Research article

A new model for the neutron and the "pseudo-vector" nature of the mass.

Francesco Ferrara

Physics teacher at state technical institute "M. Orso Corbino", located in Partinico (PA), independent researcher

Sito internet: www.proffonlineall.it

The undersigned is the author of the following textbooks:

1. **Verso la fisica**, published by Arianna Edition: text intended for the two-year period of the scientific high school, the link of which is given below https://www.amazon.it/s?k=verso+la+fisica&__mk_it_IT=ÅMÅŽÕÑ&ref=nb_sb_noss

2. **Con me stanno buoni**, a book that presents a realistic vision of today's school, going beyond the facade that hides it.https://www.amazon.it/s?k=con+me+stanno+buoni+francesco+ferrara&__mk_it_IT=ÅMÅŽÕÑ&ref=nb_sb_noss

3. **Il danzatore cosmico**, Aracne edizioni, divulgative physics text

https://www.youtube.com/watch?v=gTgkX2K1RFE

1. Introduzione

My name is Francesco Ferrara, I am a physics teacher and an independent researcher.

I have always shown a lively involvement towards knowledge, preferring a holistic approach: my interests range from physics, to electronics, from medicine, to philosophy. My research mainly makes use of unofficial sources, coming mainly from the world of the net, which tend to promote contents other than those officially accepted. I believe that the contribution that independent researchers have given to science, in the most disparate sectors, is noteworthy, since these scholars have been exclusively motivated by a healthy curiosity, devoid of economic interests.

Considering the knowledge gained from reading the documents of some Italian researchers, I have built, through my theoretical research, a model for the neutron.

1.1 The true nature of matter

The theoretical research of some Italian physicists regarding a new model of the electron, suggest a radical change of the point of view from which we observe reality.

A new ultimate constituent of matter emerges, different from what official science proposes us.

From the theoretical developments of our physicists, including mine, which is inspired by their work, it would emerge that the particles are described by massless charged balls, rotating at the speed of light, which describe some loops of current.

The loops of current thus represented, although formed by massless balls, would have an intrinsic mass, of a purely electromagnetic nature. This mass would be directly proportional to the pulsation with which the balls rotate and inversely proportional to the radius of the circumferences described.

These recent facts inevitably lead to a new vision of reality: light and its speed would be the real protagonists in the formation of matter. The ultimate constituent of matter, whose research has been fateful for physicists of all time, could simply be: Light!

1.1 Natural units

Before presenting the new model for the neutron, it is necessary to introduce the natural units: a measurement system that considers unitary and dimensionless, the followings physical quantities: the speed of light c, the reduced Planck constant and the constant $4\pi\varepsilon_0$

$c = \hbar = 1$ Relazione 1

$4\pi\varepsilon_0 = 1$ Relazione 2

In this system all other physical quantities are expressed a positive, negative or zero power of the "electron volt".

Dichiarazione delle grandezze fisiche del modello e corrispondenza fra unità naturali ed MKSA

Grandezza fisica	**Simbolo**	**Unità nel sistema naturale**	**Unità nel sistema MKSA**
Momentum	P	$1\ eV$	$5.3442883 \times 10^{-28}\ \frac{\mathrm{kg \cdot m}}{\mathrm{s}}$
Mass accepted for the neutron	m_n	939.56563 MeV	$1.6749286 \times 10^{-31}$ kg
Electron charge	e	8.5424546×10^{-2}	$1.60217733 \times 10^{-19}$ C
Carrier potential	A	eV	vsm^{-1}
c	R_p	$1/eV$	m
Radius of the current loop formed by the negatively charged ball	R_e	$1/eV$	m
Classical electron radius	r	$1{,}42805577 \cdot 10^{-8}\ /eV$	$2{,}817940326 \times 10^{-15}\ m$
Bohr radius $\frac{\hbar^2}{me^2}$	a_0	2.6817268×10^{-4}/eV	$5.29177249 \times 10^{-11}$ m

