# Electrical-Quantum Modelling of the Neutron and Proton as a Three-Phase Alternating Current Electrical Generator. Determination of the Number of Quarks-Antiquarks-Gluons and Gravitons, Inside a Neutron

**Hector Gerardo Flores [1,\*] and Maria Isabel Gonçalves de Souza [2,\*]**

[1]  Tucumán University, Argentina
[2]  Universidad Federal de Campina Grande, Brazil
[\*]  Correspondence: hectorisabel2011@hotmail.com (H.G.F.); isa271938@hotmail.com (M.I.G.d.S.)

**Abstract:** Here we will electrically-quantum model the neutron and proton as a three-phase alternating current electric generator, for this, we will use the theory of three-phase electric generators and vector or phasor diagrams. We will use this model to hypothesize how the quarks that form neutrons and protons with a combined mass of 10 MeV/c², can generate, through quarks-antiquarks-gluon interactions, a mass of 939.56 MeV/c² for the neutron and a mass of 938.27 MeV/c² for the proton. Using quantum mechanics and the theory of the generalization of the Boltzmann constant in curved space-time we will calculate the number of quarks-antiquarks-gluons and gravitons inside a neutron. We will also analyse β⁻ decay using vector diagrams, we will calculate the tension of the string $T_0$ and the length of the string $\ell s$ between quarks-antiquark and finally, we will model a black hole using a neutron equivalent model.

**Keywords:** RLC electrical model; RC electrical model; cosmology; astronomy; astrophysics; background radiation; Hubble's law; Boltzmann´s constant; dark energy; dark matter; black hole; Big Bang; cosmic inflation; early universe; quantum gravity; CERN; LHC; Fermilab; general relativity; particle physics; condensed matter physics; M theory; super string theory; extra dimensions

## 1. Relationship between a three-phase electric generator and the quarks-antiquarks-gluons inside a neutron and proton

According to Max Planck, science is not only about discoveries, but also about changing the way we think, we should not be afraid of the unknown and we must feel free to follow our curiosity. Following this premise, we are going to develop this theory.

It is important to make clear that the interpretation we use of the structure of quarks does not correspond to QCD theory, it is a personal interpretation. In other words, this theory is outside the formal theory of quarks and gluons (QCD), it is totally personal.

The main idea is to try to demystify the realm in which quark-antiquark-gluon interactions dominate, presenting an alternative theory that contributes to the formal QCD theory.

Whenever we analyse scientific literature, articles, papers, that are related to collisions of subatomic particles, we see that in the collisions of subatomic particles, pairs of particles of matter and antimatter are produced, this always happens, fulfilling the principle of conservation of energy.

Taking into account what has been stated, we are going to consider matter and antimatter, to develop our theory. We are going to propose the following model for the neutron and the proton.

Here we put forward the hypothesis for a neutron, as a quark-antiquark-gluon interaction, and not as represented in the formal theory of QCD, as a quark-gluon interaction. See Figure 1
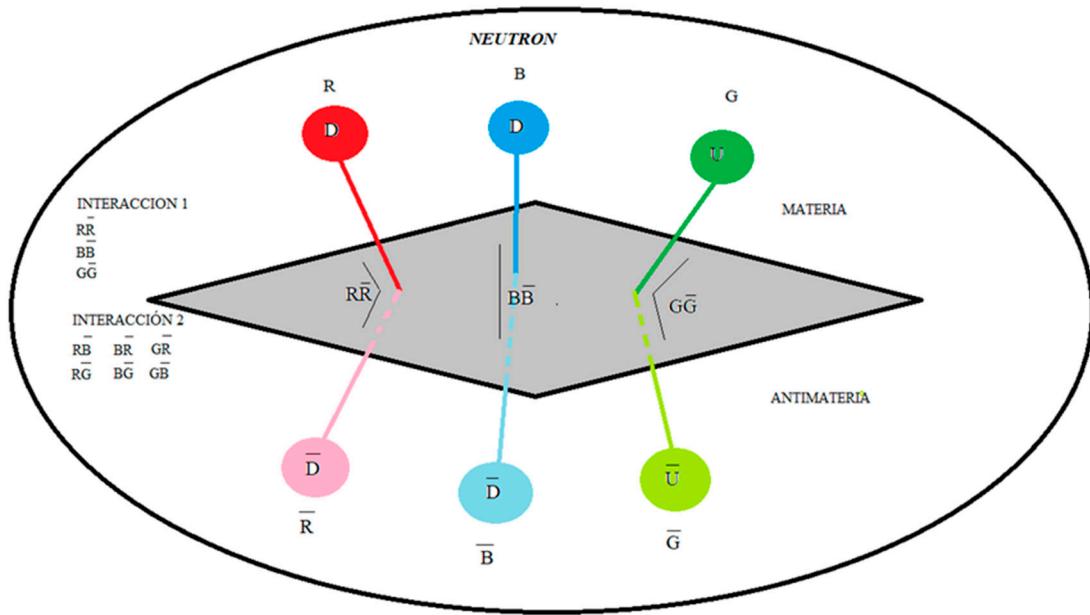
**Figure 1.** - Electrical model of the neutron considering matter and antimatter.

Where D corresponds to the D quark and D corresponds to the D antiquark.

Where U corresponds to the U quark and U corresponds to the U antiquark.

The gluon interaction is given by (R, B, G) and (R, B, G).

Here we put forward the hypothesis for a proton, as a quark-antiquark-gluon interaction, and not as represented in the formal theory of QCD, as a quark-gluon interaction. See Figure 2.

Before continuing, let's explain why the UU and DD dipoles do not annihilate each other.

When we developed the paper titled: Theory of the Generalization of the Boltzmann's Constant in Curved Space-Time. Shannon-Boltzmann Gibbs Entropy Relation and the Effective Boltzmann's Constant; at the end of the paper, we show that the up quark and down quark, with a temperature of the order of $10^{10}$ K, have a space-time contraction factor of the order of $10^6$, in other words, the space-time envelope that surrounds the quark acts as a shell, like a protection, preventing the U quark and the U antiquark from annihilating each other, the same happens with the D quark and its D antiquark. , avoiding its annihilation.

This happens only at the quark level, as matter increases in complexity, this space-time protection becomes weaker, which leads to matter-antimatter annihilation.
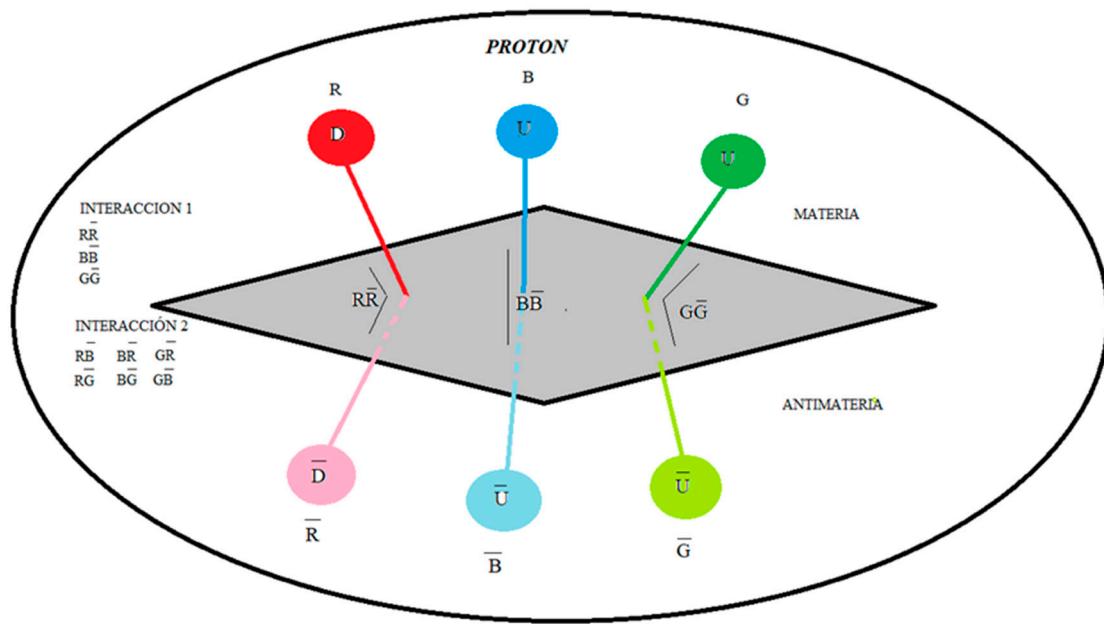
**Figure 2.** - Electrical model of the proton considering matter and antimatter.

In Figures 3 and 4; we are going to represent a three-phase generator.
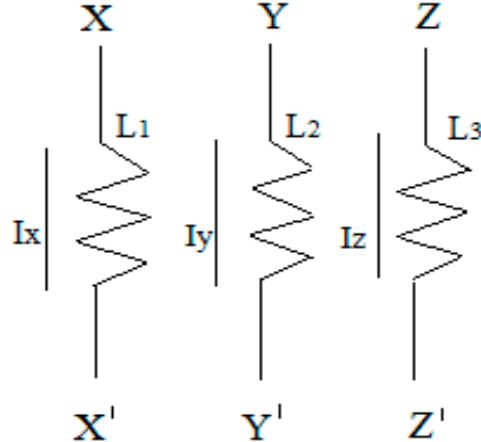
**Figure 3.** – Three phase generator.

If we look at Figures 3 and 4, which correspond to the electrical circuit of a three-phase generator, we see that the electrical circuit of a neutron represented in Figure 1 and the electrical circuit of a proton represented in Figure 2, have an identical diagram. Basically, the difference is the following, in a three-phase generator, the pairs, XX', YY' and ZZ' have the same frequency and in the case of a proton and neutron the DD̲ pairs have twice the frequency of the UU̲ pairs.
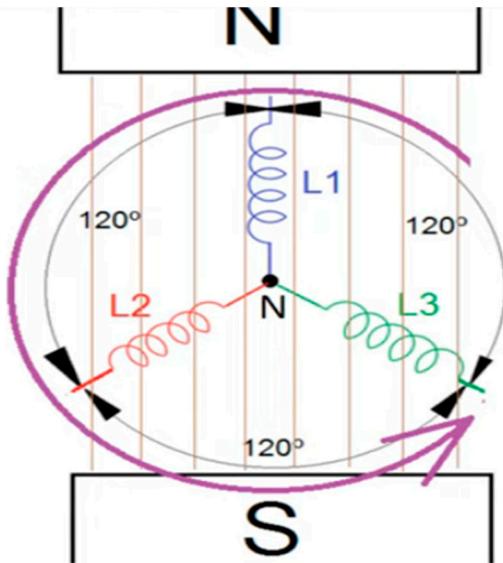
**Figure 4.** - Three phase generator.

