it now turns out that the electromagnetic energy component without radiation also makes up exactly three quarters of its rest energy.

The same question arises today as it did then for the electron. What is the last quarter of the energy? Equation (09) shows the answer. It is electromagnetic radiation. This radiation is time [1.].

The following equations illustrate the relationships between the energy components of the proton:

$$E_{p\,em} = \frac{3}{4} E_{p\,rest} \qquad E_{p\,rest} = \frac{4}{3} E_{p\,em} \tag{14}$$

$$E_{p\,em} = \frac{3}{4} m_p\, c^2 = 2 \frac{R_{Kl}}{Z_0} \left(\frac{p^2}{4\pi \mu_0 r_p} + \frac{e^+ p_{NP}\, c}{4\pi r_p} + \frac{e^+ p_{SP}\, c}{4\pi r_p} \right) \tag{15}$$

$$E_{p\,em} = \frac{3}{4} m_p\, c^2 = \left(m_{po}\, c^2 + m_{NP}\, c^2 + m_{SP}\, c^2 \right) \tag{16}$$

Equations (15) and (16) show that the relativistic energy of each partial mass of the proton (positron, north pole, south pole) corresponds to twice the energy equivalent between two charges. This was shown by equation (07) for the relativistic energy of the positron.

The radiation energy $E_{p\,rad}$ is a quarter of the rest energy of the proton:

$$E_{p\,rad} = \frac{1}{4} E_{p\,rest} = E_{po} = m_{po}\, c^2 = 2 \frac{R_{Kl}}{Z_0} \frac{epc}{4\pi r_p} = \frac{R_{Kl}}{Z_0} \frac{epc}{\lambda_{po}} \tag{17}$$

$$E_{p\,rad} = \frac{1}{3} E_{p\,em} = E_{po} = h f_p = \frac{\hbar\, v_{po}}{r_p} = \frac{\hbar}{t_p} \tag{18}$$

$$E_{p\,rest} = E_{pt\,em} = m_p\, c^2 = E_{p\,em} + E_{p\,rad} = \frac{3}{4} E_{p\,rest} + \frac{1}{4} E_{p\,rest} \tag{19}$$

Because the time radiation is also electromagnetic, the rest mass of the proton $m_{p\,rest}$ corresponds to the total electromagnetic mass $m_{pt\,em}$:

$$m_{pt\,em} = m_{p\,rest} = \frac{E_{pt\,em}}{c^2} = \frac{E_{p\,rest}}{c^2} \tag{20}$$

<u>Designations and values</u>

h	Planck constant, $h = 6.626\ 10^{-34}\ Ws^2$
$\hbar$	reduced Planck constant $\hbar = h/(2\pi)$
c	Speed of light, $c = 2.9979\ 10^{8}\ m/s$
α	Fine structure constant, $\alpha = 7.297\ 10^{-3}$
ε_0	Permittivity of the vacuum, $\varepsilon_0 = 8.854\ 10^{-12}\ Vs/(Am)$
μ_0	Permeability of the vacuum, $\mu_0 = 1.257\ 10^{-6}\ As/(Vm)$
R_{Kl}	Klitzing resistance, $R_{Kl} = 2.581\ 10^{4}\ \Omega$
Z_0	Vacuum characteristic impedance, $Z_0 = 3.767\ 10^{2}\ \Omega$
μ_r	Permeability of the proton, substance-dependent $\mu_r = R_{Kl}/Z_0$

F_{em} Force, electromagnetic E_{em} Energy, electromagnetic

E_{po} energy, relativistic of the positron in the proton, $E_{po} = 3.758\ 10^{-11}\ Ws$

E_{em1} Energy, electromagnetic between positron and north pole p_{NP} in the proton

E_{em2} Energy, electromagnetic between positron and south pole p_{SP} in the proton

$E_{p\ em}$ Energy, electromagnetic, proton without radiation

$E_{pt\ em}$ Energy, electromagnetic total, proton with radiation

$E_{p\ rest}$ Rest energy of the proton, $E_{p\ rest} = 1.503\ 10^{-10}\ Ws$

m_{po} Mass, relativistic of the positron, $m_{po} = m_p/4 = 4.182\ 10^{-28}\ kg$

m_{po0} Rest mass of the positron, $m_{po0} = m_e = 9.109\ 10^{-31}\ kg$

m_p Rest mass of the proton, $m_p = 1.673\ 10^{-27}\ kg$

m_{NP} Mass, relativistic of the North Pole, $m_{NP} = m_p/4 = 4.182\ 10^{-28}\ kg$

m_{SP} Mass, relativistic of the south pole, $m_{SP} = m_p/4 = 4.182\ 10^{-28}\ kg$

v_{po} Speed of the positron in the proton, $v_{po} = c\sqrt{1 - \frac{{m_{po0}}^2}{{m_{po}}^2}}$

f_p Frequency of the proton radiation, $f_p = 1/(2\pi t_{po}) = 5.672\ 10^{22}\ Hz$

t_p reduced period of the proton radiation, $t_p = r_p/v_{po} = 2.806\ 10^{-24}\ s$

p_{NP} North pole elementary charge, $p_{NP} = p = \sqrt{\alpha 4\pi c \mu_0 \hbar} = 6.036\ 10^{-17}\ Vs$

p_{SP} South pole elementary charge, $p_{SP} = p$

r_p Proton radius, $r_p = 4\hbar/\left(m_p\ c\right) = 8.412\ 10^{-16}\ m$ with proton mass m_p

e^+ Charge of the positron, $e^+ = e^- = e = 1.602\ 10^{-19}\ As$

With these values, the relativistic energy of the positron in the proton according to equation (01) is $E_{po} = 3.758\ 10^{-11}\ Ws$. This corresponds to exactly a quarter of the rest energy of a proton. The total electromagnetic energy of the proton including radiation is $E_{pt\ em} = 1.503\ 10^{-10}\ Ws$ and is as large as its rest energy. The electromagnetic energy without the radiation component is 3 quarters of the rest energy, i.e. $E_{p\ em} = 3/4\ \ 1.503\ 10^{-10}\ Ws = 1.127\ 10^{-10}\ Ws$. This makes it possible to explain the baryonic mass in the universe with its electromagnetic origin. Neutrons, which also make up a certain proportion of the mass in the universe, are very similar to protons. They only have an additional electron and an electron antineutrino, which are released alongside the proton during the beta-minus decay of free neutrons.

As it is theory that determines what experimental research can look for, the proton can now be investigated anew with regard to the properties described. On the basis of the available research results, experimental proof of the proton structure and the energy content of its components can be provided. It will certainly also be possible to reinterpret experiments that have already been carried out.

3. Summary

The proton structure presented not only explains the fundamental forces on the basis of an electro-magnetic origin and not only leads to a perfect symmetry between the charges in the universe and in the hydrogen atom. This proton structure also explains the energy equilibrium between the relativistic energy of its

positron and its two magnetic poles as well as the energy equilibrium between the proton rest energy and the electromagnetic energy of its three charges including a radiation component.

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