Time taken by the sphere positively charged to complete a complete turn	T_p	1/ eV	s
Pulsation of the sphere that is positively charged.	ω_p	eV	s^{-1}
Time taken by the negatively charged sphere to make a complete turn	T_e	1/ eV	s
Pulsation of the sphere charged negatively.	ω_e	eV	s^{-1}
Loop of current, generated by the negative charge	i_e	eV	A
Loop of current, generated by the positive charge	i_p	eV	A
Magnetic moment of the current loop charged positively	L_p	1/ eV	JT^{-1}

Magnetic moment of the current loop charged negative	L_e	$1/eV$	JT^{-1}
Magnetic moment modulus of neutron	$\|\vec{\mu}_n\|$	$8{,}708597036 \cdot 10^{-11}/eV$	$9{,}6623647(23) \cdot 10^{-27} JT^{-1}$
Area of the circular surface delimited by the current loop, generated by the negative sphere	s_e	$(1/eV)^2$	m^2
Area of the circular surface delimited by the current loop, generated by the positive sphere	s_p	$(1/eV)^2$	m^2
Radius of sphere negative charged	r_e	$1/eV$	m
radius of sphere positive charged	r_p	$1/eV$	m
Time	t	$1/eV$	6.5821220 $10^{-16} s$
Area of the circular surface delimited by the loop of current,	s_e	$(1/eV)^2$	m^2

generated by the negative sphere			
Length	L	1/ eV	$1.9732705 \cdot 10^{-7}$m

Bohr's Magneton	μ_B	8.3585815 10^{-8}/eV	9.2740154 10^{-24} J/T
Universal gravitation constant	G	6.70711 10^{-57}/eV^2	6.67259 $10^{-11} \frac{Nm^2}{k_g^2}$
Mass	m	1 eV	1.7826627 $\times 10^{-36} kg$
Frequency	ν	1 eV	1.5192669 $\times 10^{15} H_z$
Energy	E	1 eV	1.6021773$\times$ $10^{-19} J$
Conductivity	σ	1 eV	1.6904124 $\times 10^{5}$ S/m
Energy 1 electron volt	eV	1 eV	1.60217733 $\times 10^{-19}$ J
Electric current	I	1 eV	2.8494561 mA
Electric potential	ϕ	1 eV	85.424546 mV
Rydberg energy, $\frac{e^2}{2a_0}$	ERyd	13.605698 eV	2.1798741 $\times$ 10^{-18} J
Hartree energy, $\frac{e^2}{a_0}$	Eh	27.211396 eV	4.3597482 $\times$ 10^{-18} J

Power	P	$1eV^2$	0.24341350 mW
Eletric field	E	$1eV^2$	432.90844 V/mm
Magnetic induction	B	1eV^2	1.4440271 mT
Magnetization	M	1eV^2	1.4440271×10^4 A/m
Density of current	J	$1eV^3$	$7.3179379 \times 10^{10} \frac{A}{m^2}$
Proton mass	m_p	938.27234 MeV	1.6726231 10^{-27} kg
Neutron mass	m_n	939.56563 MeV	1.6749286 10^{-27} kg
Magnetic permeability of the vacuum	μ_0	4π	$4\pi \cdot 10^{-7} \frac{H}{m}$
Dielectric constant of vacuum	ε_0	$\frac{1}{4\pi}$	8.854187817 $10^{-12} \frac{F}{m}$

2. Presentation of the model for the neutron

My goal is to find a model that describes a neutron, starting from the distinctive properties of this elementary particle already known to us and from some assumptions:

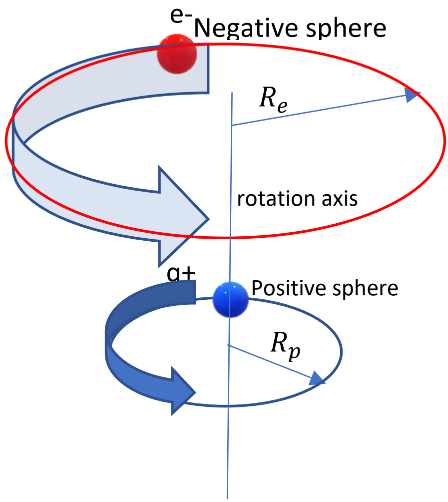
1. The neutron has a mass $m_n \cong 1.6749286 \times 10^{-27}\ kg$
2. The neutron has an overall zero electric charge.
3. I hypothesize that it is composed of two spheres, without mass, having equal charges in modulus but of opposite sign, equal to the charge of an electron, both of which describe a circular trajectory at the speed of light, proceeding in the same direction.
4. We indicate with R_p, [m] or $[eV^{-1}]$, the radius of the trajectory of the first sphere, the one with a positive charge.
5. We indicate with R_e, [m] or $[eV^{-1}]$, the radius of the trajectory of the second sphere, the one with negative charge.
6. The two circumferences, described, lie on two parallel planes, whose distance is equal to the Compton wavelength reduced for the neutron (2,100194450997$\times 10^{-16} m$)