In Figure 5 we are going to represent the diagram of the standard model of particle physics.

## Standard Model of particle physics

### Standard Model of Elementary Particles

|  | three generations of matter (fermions) | | | interactions / force carriers (bosons) | |
|---|---|---|---|---|---|
| **QUARKS** | mass ≈2.2 MeV/c² charge ⅔ spin ½ **u** up | ≈1.28 GeV/c² ⅔ ½ **c** charm | ≈173.1 GeV/c² ⅔ ½ **t** top | 0 0 1 **g** gluon | ≈124.97 GeV/c² 0 0 **H** higgs |
|  | ≈4.7 MeV/c² −⅓ ½ **d** down | ≈96 MeV/c² −⅓ ½ **s** strange | ≈4.18 GeV/c² −⅓ ½ **b** bottom | 0 0 1 **γ** photon |  |
| **LEPTONS** | ≈0.511 MeV/c² −1 ½ **e** electron | ≈105.66 MeV/c² −1 ½ **μ** muon | ≈1.7768 GeV/c² −1 ½ **τ** tau | ≈91.19 GeV/c² 0 1 **Z** Z boson |  |
|  | <1.0 eV/c² 0 ½ **Ve** electron neutrino | <0.17 MeV/c² 0 ½ **Vμ** muon neutrino | <18.2 MeV/c² 0 ½ **Vτ** tau neutrino | ≈80.360 GeV/c² ±1 1 **W** W boson |  |

**Figure 5.** – Standard Model.

In Figure 6, it represents the characteristics of the up and down quark, we can see that the frequency of the down quark is approximately double that of the up quark.

If we rotate the rotor of a generator, this induces a variable magnetic field in the stator and this generates a three-phase sinusoidal voltage, out of phase by 120 degrees, as seen in Figure 7, that is the operating principle of a generator.

| | UP | DOWN |
|---|---|---|
| MASS (kg) | $4.10 \cdot 10^{-30}$ | $8.55 \cdot 10^{-30}$ |
| ENERGY (J) | $3.60 \cdot 10^{-13}$ | $7.69 \cdot 10^{-13}$ |
| FREQUENCY (Hz) | $5.56 \cdot 10^{20}$ | $11.60 \cdot 10^{20}$ |
| TEMPERATURE (K) | $2.67 \cdot 10^{10}$ | $5.57 \cdot 10^{10}$ |

**Figure 6.** - Characteristics of the up and down quark.
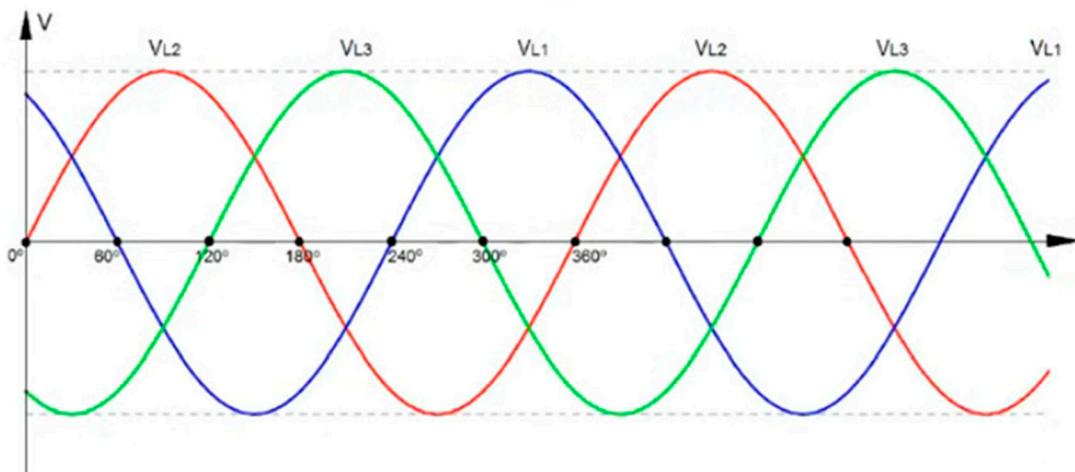
**Figure 7.** - Three-phase voltage generated with a phase shift of 120 degrees.

In analogy to what happens in a generator, in the proton and the neutron, the D$\underline{D}$ dipoles vibrate at approximately twice the frequency of the U$\underline{U}$ dipoles. Continuing with the analogy, the dipoles, XX', YY' and ZZ' in a generator would be analogous to the dipoles D$\underline{D}$, D$\underline{D}$ and U$\underline{U}$ in a neutron and the dipoles D$\underline{D}$, U$\underline{U}$ and U$\underline{U}$ in a proton.

If we consider that the voltages, VL1, VL2 and VL3 are the result of rotating the rotor, which produces a variation of the magnetic field and ends up inducing and generating the voltages in the stator, continuing with the analogy, we can say that the dipoles D$\underline{D}$, D$\underline{D}$ and U$\underline{U}$ in a neutron and the dipoles D$\underline{D}$, U$\underline{U}$ and U$\underline{U}$ in a proton, is the result of a variable magnetic field that is generated from the interaction of quarks and anti-quarks with gluons, precisely this mechanism makes protons and neutrons generate their mass and are self-sustaining, this is the mechanism that allows the existence of hadrons.

Let us remember that Maxwell's fourth law does not say that a variable magnetic field produces a variable electric field and thus repeats itself indefinitely, precisely through this mechanism a photon is self-sustaining, we can say that a photon has infinite life, and we can confirm this with the CMB which is the result of primordial photons.

the dipoles D$\underline{D}$, D$\underline{D}$ and U$\underline{U}$ in a neutron and the dipoles D$\underline{D}$, U$\underline{U}$ and U$\underline{U}$ in a proton, are also out of phase with a phase angle that we are going to determine, the nomenclature of the gluons (R, B, G) and ($\underline{R}$, $\underline{B}$, $\underline{G}$) serves to remind us that the Interactions between quarks and gluons are vectors.

Taking into account the statement, in Figures 8 and 9 we are going to represent the intrinsic interactions of the neutron and the proton.

| NEUTRON | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | INTERACTION 1 | | | | INTERACTION 2 | | | | |
| R B G | | R | B | G | | R | R | B | B | G | G |
| D D U | | D | D | U | | D | D | D | D | U | U |
| $\underline{D}$ $\underline{D}$ $\underline{U}$ | | $\underline{D}$ | $\underline{D}$ | $\underline{U}$ | | $\underline{D}$ | $\underline{U}$ | $\underline{D}$ | $\underline{U}$ | $\underline{D}$ | $\underline{D}$ |
| $\underline{R}$ $\underline{B}$ $\underline{G}$ | | $\underline{R}$ | $\underline{B}$ | $\underline{G}$ | | $\underline{B}$ | $\underline{G}$ | $\underline{R}$ | $\underline{G}$ | $\underline{R}$ | $\underline{B}$ |

**Figure 8.** – Neutron.

| PROTON | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | B | G | | R | R | B | B | G | G |
| R B G | | D | U | U | | D | D | U | U | U | U |
| D U U | | D | U | U | | U | U | D | U | D | U |
| D U U | | R | B | G | | B | G | R | G | R | B |
| R B G | | | | | | | | | | | |

**Figure 9.** – Proton.

Figure 8 and 9 represent the interactions that exist in a neutron and a proton, divided into interaction 1 and interaction.

Interaction 1 represents direct interactions between quarks and antiquarks and interaction 2 represents cross interactions between quarks and antiquarks.

Next, we are going to analyse the frequency; We said that in a three-phase generator, the frequency is always the same, we also said that the frequency of the down quark is approximately double the frequency of the up quark. We are going to analyse precisely that difference in frequency and its interpretation.

The analysis that we are going to perform is important for the following reason, when we perform a vector or phasor operation that has the same frequency, we do not have problems, but what happens if we are going to perform a vector or phasor operation with operators that have different frequencies. In this analysis we are going to answer this question!!!!!!

If we analyse Figure 9 - proton, we observe that interaction 1 between quarks and antiquarks, direct interaction, are carried out at the same frequency.

Again, if we analyse Figure 9, proton, we observe that interaction 2 between quarks and antiquarks, cross interaction, in analogy with interaction 1, the frequency difference between quarks and antiquarks, does not represent a drawback in energy exchanges.

In Figure 10 we represent the energy exchanges between quarks and antiquarks and we see how the gluons act.

**Figure 10.** - Cross-gluon interaction in a proton.

In blue we represent the quarks with the frequency of the Down quark and the associated gluon also in blue, when the energy exchange is carried out so that one quark becomes another quark.

In yellow we represent the quarks with the frequency of the up quark and the associated gluon also in yellow, when the energy exchange is carried out, so that one quark becomes another quark.

We can represent the statement in Figure 11. We see why the exchange of gluons so that one quark becomes another quark does not represent a problem with frequency.

| R | B | | G | B | R | G | | R | B | B | G |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D | U | | | | D | U | | | | D | U |

**Figure 11.** - Represents a quark transforming into another quark through the exchange of gluons. In blue represents the frequency of the down quark and in yellow the frequency of the up quark.

Quark U B transform quarks U G through gluon exchange G B, at the up-quark frequency, yellow.

Quark D R transform quarks D B through gluon exchange R B, at the down quark frequency, blue.

Taking into account what has been analysed so far, we can propose vector or phasor operations as valid, in analogy to that of a three-phase alternating current generator, which works with a single frequency.

It is the exchange of gluons, which is carried out at the appropriate frequency, allowing one quark to become another quark; it is this mechanism that allows us to perform a vector or phasor sum, as if this entire mechanism worked at a single frequency.

2. Electrical-quantum modelling of the neutron as a three-phase alternating current electrical generator.

We are going to work with Figure 12 to create our electrical model of the neutron as a three-phase alternating current electrical generator.

| NEUTRON | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | INTERACTION 1 | | | | INTERACTION 2 | | | | |
| R B G | | R | B | G | | R | R | B | B | G | G |
| D D U | | D | D | U | | D | D | D | D | U | U |
| D D U | | D | D | U | | D | U | D | U | D | D |
| R B G | | R | B | G | | B | G | R | G | R | B |

**Figure 12.** – Neutron.

The dipole DD is analogous to L1 and RR is analogous to the current flowing through L1.

The dipole DD is analogous to L2 and BB is analogous to the current flowing through L2.

The dipole UU is analogous to L3 and GG is analogous to the current flowing through L3.

We see that there are two types of interactions.

Interaction 1 or direct interaction and interaction 2 or cross interaction.

We said that down quarks have one frequency and up quarks have another frequency; Thanks to gluons, vector or phasor operations cease to be a problem, making it possible for a quark to transform into another quark, of the same frequency, thanks to the exchange of gluons. It is an amazing mechanism. We can see this mechanism in Figure 10.

In analogy to a three-phase alternating current electric generator, we are going to represent interaction 1 and interaction 2, using vectors whose resulting vector is null. In this way, we are going to simulate a neutron as a three-phase alternating current electrical generator.

In Figure 5 of the standard model, we see that the up quark has a mass of 2.2 MeV/c² and the down quark has a mass of 4.7 MeV/c².

Taking these values as reference we are going to make our vector diagram of the neutron.

Quark Down = 4.7 MeV/c²

Quark up = 2.2 MeV/c²

It is important to make it clear that all interactions are vector, although we do not represent them as such in the figures.

Interaction 1:
If we analyse Figure 13, star connection, we see that the following vector sum is null:

R(D<u>D</u>)<u>R</u> + B(D<u>D</u>)<u>B</u> + G(U<u>U</u>)<u>G</u> = 0

If we analyse Figure 13, triangle connection, we see that the following vector sum is null:

R(DD)B + B(DU)G + R(DU)G = 0

This is telling us that the net charge in interaction 1 is zero.
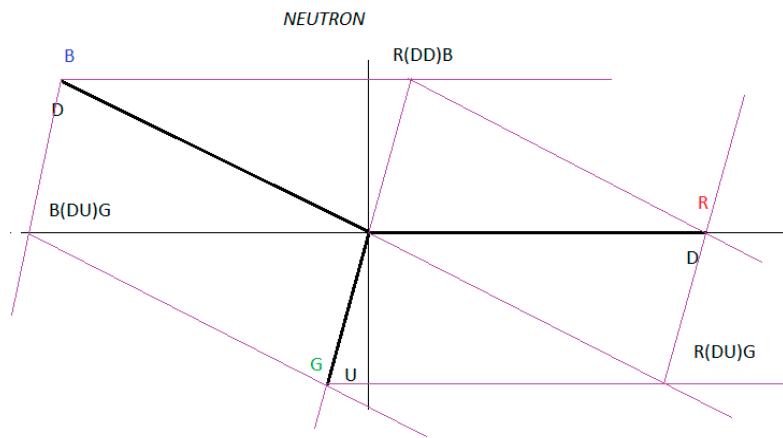
**Figure 13.** - interaction 1 of the neutron.

Interaction 2:
If we analyse Figure 14, we observe that the following vector sum is also null:

R(D<u>D</u>)<u>B</u> + R(D<u>U</u>)<u>G</u> + B(D<u>D</u>)<u>R</u> + B(D<u>U</u>)<u>G</u> + G(U<u>D</u>)<u>R</u> + G(U<u>D</u>)<u>B</u> = 0

This is telling us that the net charge in interaction 2 is zero.
Taking into account interaction 1 and interaction 2, the total net charge of the neutron is zero, as appropriate.
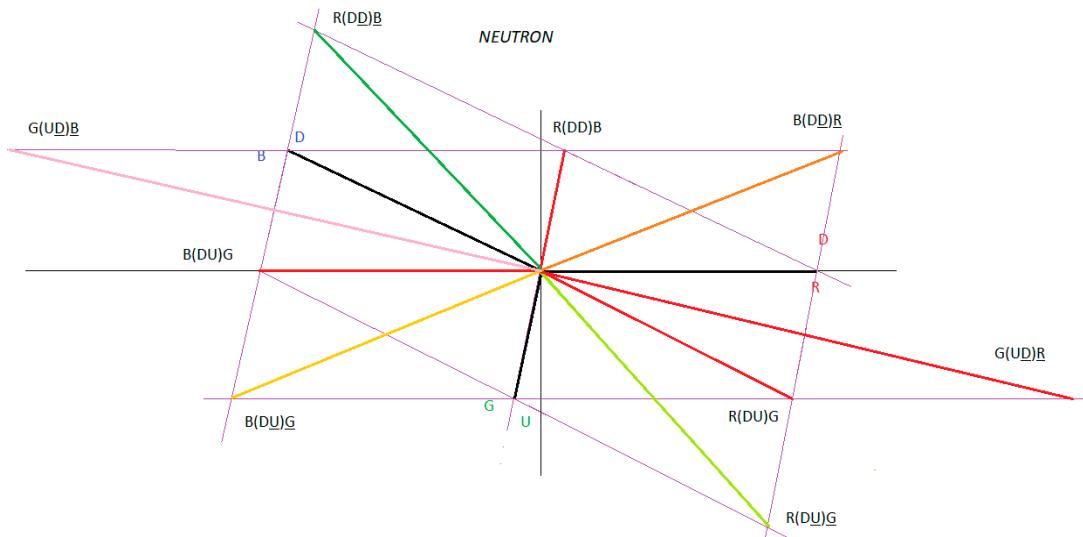
**Figure 14.** – Interaction 1 & 2 of the neutron.

Knowing that the total mass of the neutral is 939.5 MeV/c², we are going to calculate the mass content in each interaction:

R(D<u>D</u>)<u>R</u> = 85.7 MeV/c²

B(D<u>D</u>)<u>B</u> = 85.7 MeV/c²

G(U<u>U</u>)<u>G</u> = 40.2 MeV/c²

R(D<u>D</u>)<u>B</u> = 99 MeV/c²

R(D<u>U</u>)<u>G</u> = 99 MeV/c²

B(D<u>D</u>)<u>R</u> = 99 MeV/c²

B(D<u>U</u>)<u>G</u> = 99 MeV/c²

G(U<u>D</u>)<u>R</u> = 165.9 MeV/c²

G(U<u>D</u>)<u>B</u> = 165.9 MeV/c²

We are going to represent these values in Figure 15:

| NEUTRON | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | B | G | | R | R | B | B | G | G |
| R B G | | D | D | U | | D | D | D | D | U | U |
| D D U | | D | D | U | | D | U | D | U | D | D |
| D D U | | D | D | U | | B | G | R | G | R | B |
| R B G | | R | B | G | | | | | | | |
| m( Mev/c²) | 939.5 | 211.7 | | | | 727.8 | | | | | |
| | | 85.7 | 85.7 | 40.3 | | 99 | 99 | 99 | 99 | 165.9 | 165.9 |

**Figure 15.** - Mass distribution in interactions 1 & 2.

The electrical modelling of a neutral as a three-phase alternating current electrical generator allows us to assign a mass value to interactions 1 & 2, which we represent using a phasor diagram, as shown in Figure 14. It also allows us to verify that the sum of net charge in interactions 1 & 2 is zero, as appropriate.

Analysing the vector diagrams in Figures 13 and 14, we see that the degrees of freedom of the vectors are practically zero, there is no possibility of deviations, the hypothesis that the charge has to be zero restricts any possibility of changes in the position of the vectors, that is, the vectors have a unique configuration, given in Figures 13 and 14.

Conclusions: It is important to keep in mind that the relationship between the interactions of quarks, anti-quarks and gluons is vector-type, that is, each interaction will be represented by a module and an angle.

In the neutron, if we add the phasors of interaction 1 and interaction 2 vector-wise, we see that the resulting vector is zero, in other words, the net charge is zero; but if we add the module of each vector in MeV/c² scalarly, the sum gives us 939.5 MeV/c², we represent this in Figures 14 and 15, which corresponds to the neutron.

*Definitely, we can assure that neutrons are true generators of energy, mass and gravity; We have verified how with three quarks that add up to approximately 10 MeV/c², we can generate a mass of 939.5 MeV/c² through the interactions of quarks, anti-quarks and gluons.*

*2.1. Mechanism that generates mass in neutrons, calculation of the number of quarks-antiquarks-gluons inside a neutron*

If we look at Figure 15, we see that the neutron has a mass of 939.5 MeV/c², if we add the mass of the two D Quark and the mass of the U quark it gives us approximately 10 MeV/c²; We ask ourselves, how is the mass of 929 MeV/c² generated? That is precisely what we want to answer in this section.

If we look at Figure 15, we see that we can represent the neutron by dipoles of matter and antimatter formed by quark and anti-quark. Interaction 1 can be represented by 3 dipoles and interaction 2 can be represented by 6 dipoles.

If we analyse any dipole, we see that at one end it is formed by matter and at the other end by antimatter, opposite charges of the opposite sign.

These dipoles behave like electrical antennas, if we consider that these dipoles move in one direction, they vibrate, they are polarized, they generate an electromagnetic field in analogy to the dipoles of antennas.

The variation of the electric field in the antennas produces a variation in the electric potential and this in turn produces a flow of current, thus generating an electromagnetic wave.

In analogy to dipole antennas, polarized vibrations in one direction produce a flow of gluons that carry charge, producing a current that would generate an electromagnetic field. This flow of charge-carrying gluons would be analogous to a flow of current and this would produce an electromagnetic field generated by the matter-antimatter dipole.

We know through the equation $E = mc^2$, that energy is related to mass and precisely that energy that results from gluonic exchange is the energy that generates the mass 929 MeV/$c^2$ in a neutron.

Neutron mass = 939.56 MeV/$c^2$

$2m_d + m_u$ = 11.6 MeV/$c^2$

where $m_d$ is the mass of the D quark and $m_u$ is the mass of the U quark.

Gluon exchange mass = 928 MeV/$c^2$

We are going to perform the following calculations:

We are going to work with the bond energy that keeps the electron attached to the proton, in the hydrogen atom.

13.6 eV = 2.17 $10^{-18}$ Joules

$E = h \times f$; $f = E/h$ = 2.17 $10^{-18}$ / 6.63 $10^{-34}$

$f$ = 3.2 $10^{15}$ Hz

$E = K \times T$; $T = E/K$ = 2.17 $10^{-18}$ / 1.38 $10^{-23}$

$T$ = 1.57 $10^{5}$ K

M(photon) = $h / (\lambda \times C)$

$c = \lambda \times f$; $\lambda = c/f$ = 3 $10^{8}$ / 3.2$10^{15}$ = 0.937 $10^{-7}$

$\lambda$ = 9.37 $10^{-8}$ m

M(photon) = $h / (\lambda \times C)$ = 6.63 $10^{-34}$ / 9.37 $10^{-8}$ x 3 $10^{8}$

M(photon-gluon) = 2.35 $10^{-35}$ kg

That would be the mass of the photon-gluon that holds the electron to the proton in the hydrogen atom.