   The centers of the two circumferences lie on the same axis, perpendicular to the planes containing the circumferences themselves.

The figure shows the two current loops, the one with the smaller radius, formed by the positive charge and the one with the greater radius formed by the negative charge.

We will calculate the two radii R_e ed R_p by imposing that:

1. The difference of the two masses, of the two particles, of a purely electromagnetic nature, is equal to the mass accepted for the neutron.
2. The difference, in absolute value, between the magnetic moment of the negative particle and that of the positive particle, has a net value equal to the modulus of the magnetic moment of the neutron.



2. The ring formed by the positive charge sphere

The positive current loop consists of a sphere, without mass, which rotates at the speed of light, along a circumference with a radius equal to R_p.

A question is legitimate: how can a model, made up of a massless sphere, possess a mass?

It is easy to give an answer after introducing the concept of potential vector $\vec{A}$.

In the same way in which a charge element generates a scalar potential, whose derivative in space allows to calculate the electric field, generated by the same charge, a current element generates a vector field, called "vector potential" and indicated with the symbol "$\vec{A}$", the derivative of which over time represents the electric field generated by the current element itself.

The product of the charge "q", for the potential vector "$\vec{A}$", "seen" by the charge itself, has the size of a momentum. In fact, a simple dimensional analysis allows us to reach this conclusion. The potential vector has the physical dimensions of an electric field for a time, then we have: $[qA] = [qEt] = [Ft] = [P]$, an electric field for a charge gives rise to a force, and finally, a force for a time gives rise to a momentum.

The loop of electric current generated by positive sphere, which forms a part of the model of the neutron, has a purely electromagnetic momentum.

It is almost spontaneous to associate, to the loop of current, generated by the positive sphere, a resting mass m_p , assuming as a postulate, the relationship:

$$q\vec{A} = m_p\vec{c}.$$ Relazione 3

3. Einstein and Planck's equations applied to the "positive" current loop

Now, let's focus our attention on two important mathematical relations: one, that of the physicist Planck, father of quantum mechanics, who has solved the arduous problem of the radiation diagram of a black body, introducing the concept of the quantum of light, other, that of Einstein, which expresses the concept that mass and energy are two manifestations of the same entity.

$$E = h\nu = \hbar\omega_p$$ Relazione 4

$$E = m_p c^2$$ Relazione 5

The first mathematical formula links the physical quantity "energy”, at the angular pulsation, of an electromagnetic wave. An electromagnetic wave behaves like a photon’s gas, whose energy is directly proportional to the pulsation of the radiation itself.

The second relationship intimately links energy and mass.

Relations 4 and 5 can be applied to electric current loop, generated by the positively charged ball, which forms a part of the new model for the neutron. Thus, applying equations 4 and 5 to the model and referring to the system of natural units, we have:

$$\left[m_p = \omega_p = \frac{1}{R_p}\right]_{\mathrm{N}U}$$ Relazione 6

The relation number six is of remarkable formal elegance and of remarkable clarity, in that it gives an immediate physical meaning to the mass: in the natural units of measurement, the latter represents the angular pulsation of the rotating charged sphere and, at the same time, the inverse of its radius of curvature.

dividing the force applied to a certain object and its acceleration. In turn, however, force is defined as a physical quantity that can vary the state of quiet or of movement of an object with has a mass. In other words, the concept of force is used to define the concept of mass, but subsequently the concept of mass is used to define that of force. What has been said constitutes a real tautology, which for years, as a physics teacher, has left me perplexed.

The mass of the "positive" current loop is evident from the model itself, it is not conferred "sic et simpliciter".

Considering the Planck and Einstein equations:

$$E = \hbar\omega_p \quad \text{Relazione 7}$$

$$E = m_p c^2 \quad \text{Relazione 8}$$

Comparing the two mathematical formulas, member to member, we have:

$$m_p = \frac{\hbar}{R_p\, c} \quad \text{Relazione 9}$$

The mathematical equation number nine expresses the resting mass, of a purely electromagnetic nature, of the current ring, generated from positive sphere, which forms a part of our model of the neutron.

4. Einstein's equations, Planck's equations applied to the current loop, generated by the negative sphere

The "negative" current loop is formed by a sphere, without mass, which rotates at the speed of light along a circumference having radius R_e .

Also, in this case, the "negative" current loop has a purely electromagnetic mass, which can be expressed, depending on the radius of the circumference described, by applying, once again, the Einstein and Planck equations.

Considering the Planck and Einstein equations, we have:

$$E = \hbar\omega_e$$ Relazione 10

$$E = m_e c^2$$ Relazione 11

Comparing the two mathematical formulas, member to member, we have:

$$m_e = \frac{\hbar}{R_e\, c}$$ Relazione 12

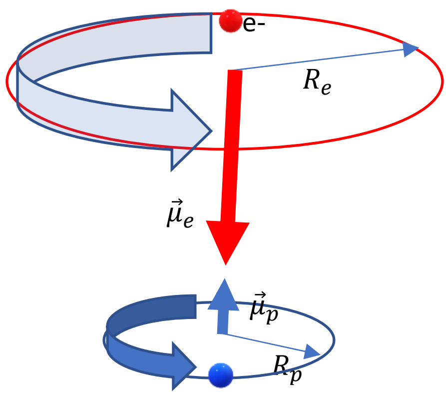
The mathematical formula number twelve expresses the resting mass, of a purely electromagnetic nature, of the "negative" current loop, which constitutes the second part of the new model for the neutron.

The magnetic moment of the model of the neutron.

The negatively charged sphere generates a magnetic moment represented by the vector $\vec{\mu}_e$ in the figure. y applying the rule of the right hand, this carrier would be directed upwards, but, considering that the charge has a negative sign, it will in fact be directed downwards.

The positively charged sphere generates a magnetic moment $\overrightarrow{\mu_p}$, directed in the opposite direction to that generated by the negative charge.

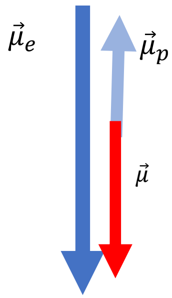
Negative sphere



Positive Sphere

The difference, in absolute value, between the modules of the two vectors, which have the same opposite direction and orientation, will give rise to the overall magnetic moment of the "neutron" particle.

Adding the two vectors we have in fact:



$$|\vec{\mu}| = \left|\vec{\mu}_e - \vec{\mu}_p\right|$$

4. Imposition of the condition on the total mass

The two current loops have a purely electromagnetic mass which can be expressed as a function of their rays.

One of the equations, which allows us to characterize the model, is obtained by imposing that, the difference of the two electromagnetic masses, of the two current loops, is equal to the mass accepted for the neutron. It is important to underline that, the total mass of the system composed of the two loops of current, is not obtained as the sum of the masses of the individual loops, but as a difference. On the other hand, according to Einstein's equations, mass and energy are two manifestations of the same thing.

If we approach one of the two loops of current to the other loop, it is as if a current coil were approaching to another current coil. The two coils of current are cross by currents that flow in opposite directions. The net current of the system, the algebraic sum of the two currents is less than the single currents, since, in fact, it is obtained by operating the difference between the two values. This model attributes, for the first time in the history of physics, a pseudo-vector nature to mass: to obtain the total mass of a system, consisting of two objects with have a mass, we do the difference between the two masses, instead of the sum. This is remarkable!

$$\frac{\hbar}{R_p c} - \frac{\hbar}{R_e c} = m_n \quad \text{Relazione 13}$$

5. Condizione sui momenti magnetici

We calculate, now, the current of the two loops of current.