Let's assume that the binding energy is 136,000 eV:

136,000 eV = 2.17 $10^{-14}$ Joules

$E = h \times f$; $f = E/h$ = 2.17 $10^{-14}$ / 6.63 $10^{-34}$

$f$ = 3.2 $10^{20}$ Hz

$E = K \times T$; $T = E/K$ = 2.17 $10^{-14}$ / 1.38 $10^{-23}$

$T$ = 1.57 $10^{9}$ K

M(photon) = $h / (\lambda \times C)$

$c = \lambda \times f$; $\lambda = c/f$ = 3 $10^{8}$ / 3.2 $10^{20}$ = 0.937 $10^{-12}$

$\lambda$ = 9.37 $10^{-13}$ m

M(photon) = $h / (\lambda \times C)$ = 6.63 $10^{-34}$ / 9.37 $10^{-13}$ x 3 $10^{8}$

M(photon-gluon) = 2.35 $10^{-30}$ kg

Let's assume that the binding energy is 1,360,000,000 eV:

1,360,000,000 eV = 2.17 $10^{-10}$ Joules

E = h x f; f = E/h = 2.17 $10^{-10}$ / 6.63 $10^{-34}$

f = 3.2 $10^{23}$ Hz

E = K x T; T = E/K = 2.17 $10^{-10}$ / 1.38 $10^{-23}$

T = 1.57 $10^{13}$ K

M(photon-gluon) = h / ($\lambda$ x C)

c = $\lambda$ x f; $\lambda$ = c/f = 3 $10^8$ / 3.2 $10^{23}$ = 0.937 $10^{-15}$

$\lambda$ = 9.37 $10^{-16}$ m

M(photon) = h / ($\lambda$ x C) = 6.63 $10^{-34}$ / 9.37 $10^{-16}$ x 3 $10^8$

M(photon-gluon) = 2.35 $10^{-27}$ kg

Let's assume that in a hydrogen atom the electron is linked to the proton through the B$\underline{B}$ gluons, which are analogous to photons and can escape confinement, in addition, the rest of the gluons have colour charge other than zero, they cannot escape confinement. We can consider that in general from the point of view of energy, for the same temperature conditions all gluons have equivalent energies of the same order.

Later, when we analyse $\beta^-$ decay, we will show that a neutron decays into a proton and if the released electron is trapped forming the hydrogen atom, we will see that the B$\underline{B}$ gluons would be the linked photons in the electromagnetic theory, that unites the proton with the electron

With the calculations carried out, we are going to generate the following table:

**Table 1.** – Gluon Mass.

| ENERGY (Joules) | FRECUENCY (Hz) | TEMPERATURE (k) | WAVELENGTH(m) | GLUON MASS (Kg) |
|---|---|---|---|---|
| 2.17 $10^{-18}$ | 3.2 $10^{15}$ | 1.57 $10^5$ | 9.37 $10^{-8}$ | 2.35 $10^{-35}$ |
| 2.17 $10^{-14}$ | 3.2 $10^{20}$ | 1.57 $10^9$ | 9.37 $10^{-13}$ | 2.35 $10^{-30}$ |
| 2.17 $10^{-10}$ | 3.2 $10^{23}$ | 1.57 $10^{13}$ | 9.37 $10^{-16}$ | 2.35 $10^{-27}$ |

In table 1, we observe that as the energy increases, the frequency increases, the temperature increases and consequently the mass of the gluon increases.

If we remember what we said that neutrons and protons are formed by dipoles of matter and antimatter (quark and anti-quark), which oscillate in a certain direction similar to the electric dipoles in antennas, if we analyse table 1, we see that as the dipoles increase their vibration frequency, their energy increases, their temperature increases and the mass of the gluon also increases as predicted.

If we look at table 1, for T = 1.57 $10^9$ K, we see that the mass of the gluons is approximate to the mass of the U quark and D quark, shown in Figure 6. This is telling us that if we consider the correct temperature, the mass of the gluons will coincide with the mass of the U quark and D quark.

mu = 4.10 $10^{-30}$ kg, T = 2.67 $10^{10}$ K

md = 8.55 $10^{-30}$ kg, T = 5.57 $10^{10}$ K

Gluon mass = 2.35 $19^{-30}$ kg, T = 1.57 $10^9$ K

Taking into account the statement:

We are going to perform the following calculation:

Neutron mass = 939.56 MeV/c²

2md + mu = 11.6 MeV/c²

Number of gluons = neutron mass / unit mass of a gluon

For T = 1.57 $10^5$ K:

Approximate number of gluons per neutron = 1.67 $10^{-27}$ / 2.35 $10^{-35}$

Approximate number of gluons per neutron = 0.71 $10^8$

QTY g = 7.1 $10^7$ = 71,000,000.00

71 million gluons in a neutron, for T = 1.57 $10^5$ K.

Where QTY g, is the number of gluons inside a neutron.

When we talk about gluons, we refer to quarks-antiquarks and gluons as a whole, as long as the interaction relationship 1 & 2 is fulfilled, as shown in Figure 15.

According to table 1, we see that the number of gluons in a neutron depends on the temperature (energy) at which the calculation is carried out.

Looking at table 1, we see that as the temperature increases, the mass of the quark-gluons increases, for example, for a temperature of $10^9$ K, the mass of a quark-gluon is in the order $10^{-30}$ kg. Now, for a temperature of $10^{13}$ K, the mass of the quark-gluons is on the order of $10^{-27}$ kg.

Next, we are going to calculate the quantity of quarks-antiquarks-gluons existing, in a discriminated manner, in the dipoles of the interaction 1 & 2.

Interaction 1:

QTY g INT 1:   $= 0.376 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ kg $= 1.6 \ 10^7$ Q-Gluons

Qty g R(D$\underline{D}$)$\underline{R}$ $= 0.152 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ kg $= 0.648 \ 10^7$ Q-Gluons

Qty g B(D$\underline{D}$)$\underline{B}$ $= 0.152 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ kg $= 0.648 \ 10^7$ Q-Gluons

Qty g G(U$\underline{U}$)$\underline{G}$ $= 0.072 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ kg $= 0.306 \ 10^7$ Q-Gluons

Interaction 2:

QTY g INT 2 $= 1.293 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ kg $= 5.50 \ 10^7$ Q-Gluons

QTY g R(D$\underline{D}$)$\underline{B}$ $= 0.1759 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ $= 0.748 \ 10^7$ Q-Gluons

QTY g R(D$\underline{U}$)$\underline{G}$ $= 0.1759 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ $= 0.748 \ 10^7$ Q-Gluons

QTY g B(D$\underline{D}$)$\underline{R}$ $= 0.1759 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ $= 0.748 \ 10^7$ Q-Gluons

QTY g B(D$\underline{U}$)$\underline{G}$ $= 0.1759 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ $= 0.748 \ 10^7$ Q-Gluons

QTY g G(U$\underline{D}$)$\underline{R}$ $= 0.294 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ $= 1.254 \ 10^7$ Q-Gluons

QTY g G(U$\underline{D}$)$\underline{B}$ $= 0.294 \ 10^{-27}$ kg / $2.35 \ 10^{-35}$ $= 1.254 \ 10^7$ Q-Gluons

Where Q-Gluons, it means quarks-antiquarks-gluons.

It is very important to be clear that the mass of quark-antiquarks-gluons varies with temperature.

These calculations were carried out for a temperature $T = 1.57 \ 10^5$ K.

2.1.1. Calculation of the number of gluons by dividing the volume of the neutron by the volume of the quark.

Rn $= 0.4 \ 10^{-15}$ m

Where Rn is radius of the neutron

Vn $= (4/3) \ π \ R^3 = (4/3) \times 3.14 \times (0.4 \ 10^{-15})^3$

Vn $= 0.267 \ 10^{-45}$ m³

Rq $= 0.43 \ 10^{-18}$ m

Where Rq is quark radius.

Vq $= (4/3) \ π \ R^3 = (4/3) \times 3.14 \times (0.43 \ 10^{-18})^3 =$

Vq $= 0.33 \ 10^{-54}$ m³

Where Vq is volume of the quark

D $=$ Vn / Vq $= 0.267 \ 10^{-45}$ m³ / Vq $= 0.33 \ 10^{-54}$ m³

D $= 0.80 \ 10^9 = 8.0 \ 10^8$

D $= 80 \ 10^7$ gluons

Where D is the number of quark-antiquarks-gluons

According to our calculations, we have:

D $\approx$ 10 QTY g

We said that the mass of gluons decreases with temperature, see table 1, if we calculate the number of quarks-antiquarks-gluons for a temperature lower than $T = 10^5$ K, we will achieve the equality D = QTY g.

D = 10 QTY g

*2.2. Mechanism that generates gravity in neutrons, calculation of the number of gravitons inside a neutron*

From the point of view of charge, we said that interaction 1 and interaction 2 of quarks represent electric dipoles (Spin 1). We also said that these dipoles are polarized and vibrate in one direction,

producing an electromagnetic field that gives rise to a flow of gluons that generates an electric current and through this mechanism we manage to produce mass in Hadrons (proton, neutron, etc).

From the point of view of mass, if we consider quark and anti-quark dipoles as point masses that vibrate, we can idealize it as a quark linked to an anti-quark by a spring (Gravitons with spin 2), these two masses vibrating together by a spring, they would produce disturbances in space-time that would propagate in the form of gravitational waves.

This would be the mechanism by which gravitational waves are generated, gravitons that would propagate in space-time.

In conclusion, it is the charge and mass properties in the quark and anti-quark dipoles represented in interaction 1 and interaction 2, which produce 100% of the mass in protons and neutrons and also cause the gravitational waves (gravitons), that propagate in space-time, what we call gravity.

Neutron mass = 939.56 MeV/c²

$2m_d + m_u$ = 11.6 MeV/c²

where $m_d$, is the mass of the D quark and $m_u$, is the mass of the U quark.

We are going to perform the following calculations using the effective Boltzmann constant to quantize and quantify gravity.

$K_{Bl}$ = 9.15 10⁻²⁶ J/K,

Where $K_{Bl}$ is approximate effective Boltzmann constant of the moon.

$E_l = K_{Bl} \times T$

$E_l$ = 9.15 10⁻²⁶ x 1.6 10³ = 14.64 x 10⁻²³

$E_l$ = 14.64 10⁻²³ Joules

$E_l = h \times f_l$; $f_l = E_l / h$ = 14.64 10⁻²³ / 6.63 10⁻³⁴ = 2.34 10¹¹

$f_l$ = 2.34 10¹¹ Hz

M(graviton) = h / ($\lambda_l \times c$)

$c = \lambda_l \times f_l$; $\lambda_l = c / f_l$ = 3 10⁸ / 2.34 10¹¹ = 1.28 10⁻³

$\lambda_l$ = 1.28 10⁻³ m

M(graviton) = h / ($\lambda_l \times c$) = 6.63 10⁻³⁴ / 1.28 10⁻³ x 3 10⁸ = 1.72 10⁻²⁹

M(graviton)l-eff = 1.72 10⁻²⁹ kg

$K_{Bt}$ = 2.68 10⁻²⁸ J/K,

Where $K_{Bt}$ is approximate effective Boltzmann constant of the earth.