Respecting the adopted symbology, we have:

$$i_p = \frac{e}{T_p} = \frac{e\omega_p}{2\pi} = \frac{ec}{2\pi R_p} \quad \text{Relazione 14}$$

Similarly, we have:

$$i_e = \frac{e}{T_e} = \frac{e\omega_e}{2\pi} = \frac{ec}{2\pi R_e} \quad \text{Relation 15}$$

We calculate the magnetic moments in modulus of the two individual current loops, equal to the product of the respective currents for the area of the surface the respective loops

$$\mu_e = i_e \cdot s_e = \frac{ec}{2\pi R_e}\pi R_e^2 = \frac{ecR_e}{2}$$ Relazione 16

$$\mu_p = i_p \cdot s_p = \frac{ec}{2\pi R_p}\pi R_p^2 = \frac{ecR_p}{2}$$ Relazione 17

$$|\vec{\mu}_n| = \left|\vec{\mu}_e - \vec{\mu}_p\right| = \frac{ecR_e}{2} - \frac{ecR_p}{2} = \frac{ec}{2}\left(R_e - R_p\right)$$

Relazione 18

$$|\vec{\mu}_n| = \frac{ec}{2}\left(R_e - R_p\right)$$ Relazione 19

Now, we consider the system formed by the equations number 16 and number 19, we have:

$$\begin{cases} \frac{\hbar}{R_p c} - \frac{\hbar}{R_e c} = m_n \\ |\vec{\mu}_n| = \frac{eC}{2}\left(R_e - R_p\right) \end{cases}$$ Relazione 20

The equations number 20, can be rewritten as follows:

$$\begin{cases} \frac{\hbar}{R_p c} - \frac{\hbar}{R_e c} = m_n \\ R_e - R_p = \frac{2|\vec{\mu}_t|}{ec} \end{cases}$$ Relazione 21

We have:

$$\begin{cases} \frac{\hbar}{R_p c} - \frac{\hbar}{R_e c} = m_n \\ R_p = R_e - \frac{2|\vec{\mu}_t|}{ec} \end{cases}$$ Relazione 22

We replace in the first equation of 22, instead of R_p, the quantity $R_e - \frac{2|\vec{\mu}_t|}{ec}$, we have:

$$\frac{\hbar}{\left(R_e - \frac{2|\vec{\mu}_t|}{ec}\right)c} - \frac{\hbar}{R_e c} = m_n$$ Relazione 23

$$\frac{\hbar e}{eR_e \cdot c - 2|\overrightarrow{\mu_t}|} - \frac{\hbar}{Re\, c} = m_n$$

$$\frac{\hbar ecR_e - \hbar ecR_e + 2\hbar|\overrightarrow{\mu_t}| - m_n ec^2 R_e^2 + m_n 2cR_e|\overrightarrow{\mu_t}|}{ecR_e(ecR_e - 2|\overrightarrow{\mu_t}|)} = 0$$

$$2\hbar|\overrightarrow{\mu_t}| - m_n ec^2 R_e^2 + 2cm_n\, Re|\overrightarrow{\mu_t}| = 0$$

$$R_e^2 - \frac{2|\overrightarrow{\mu_t}|}{ec} R_e - \frac{2\hbar|\overrightarrow{\mu_t}|}{ec^2 m_n} = 0$$

By replacing the numeric values, in place of the symbols, we have:

$$R_e^2 - 4{,}023297404 \cdot 10^{-16} R_e - 8{,}449706882 \times 10^{-32} = 0$$

$$\Delta = 4{,}998574953 \cdot 10^{-31}$$

$$R_{e1,2} = \frac{4{,}023297404 \cdot 10^{-16} \pm \sqrt{4{,}998574953 \cdot 10^{-31}}}{2}$$

$$R_{e1} = R_e = 5{,}546678742 \cdot 10^{-16}\, m$$

One of the two roots is negative has therefore no physical meaning and has been discarded.