$E_t = K_{Bt} \times T$

$E_t$ = 2.68 10⁻²⁸ x 6.7 10³ = 17.95 x 10⁻²⁵

$E_t$ = 17.95 10⁻²⁵ Joules

$E_t = h \times f_t$; $f_t = E_t / h$ = 17.95 10⁻²⁵ / 6.63 10⁻³⁴ = 2.70 10⁹

$F_t$ = 2.70 10⁹ Hz

M(graviton) = h / ($\lambda \times C$)

$c = \lambda_t \times f_t$; $\lambda_t = c/f_t$ = 3 10⁸ / 2.70 10⁹ = 1.11 10⁻¹

$\lambda_t$ = 11.1 10⁻¹ m

M(graviton) = h / ($\lambda_t \times c$) = 6.63 10⁻³⁴ / 1.11 10⁻¹ x 3 10⁸

M(graviton)t-eff = 1.99 10⁻⁴¹ kg

$K_{Bs}$ = 3.58 10⁻³⁷ J/K

Where $K_{Bs}$ is approximate effective Boltzmann constant of the sun.

$E_s = K_{Bs} \times T$

$E_s = 3.58 \ 10^{-37} \times 15 \ 10^6 = 53.7 \times 10^{-31}$

$E_s = 53.7 \ 10^{-31}$ Joules

$E_s = h \times f_s; \ f_s = E_s / h = 53.7 \ 10^{-31} / 6.63 \ 10^{-34} = 8.09 \ 10^3$

$f_s = 8.09 \ 10^3$ Hz

$M(graviton) = h / (\lambda_s \times c)$

$c = \lambda_s \times f_s; \ \lambda_s = c / f_s = 3 \ 10^8 / 8.09 \ 10^3 = 0.37 \ 10^5$

$\lambda_s = 3.7 \ 10^4$ m

$M(graviton) = 6.63 \ 10^{-34} / (3.7 \ 10^4 \times 3 \ 10^8) = 0.59 \ 10^{-46}$

$M(graviton)s\text{-}eff = 5.9 \ 10^{-47}$ kg

$K_{Be} = 1.9 \ 10^{-37}$ J/K

Where $K_{Be}$ is approximate effective Boltzmann constant of a star white dwarf.

$E_e = K_{Be} \times T$

$E_e = 1.9 \ 10^{-37} \times 20 \ 10^6 = 38 \times 10^{-31}$

$E_e = 38 \ 10^{-31}$ Joules

$E_e = h \times f_e; \ f_e = E_e / h = 38 \ 10^{-31} / 6.63 \ 10^{-34} = 5.73 \ 10^3$

$f_e = 5.73 \ 10^3$ Hz

$M(graviton) = h / (\lambda_e \times c)$

$c = \lambda_e \times f_e; \ \lambda_e = c / f_e = 3 \ 10^8 / 5.73 \ 10^3 = 0.52 \ 10^5$

$\lambda_e = 5.2 \ 10^4$ m

$M(graviton) = h / (\lambda_e \times c) = 6.63 \ 10^{-34} / 5.2 \ 10^4 \times 3 \ 10^8 = 0.425 \ 10^{-46}$

$M(graviton)e\text{-}eff = 4.25 \ 10^{-47}$ kg

$K_{Bn} = 2.42 \ 10^{-42}$ J/K

Where $K_{Bn}$ is approximate effective Boltzmann constant of a neutron star.

$E_n = K_{Bn} \times T$

$E_n = 2.42 \ 10^{-42} \times 10^{12} = 2.42 \times 10^{-30}$

$E_n = 2.42 \ 10^{-30}$ Joules

$E_n = h \times f_n; \ f_n = E_n / h = 2.42 \ 10^{-30} / 6.63 \ 10^{-34} = 0.36 \ 10^4$

$f_n = 3.6 \ 10^3$ Hz

$M(graviton) = h / (\lambda_n \times c)$

$c = \lambda_n \times f_n ; \ \lambda_n = c / f_n = 3 \ 10^8 / 3.6 \ 10^3 = 0.83 \ 10^5$

$\lambda_s = 8.3 \ 10^4$ m

$M(graviton) = h / (\lambda_n \times c) = 6.63 \ 10^{-34} / 8.3 \ 10^4 \times 3 \ 10^8 = 0.266 \ 10^{-46}$

$M(graviton)n\text{-}eff = 2.66 \ 10^{-47}$ kg

$K_{Bq} = 1.78 \ 10^{-43}$ J/K

Where $K_{Bq}$ is approximate effective Boltzmann constant of a black hole.

$E_q = K_{Bq} \times T$

$E_q = 1.78 \ 10^{-43} \times 10^{13} = 1.78 \times 10^{-30}$

$E_q = 1.78 \ 10^{-30}$ Joules

$E_q = h \times f_q; \ f_q = E_q / h = 1.78 \ 10^{-30} / 6.63 \ 10^{-34} = 0.26 \ 10^4$

$f_q = 2.6 \ 10^3$ Hz

$M(graviton) = h / (\lambda_q \times c)$

$c = \lambda_q \times f_q ; \ \lambda_q = c / f_q = 3 \ 10^8 / 2.6 \ 10^3 = 1.15 \ 10^5$

$\lambda_q = 1.15 \ 10^5$ m

$M(graviton) = h / (\lambda_q \times c) = 6.63 \ 10^{-34} / 1.15 \ 10^5 \times 3 \ 10^8 = 1.76 \ 10^{-47}$

$M(graviton)q\text{-}eff = 1.76 \ 10^{-47}$ kg

We are going to represent all these calculations in Table 2:

**Table 2.** – Calculation of the mass of the graviton as a function of temperature.

| | EFF BOLTZMANN CONSTANT (J/K) | ENERGY (Joules) | FREQUENCY (Hz) | TEMPERATURE (k) | WAVELENGTH (m) | EFF GRAVITON MASS (Kg) |
|---|---|---|---|---|---|---|
| MOON | $9.15 \ 10^{-26}$ | $14.64 \ 10^{-23}$ | $2.34 \ 10^{11}$ | $1.6 \ 10^{3}$ | $1.28 \ 10^{-3}$ | $1.72 \ 10^{-29}$ |
| EARTH | $2.68 \ 10^{-28}$ | $17.95 \ 10^{-25}$ | $2.70 \ 10^{9}$ | $6.7 \ 10^{3}$ | $11.1 \ 10^{-1}$ | $1.99 \ 10^{-41}$ |
| SUN | $3.58 \ 10^{-37}$ | $53.7 \ 10^{-31}$ | $8.09 \ 10^{3}$ | $15 \ 10^{6}$ | $3.7 \ 10^{4}$ | $5.9 \ 10^{-47}$ |
| WHITE DWARF STAR | $1.9 \ 10^{-37}$ | $38.0 \ 10^{-31}$ | $5.73 \ 10^{3}$ | $20 \ 10^{6}$ | $5.2 \ 10^{4}$ | $4.25 \ 10^{-47}$ |
| NEUTRON STAR | $2.42 \ 10^{-42}$ | $2.42 \ 10^{-30}$ | $3.6 \ 10^{3}$ | $10^{12}$ | $8.3 \ 10^{4}$ | $2.66 \ 10^{-47}$ |
| BLACK HOLE | $1.78 \ 10^{-43}$ | $1.78 \ 10^{-30}$ | $2.6 \ 10^{3}$ | $10^{13}$ | $1.15 \ 10^{5}$ | $1.76 \ 10^{-47}$ |

It is important to clarify that the mass of the calculated graviton is an effective mass or equivalent that is related to the definition that was used to calculate the effective Boltzmann constant, for example, in a neutron star the minimum particle considered to calculate the effective mass is a neutron and the effective graviton equivalent mass calculated for a neutron star is related to the mass of the neutron, that is, the graviton equivalent or effective mass calculated for a neutron star is a mass resulting from an unimaginable amount of individual gravitons.

In analogy with the calculations carried out for gluons, we are going to carry out similar calculations for gravitons using the mass of the effective graviton.

For a neutron star, we have:

Let's assume the mass of the neutron for $T = 10^{12}$ K:

Neutron mass = 939.56 MeV/c²

$2md + mu = 11.6$ MeV/c²

QTY gr = Neutron mass / unit mass of a graviton.

QTY gr = $1.67 \ 10^{-27}$ / $2.66 \ 10^{-47}$

m gr = $2.66 \ 10^{-47}$ kg

Where m gr, is the unit mass of the graviton for $T = 10^{12}$ K.

QTY gr = $0.627 \ 10^{20}$

QTY gr = $6.27 \ 10^{19}$

Where QTY gr, is number of gravitons in a neutron, for $T = 10^{12}$ K.

Why do we use the mass of the neutron, mn = 939.56 MeV/c², to calculate the number of gravitons in a neutron!

This question, in my opinion, would have 2 answers:

First answer, from the point of view of mass, if we consider quark and anti-quark dipoles as point masses that vibrate, we can idealize it as a quark linked to an anti-quark by a spring (Gravitons with spin 2), these two masses vibrating together by a spring, they would produce disturbances in space-time that would propagate in the form of gravitational waves. This would be the mechanism by which gravitational waves are generated, gravitons that would propagate in space-time.

Second answer, if we consider the Maldacena correspondence ADS = CFT, the right side of the equation, CFT, tells us that there is a mass that corresponds to the neutron and is mn = 939.56 MeV/c²; The left side tells us that there must be a gravitational mass equivalent to mn = 939.56 MeV/c², which must be equivalent to the CFT mass, for the equation ADS = CFT to be fulfilled.

These are the two answers, for which we use the mass of the neutron to calculate the number of gravitons inside a neutron.

We will calculate the number of corresponding gravitons, for interactions 1 & 2:

Interaction 1:

QTY gr INT 1:    = $0.376 \ 10^{-27}$ kg / $2.66 \ 10^{-47}$ kg = $1.41 \ 10^{19}$ Graviton

Qty gr R(D$\underline{D}$)R = $0.152 \ 10^{-27}$ kg / $2.66 \ 10^{-47}$ kg = $0.571 \ 10^{19}$ Graviton

Qty gr B(D$\underline{D}$)B = $0.152 \ 10^{-27}$ kg / $2.66 \ 10^{-47}$ kg = $0.571 \ 10^{19}$ Graviton

Qty gr G(U$\underline{U}$)G = $0.072 \ 10^{-27}$ kg / $2.66 \ 10^{-47}$ kg = $0.270 \ 10^{19}$ Graviton

Interaction 2:

QTY gr INT 2 = 1.293 10⁻²⁷ kg / 2.66 10⁻⁴⁷ kg = 4.86 10¹⁹ Graviton
QTY gr R(D<u>D</u>)<u>B</u> = 0.1759 10⁻²⁷ kg / 2.66 10⁻⁴⁷ = 0.661 10¹⁹ Graviton
QTY gr R(D<u>U</u>)<u>G</u> = 0.1759 10⁻²⁷ kg / 2.66 10⁻⁴⁷ = 0.661 10¹⁹ Graviton
QTY gr B(D<u>D</u>)<u>R</u> = 0.1759 10⁻²⁷ kg / 2.66 10⁻⁴⁷ = 0.661 10¹⁹ Graviton
QTY gr B(D<u>U</u>)<u>G</u> = 0.1759 10⁻²⁷ kg / 2.66 10⁻⁴⁷ = 0.661 10¹⁹ Graviton
QTY gr G(U<u>D</u>)<u>R</u> = 0.294 10⁻²⁷ kg / 2.66 10⁻⁴⁷ = 1.105 10¹⁹ Graviton
QTY gr G(U<u>D</u>)<u>B</u> = 0.294 10⁻²⁷ kg / 2.66 10⁻⁴⁷ = 1.105 10¹⁹ Graviton

It is important to make it clear that the number of gravitons calculated inside a neutron corresponds to the temperature T = 10¹² K.

If we look at table 2, we see that as the temperature increases the mass of the graviton decreases.

### 3. Electrical-quantum modelling of the proton as a three-phase alternating current electrical generator

We are going to work with Figure 16 to create our electrical model of the proton as a three-phase alternating current electrical generator.

| PROTON | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R B G | | R | B | G | | R | R | B | B | G | G |
| D U U | | D | U | U | | D | D | U | U | U | U |
| D U U | | D | U | U | | U | U | D | U | D | U |
| R B G | | R | B | G | | B | G | R | G | R | B |

**Figure 16.** – Proton.

The dipole D<u>D</u> is analogous to L1 and R<u>R</u> is analogous to the current flowing through L1.
The dipole U<u>U</u> is analogous to L2 and B<u>B</u> is analogous to the current flowing through L2.
The dipole U<u>U</u> is analogous to L3 and G<u>G</u> is analogous to the current flowing through L3.
We see that there are two types of interactions.
Interaction 1 or direct interaction and interaction 2 or cross interaction.
We said that down quarks have one frequency and up quarks have another frequency; Thanks to gluons, vector or phasor operations cease to be a problem, making it possible for a quark to transform into another quark, of the same frequency, thanks to the exchange of gluons. It is an amazing mechanism. We can see this mechanism in Figure 10.

In analogy to a three-phase alternating current electric generator, we are going to represent interaction 1 and interaction 2, using vectors whose resulting vector is not zero. In this way we are going to simulate a proton as a three-phase alternating current electrical generator.

In Figure 5 of the standard model, we see that the up quark has a mass of 2.2 MeV/c² and the down quark has a mass of 4.7 MeV/c².

Taking these values as reference we are going to make our vector diagram of the neutral.

Quark Down = 4.7 MeV/c²
Quark up = 2.2 MeV/c²

It is important to make it clear that all interactions are vector, although we do not represent them as such in the figures.

Interaction 1:
If we analyse Figure 17, star connection, we see that the following vector sum is not null:

R(D<u>D</u>)<u>R</u> + B(U<u>U</u>)<u>B</u> + G(U<u>U</u>)<u>G</u> ≠ 0
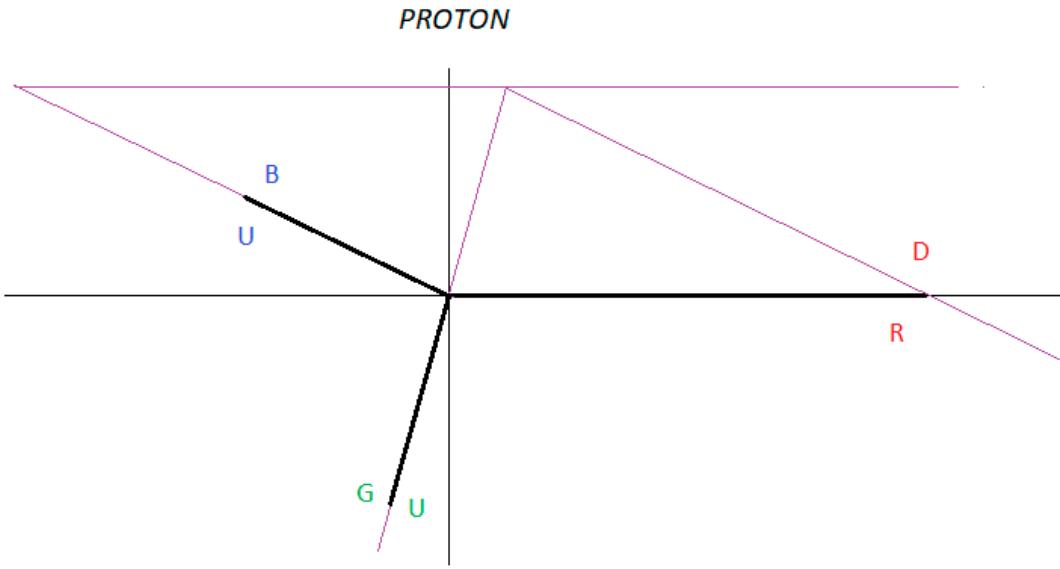
**Figure 17.** - Proton interaction 1.

Interaction 2:
If we analyse Figure 18, we observe that the following vector sum is not null:

R(DU̲)B̲ + R(DU̲)G̲ + B(UD̲)R̲ + B(UU̲)G̲ + G(UD̲)R̲ +G(UU̲)B̲ ≠ 0

From a load point of view, we have:
R(DD̲)R̲ + B(UU̲)B̲ + G(UU̲)G̲ + R(DU̲)B̲ + R(DU̲)G̲ + B(UD̲)R̲ + B(UU̲)G̲ + G(UD̲)R̲
+ G(UU̲)B̲ = 1
From the mass point of view, we have:
R(DD̲)R̲ + B(UU̲)B̲ + G(UU̲)G̲ + R(DU̲)B̲ + R(DU̲)G̲ + B(UD̲)R̲ + B(UU̲)G̲ + G(UD̲)R̲
+ G(UU̲)B̲ = 938.27 MeV/c²
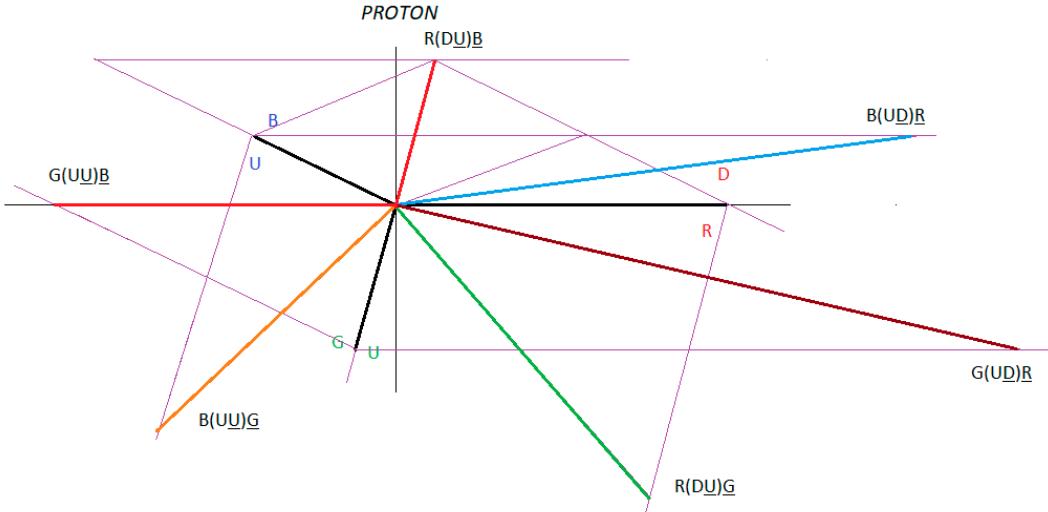
**Figure 18.** - Interaction 1 & 2 of the proton.

Knowing that the total mass of the proton is 938.27 MeV/c², we are going to calculate the mass content in each interaction:

R(D$\underline{D}$)$\underline{R}$ = 103.22 MeV/c²
B(U$\underline{U}$)$\underline{B}$ = 48.34 MeV/c²
G(U$\underline{U}$)$\underline{G}$ = 48.34 MeV/c²
R(D$\underline{U}$)$\underline{B}$ = 48.34 MeV/c²
R(D$\underline{U}$)$\underline{G}$ = 122.55 MeV/c²
B(U$\underline{D}$)$\underline{R}$ = 161.23 MeV/c²
B(U$\underline{U}$)$\underline{G}$ = 103.22 MeV/c²
G(U$\underline{D}$)$\underline{R}$ = 199.80 MeV/c²
G(U$\underline{U}$)$\underline{B}$ = 103.22 MeV/c²

We are going to represent these values in Figure 19:

| PROTON | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | INTERACTION 1 | | | | INTERACTION 2 | | | | |
| R B G | | R | B | G | | R | R | B | B | G | G |
| D U U | | D | U | U | | D | D | U | U | U | U |
| $\underline{D}$ U U | | $\underline{D}$ | $\underline{U}$ | $\underline{U}$ | | $\underline{U}$ | $\underline{U}$ | $\underline{D}$ | $\underline{U}$ | $\underline{D}$ | $\underline{U}$ |
| R B G | | $\underline{R}$ | $\underline{B}$ | $\underline{G}$ | | $\underline{B}$ | $\underline{G}$ | $\underline{R}$ | $\underline{G}$ | $\underline{R}$ | $\underline{B}$ |
| m(Mev/c²) | 938.26 | 199.90 | | | | 738.36 | | | | | |
| | | 103.22 | 48.34 | 48.34 | | 48.34 | 122.55 | 161.23 | 103.22 | 199.80 | 103.22 |

**Figure 19.** - Mass distribution in interactions 1 & 2.

The electrical modelling of a proton as a three-phase alternating current electrical generator allows us to assign a mass value to interactions 1 and 2, which we represent using a vector diagram, as shown in Figures 18 & 19.

Conclusions: It is important to keep in mind that the relationship between the interactions of quarks, anti-quarks and gluons is vector-type, that is, each interaction will be represented by a module and an angle.

Definitely, we can assure that protons are true generators of energy, mass and gravity; We have verified how with three quarks that add up to approximately 10 MeV/c², we can generate a mass of 938.27 MeV/c² through the interactions of quarks, anti-quarks and gluons.

## 4. APPLICATION OF THE MODEL AND RESULTS

*4.1. Analysis of β⁻ decay. Creation of electrons, neutrinos and photons.*

Let's briefly describe β⁻ decay:

Beta decay or β decay represents the decay of a parent nucleus to a daughter through the emission of the beta particle. Beta decay is governed by the weak interaction.