$$R_p = R_e - \frac{2|\vec{\mu}_t|}{ec} \cong$$

$$5{,}546678742 \cdot 10^{-16} +$$

$$-\frac{2 \cdot 9{,}6623647(23) \cdot 10^{-27}}{1.60217733 \times 10^{-19} \times 2{,}99792458 \cdot 10^{8}} \cong$$

$$\cong 1{,}523381338 \cdot 10^{-16}\, m$$

We have:

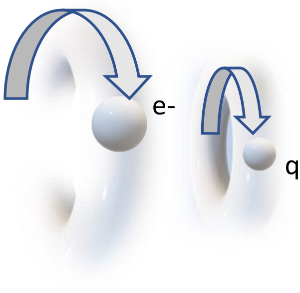
$$\boldsymbol{R_e = 5{,}546678742 \cdot 10^{-16}\, m}$$

$$\boldsymbol{R_p \cong 1{,}523381338 \cdot 10^{-16}\, m}$$

6. The spin of the neutron

We calculate, now, the spin of the neutron.

FIGURA 1



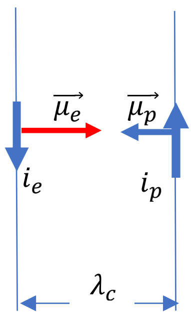
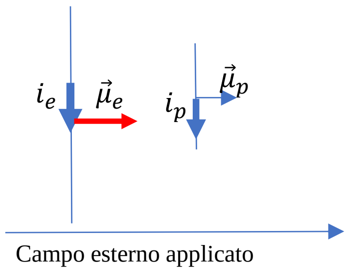


FIGURA 2

The configuration of the current loops constituting the neutron would be that shown in figures one and two. The two rings, similarly to two coils crossed by currents that proceed in opposite directions, one with respect to the other, would have opposite magnetic moments (see figure 2). If we considered an applied external magnetic field, in order to measure the spin, the two current loops will tend to align with this field.



In this situation the overall angular momentum would become equal to the sum of the angular moments of the individual current loops and would be equal to:

$$L_{tot} = R_e m_e c + R_p m_p c = 2\hbar$$

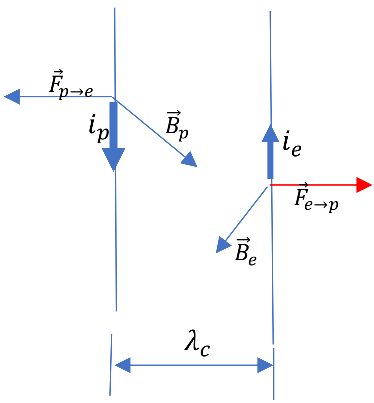
The two loops of current, like two gyroscopes, will never align with the external field, but will perform a processional motion.

In other words, the measured "spin would be the projection of the angular momentum vector $\vec{L}_{tot}$, along the direction of the external magnetic field and would be equal to $\pm\hbar$ / 2

7. Forces acting on the system

The neutron within the atom is stable!
If the two current loops are close enough, (we assume that their distance is equal to a reduced Compton wavelength for the neutron, 2,100194450997E-16 m), it is possible to treat them as two parallel currents that proceed in verse opposite to each with respect to the other.

FIGURA 3



The magnetic field generated by the ring of the negative sphere, at a certain distance r, (see figure 3), has the following expression:

$$d\overrightarrow{B_e} = \frac{\mu_0}{4\pi}\frac{i\, d\vec{e} \wedge \vec{r}}{|\vec{r}|^3}$$

Since the element $d\vec{l}$ and the vector $\vec{r}$ are perpendicular, (see picture 4), we can write:

$$dB_e = \frac{\mu_O}{4\pi} \cdot \frac{i_e\, dl}{r^2}$$

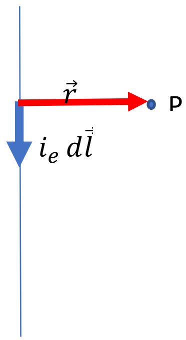


FIGURA 4

In our situation on have:

$$i_e\, dl = \frac{dq}{dt} \cdot dl = |e|\frac{dl}{dt} = |e|c$$

Assuming that "r" is precisely the distance between the two loops of current, we have:

$$B_e = \frac{\mu_O}{4\pi} \cdot \frac{|e|c}{r^2} \quad \text{Relazione 24}$$

The magnetic field B_e, generated by the "electron" ring, interacts with the moving charge of the proton ring, resulting in a magnetic force on the latter