This transition (β⁻ decay) can be characterized as:
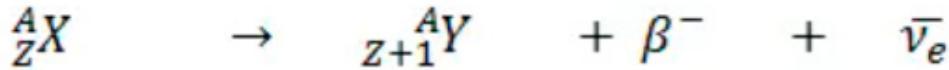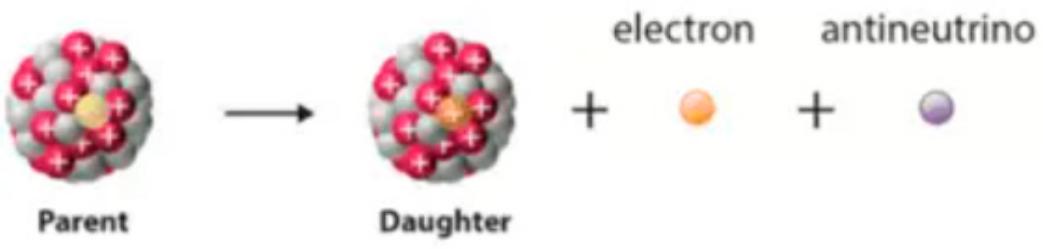
**Figure 20. -** β⁻ decay.

If a nucleus emits a beta particle, it loses an electron (or positron). In this case, the mass number of the daughter nucleus remains the same, but the daughter nucleus will form a different element.

A free neutron also undergoes this type of decay. A free neutron will decay with a half-life of approximately 611 seconds (10.3 minutes) into a proton, an electron, and an antineutrino.

**Figure 21.** - weak interaction changes one quark flavour to another.

## Beta decay energy spectrum

The electrons emitted in beta decay have a continuous rather than discrete spectrum that seems to contradict the conservation of energy, under the current assumption that beta decay is the simple emission of an electron from a nucleus. When this was first observed, it seemed to threaten the survival of one of the most important conservation laws in physics.

In the beta decay process, the neutrino carries the missing energy and also in this process the law of conservation of energy remains valid.
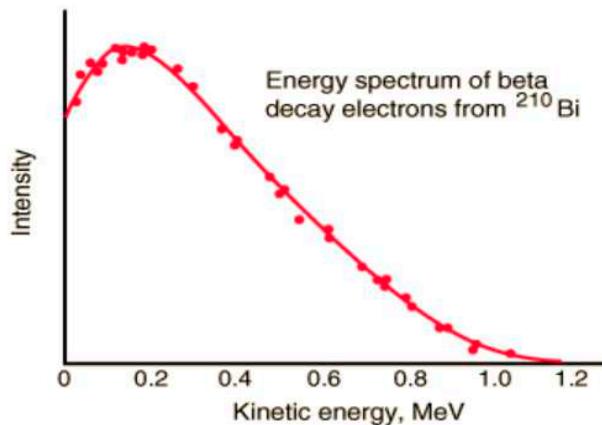
**Figure 22.** - Continuous energy spectrum of β⁻ decay.

## β⁻ Decay – Q Value

The Q value is given by:

Q = [m father – (m Daughter + m Radiation)] c²

$$^{214}_{83}Bi \quad \rightarrow \quad ^{214}_{84}Po \quad + \quad \beta^- \quad + \quad \bar{v}_e \quad + \quad 3.26\ MeV$$
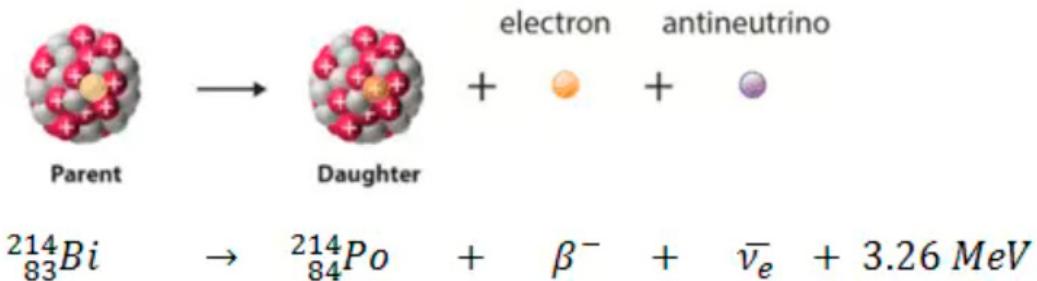
**Figure 23.** - The Q value of typical beta decay for Bi.

In the β⁻ decay process, an electron is emitted. This emission is accompanied by antineutrino emission, which shares the energy and momentum of the decay. β⁻ emission has a characteristic spectrum. This characteristic spectrum is caused by the fact that antineutrino is emitted with β⁻ particle emission. The shape of this energy curve depends on what fraction of the reaction energy (Q value - the amount of energy released by the reaction) is carried by the massive particle. Therefore, β⁻ particles can be emitted with any kinetic energy ranging from 0 to Q. After a β⁻ decay, the daughter nucleus is often left in an excited energy state. To stabilize, it subsequently emits high-energy photons, γ rays.

**Vector analysis of β⁻ decay**

To analyse the mechanism of β⁻ decay, using a vector diagram, we are going to use Figures 24 and 25.

| NEUTRON | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | INTERACTION 1 | | | | INTERACTION 2 | | | | |
| R B G | | R | B | G | | R | R | B | B | G | G |
| D D U | | D | D | U | | D | D | D | D | U | U |
| D D U | | D | D | U | | D | U | D | U | D | D |
| R B G | | R | B | G | | B | G | R | G | R | B |

**Figure 24.** – Neutron.

| PROTON | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | INTERACTION 1 | | | | INTERACTION 2 | | | | |
| R B G | | R | B | G | | R | R | B | B | G | G |
| D U U | | D | U | U | | D | D | U | U | U | U |
| D U U | | D | U | U | | U | U | D | U | D | U |
| R B G | | R | B | G | | B | G | R | G | R | B |

**Figure 25.** – Proton.

Let's analyse the simplest situation:
R(DD)R of the neutron, in phase with R(DD)R of the proton
B(DD)B of the neutron, in phase with B(UU)B of the proton
G(UU)G of the neutron, in phase with G(UU)G of the proton
We are going to present what was stated above, in Figure 22
We are going to develop the vector diagrams of the neutron and the proton, considering the interactions 1 & 2, let's divide them into parts to facilitate vector interpretation.
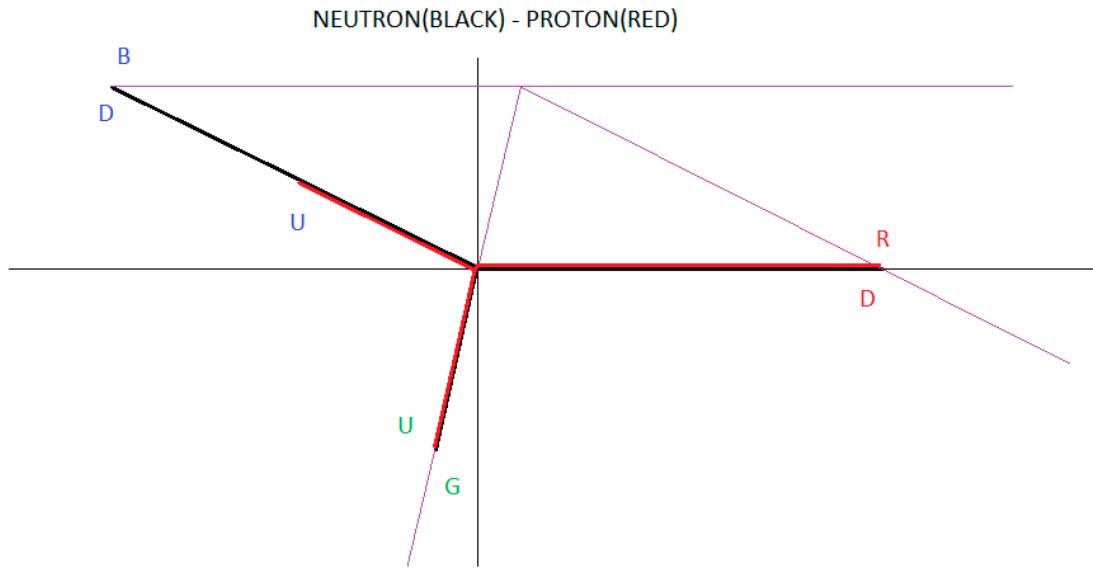
**Figure 26.** - Vector diagram of the neutron in black and vector diagram of the proton in red.
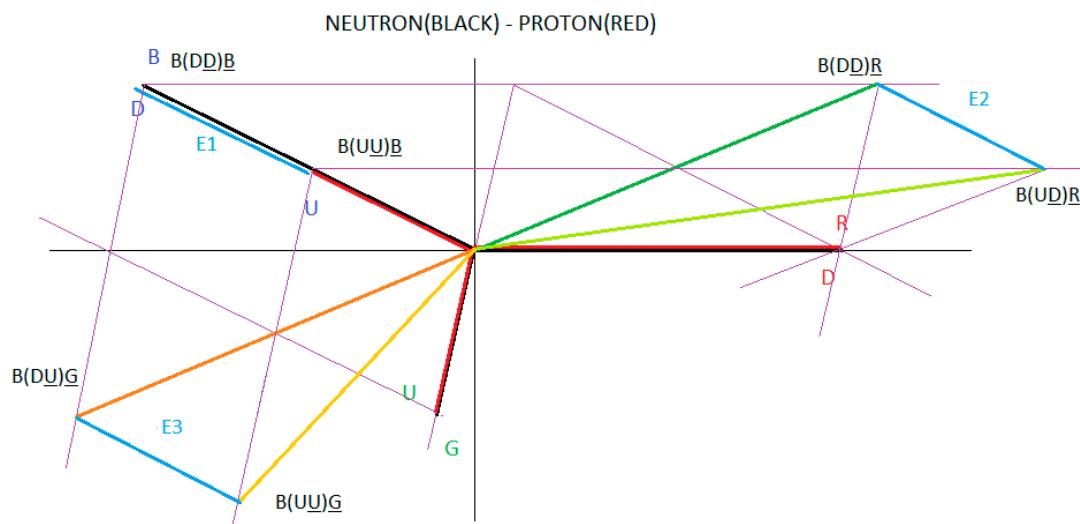
**Figure 27.** - Vector diagram of the interactions in β⁻ decay, Neutron → Proton: R(DD)R & R(DD)R, B(DD)B & B(DD)B, G(UU)G & G(UU)G, B(D<u>D</u>)<u>R</u> & B(U<u>D</u>)<u>R</u> and B(D<u>U</u>)<u>G</u> & B(U<u>U</u>)<u>G</u>.
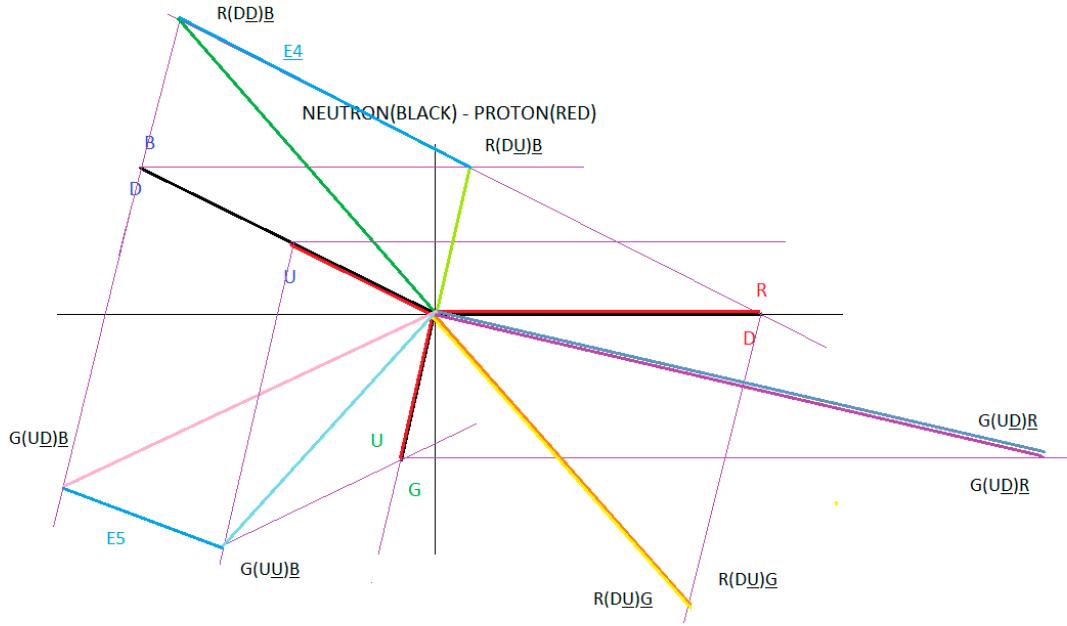
**Figure 28.** – Vector diagram of the interactions in β⁻ decay, Neutron → Proton: R(D<u>D</u>)<u>B</u> & R(D<u>U</u>)<u>B</u>, R(D<u>U</u>)<u>G</u> & R(D<u>U</u>)<u>G</u>, G(U<u>D</u>)<u>R</u> & G(U<u>D</u>)<u>R</u> and G(U<u>D</u>)<u>B</u> & G(U<u>U</u>)<u>B</u>.