$F_{e \to p} = B_e c|e|$ Relazione 25

Replacing the relation 24 in the relation 25 we have:

$$F_{e \to p} = B_e c|e| = \frac{\mu_O}{4\pi} \cdot \frac{e^2c^2}{r^2} \quad \text{Relazione 26}$$

The two current loops will repel each other with an average magnetic force equal to:

$$F_{e \to p} = F_{p \to e} = F_M = \frac{\mu_O}{4\pi} \cdot \frac{e^2c^2}{r^2} \quad \text{Relazione 27}$$

Since the two loops of current are made up of charges of opposite sign, they will attract each other with a Colombian force, whose expression will be the following:

$$F_e = \frac{1}{4\pi\varepsilon_0} \cdot \frac{e^2}{r^2} \text{ Relazione 28}$$

Suppose that the two forces: the medium magnetic one, with which the two current loops repel each other and the medium electric one, with which they attract each other, are equal. We impose the equality of the two forces, and we consider what conclusions this hypothesis leads us to.

$$F_M = \frac{\mu_0}{4\pi} \cdot \frac{e^2 c^2}{r^2} = F_e = \frac{1}{4\pi\varepsilon_0} \cdot \frac{e^2}{r^2} \text{ Relazione 29}$$

Simplifying, with simple steps we get:

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \text{ Relazione 30}$$

The relation 30 is a known relation which links the speed of light to the dielectric constant of the vacuum and to the magnetic permeability constant of the vacuum.

Having assumed that the two forces, electric and magnetic, have the same module, we arrive to a mathematical truth already consolidated in the theory of propagation of electromagnetic waves.

It is possible to conclude that the two loops of current are subject to two forces, one of a Colombian nature which would tend to attract them, the other of an electromagnetic nature which would tend to reject them: these forces are equal, assuming that the distance between the two rings is of the same order of magnitude as the Compton wavelength for the neutron. In this situation, the two rings can be treated as parallel wires crossed by currents, which flow in the opposite direction to each other. Thus, the structure of the neutron, if the distance between the two rings is of the order of the Compton wavelength, remains stable. If the distance between the two rings increases, the hypothesis of considering them as two parallel currents flowing in the opposite direction would no longer be valid.

I would like to point out that, by equating the electric force with the magnetic one, (see report 29), the radius r, distance between the two current loops, is simplified: this does not mean that the equality of the two forces is independent of the radius. If I move the two loops, beyond a certain limit, I could no longer treat them with the model of parallel currents. Obviously, there would be a range of distances, comparable with the Compton wavelength of the neutron, in which the approximation of parallel currents is valid.

If the distance between the two rings were within that range, the neutron, composed of the two rings, would be stable, otherwise it would no longer be.

It is also plausible, to assume that the model can be stable even if the two loops of current are concentric and the centers lie on the same plane.

Even in this situation, the approximation of parallel currents that flow in the opposite direction would apply.

8. Il neutrone fuori dal nucleo

It is well known that the neutron, outside the atomic nucleus, is an unstable particle. Experimental data confirm that it has a life of about a quarter of an hour and then the neutron splits and it generate, after the decay, an electron, a proton and an antineutrino.

The model of the loops of current that make up the elementary particles, allows to formulate different hypotheses about the decay of the neutron.

The basic assumption is that the vacuum itself has energy; this energy is otherwise known as zero-point energy.

The exchanges of energy, between the "neutron" particle and the vacuum, would make the system unstable: the current ring generated by the positively charged sphere, after a certain time, would decouple from the negative ring, and expand, passing from a radius of $5{,}546678742 \cdot 10^{-16}\, m$ at a radius of $0{,}386159267 \times 10^{-12}$m

The increase in its size, in terms of radius, would result in a decrease in mass.

The radius of the "positive" current loop would range from $1{,}523381338 \cdot 10^{-16}$ m to $2{,}103089322439 \times 10^{-16}\, m$

The sum of the mass of an electron and that of a proton is less than the mass of a neutron.

We have:

$massa_{neutrone} - (massa_{protone} + massa_{elettrone}) \cong 1{,}39456103 \times 10^{-30} kg$

Because mass and energy are two manifestations of the same entity, the question naturally arises: where will the energy corresponding to the mass just calculated be radiated?

Rather than introducing other particles, thus obtaining a complication of the system, in accordance with the principle of Occam's razor, it could be plausible as a hypothesis that the excess energy was simply transferred to the vacuum and therefore contributed to increase the so-called "energy of the point zero".

9. The constant of "fine structure"

The model of electron proposed by the Italian researchers, whose links are reported at the bottom of the document, presents a peculiarity.

The ratio, between the classical radius R_H of the hydrogen atom and the radius of the current ring that forms the electron, is equal to the ratio between the radius of the current loop and the classical radius, r, of the electron.

The inverse of this relation is called a fine structure constant.

It is plausible that the ratio between the radius r_e, of the negative sphere that determines the negative current loop, in the model of neutron and the radius $\mathrm{R_e}$ of the same ring, is also equal to the fine structure constant 1/137.

The negatively charged sphere, which determines the negative current loop, would have a radius that can be determined starting from the following condition:

$$\frac{r_e}{R_e} = \frac{1}{137}$$

We have:

$$\mathrm{r_e} = \frac{\mathrm{R_e}}{137} \cong \frac{5{,}546678742 \cdot 10^{-16}}{137} \cong 4{,}048670615 \times 10^{-18}\ \mathrm{m}$$

The radius of positive sphere will be:

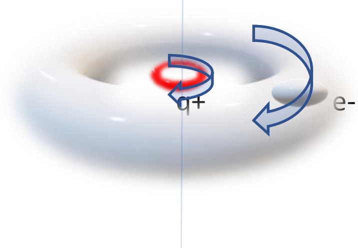
$$r_p = \frac{R_p}{137} \cong \frac{1{,}523381338 \cdot 10^{-16}}{137} \cong 1{,}111957181 \times 10^{-18}\ \mathrm{m}$$

In the following pages, two tables summarize the distinctive properties of elementary particles: proton, electron and neutron.

	Radius of loop of current	**Rotating sphere radius**	**Mass calculated by the model**
Electron	0,386159267 $\times 10^{-12}$m	2,8179403267 $\times 10^{-15}$m	9.10938 $\times 10^{-31}$k
Proton	2,1030893041$\times 10^{-16} m$	1,5351016818$\times 10^{-18} m$	1,6726231$\times 10^{-27}$ kg
Neutron: positive loop of current"	$\mathbf{1,52338133 \cdot 10^{-16}}$ $\boldsymbol{m}$	1,111957181 $\times 10^{-18}$ m	2,309123569 $\times 10^{-27}$ kg
Neutron: negative loop of current	**5,546678742$\times 10^{-16}$ m**	4,048670615 $\times 10^{-18}$ m	6,341949687657 10^{-28} kg
Neutron: complete model, including both current loops	NA	NA	**1,6749286 $\times 10^{-27}$ k**

Model of the neutron, with the two concentric current loops lying on the same plane

Rotation axis



	Angular momentum	**Spin**	**Loop of current**	**Moment Magnetic**
Electron	$\hbar$	$\pm\hbar\ /\ 2$	19,79634234 A	9,2740140839 $10^{-24}\ JT^{-1}$
Proton	$\hbar$	$\pm\hbar\ /\ 2$	3,6349103353× $10^4 A$	
Neutron: positive loop of current”	$\hbar$		5,01814014× $10^4\ A$	3,65855780× $10^{-27}\ JT^{-1}$
Neutron: negative loop of current	$\hbar$		1,37821954× $10^4\ A$	- 1,33209225 $10^{-26}\ JT^{-1}$ -
Neutron: complete model, including both current loops	$2\hbar$	$\pm\hbar\ /\ 2$	NA	**-9,66236472×** $\mathbf{10^{-27}\ JT^{-1}}$

Summary

Bibliographical references

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