Analysing the interactions, we have:

| β⁻ DECAY | | |
|---|---|---|
| NEUTRON | PROTON | INTERACTION |
| R(D<u>D</u>)<u>R</u> | R(D<u>D</u>)<u>R</u> | E = 0 |
| B(D<u>D</u>)<u>B</u> | B(U<u>U</u>)<u>B</u> | E1 |
| G(U<u>U</u>)<u>G</u> | G(U<u>U</u>)<u>G</u> | E = 0 |
| B(D<u>D</u>)<u>R</u> | B(U<u>D</u>)<u>R</u> | E2 |
| B(D<u>U</u>)<u>G</u> | B(U<u>U</u>)<u>G</u> | E3 |
| R(D<u>D</u>)<u>B</u> | R(D<u>U</u>)<u>B</u> | E4 |
| R(D<u>U</u>)<u>G</u> | R(D<u>U</u>)<u>G</u> | E = 0 |
| G(U<u>D</u>)<u>R</u> | G(U<u>D</u>)<u>R</u> | E = 0 |
| G(U<u>D</u>)<u>B</u> | G(U<u>U</u>)<u>B</u> | E5 |

**Figure 29.** - interactions β⁻, neutral → proton.

If we look at Figure 27 & 28, we have:
E1, E2 and E3; they are vectors that indicate the same direction.
E4 and E5; they are vectors that indicate the same direction.
We are going to assume that E1 and E5 are equal, then we are going to graphically represent E2, E3 and E4.
We know that E4 is equal to D.
We also know that E2 + E3 = 1.0625 D
Graphically we are going to represent it as follows:
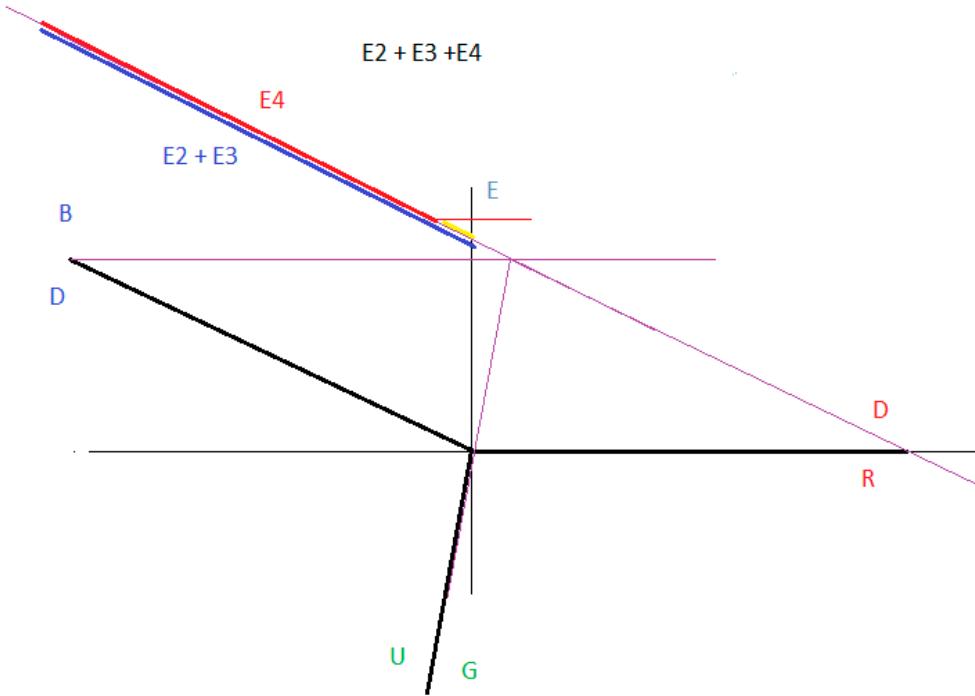
**Figure 30.** - Vector representation of: E2 + E3 + E4 = E.

E (yellow), corresponds approximately to 0.5 on the graphic scale and this gives a value of 0.29 MeV/c², compared to the value of D = 4.7 MeV/c².

E = 0.29 MeV/c²

To finish, we apply the last conversion factor:
When we apply the conversion factor to calculate the mass involved in interactions 1 & 2 of the proton, we obtained:

Fc = 12.89

Therefore, applying the conversion factor we have:

E = 12.89 x 0.29 MeV/c² = 3.73 MeV/c²

When we apply the conversion factor to calculate the mass involved in interactions 1 & 2 of the neutron, we obtained:

Fc = 10.70

Therefore, applying the conversion factor we have:

E = 10.70 x 0.29 MeV/c² = 3.10 MeV/c²

In this way, we conclude the following:
Taking into account that E = mc²
The energy released in Beta decay corresponds, according to our calculation, to the value between 3.10 MeV and 3.73 MeV

ΔE = 0.63 MeV

Conclusion, in our analysis we calculate that the decay of a neutron into a proton has a Q value that varies between the following values:

Q = Δmc² = 3.10 MeV to 3.73 MeV
Q = (3.10 + ΔE) MeV

Let's compare these values with a typical decay like the one shown in Figure 23, bismuth decays into polonium.

$$^{214}_{83}Bi \quad \rightarrow \quad ^{214}_{84}Po \quad + \quad \beta^- \quad + \quad \overline{\nu}_e \quad + \quad 3.26 \, MeV$$

$Q = \beta^- + \tilde{V} + 3.26$ MeV.

Comparing both decays, we observe that the energy values, Q, are in the order, taking into account that we work with vectors.

Another important conclusion to highlight, the W$^-$ boson, is an ideal boson, the result of interactions between quarks, antiquarks and gluons; the phasor diagrams show that the W$^-$ boson does not exist, in other words, we have no way to determine the W$^-$ boson through a theory, which is why we postulate its existence through practical experiments, because its existence was determined in this way, because of this way we were able to measure it, until now.

Let the experts in this matter analyse carefully and draw the correct conclusions.

*4.2. Simple harmonic oscillator, string theory and the calculation of ℓs and $T_0$*

In a simple harmonic oscillator, we have:

F = - k x

$k = m \omega^2$

Where K is recovery constant, m is mass and $\omega$ is angular frequency.

In string theory, we have:

$\ell s = h \, c \sqrt{\alpha'} / 2\pi,$

Where ℓs is natural or spatial length of a string.

$T_0 = 1 / \alpha' \, h \, c,$

Where $T_0$ is string tension.

To calculate ℓs and $T_0$ we are going to assume the following:

$T_0 = k$, this assumption is very important, it is a forced assumption.

In the following example we are going to calculate ℓs and $T_0$ for the following dipole R(D$\underline{D}$)$\underline{R}$ in a proton:

R(D$\underline{D}$)$\underline{R}$ = 103.22 MeV/c²

$\omega = 2 \pi f = 2 \times 3.14 \times 1.16 \, 10^{21} = 7.28 \, 10^{21}$,

Where $\omega$ is frequency for the D quark.

$\omega = 7.28 \, 10^{21}$ rad/s

$k = m \omega^2 = 1.84 \, 10^{-28} \times (7.28 \, 10^{21})^2 = 97.51 \, 10^{14}$ N/m

$K = 97.51 \, 10^{14}$ N/m

$T_0 = k = 97.51 \, 10^{14}$ N/m

$T_0 = 1 / \alpha' \, h \, c$

$\alpha' = 1 / T_0 \, h \, c = 1 / (97.51 \, 10^{14} \times 6.62 \, 10^{-34} \times 3 \, 10^8) = 1 / 1936.54 \, 10^{-12} = 5.16 \, 10^8$

$\alpha' = 5.16 \, 10^8$

$\alpha' = 5.16 \, 10^8$,

Where $\alpha'$ is universal regge slope.

$\ell s = h \, c \sqrt{\alpha'} / 2\pi$

$\ell s = (6.62 \, 10^{-34} \times 3 \, 10^8 \times \sqrt{5.16 \, 10^8}) / 2 \times 3.14$

$\ell s = 7.18 \, 10^{-22}$ m

$T_0 = k = 97.51 \, 10^{14}$ N/m

$\ell s = 7.18 \, 10^{-22}$ m

We calculate that the length ℓs that separates the quark from the antiquark is in the order of $10^{-22}$ m.

We calculate that the tension $T_0$ that separates the quark from the antiquark is in the order of $10^{14}$ N/m.

We have calculated the approximate string tension $T_0$ and the space length ℓs for the dipole R(D$\underline{D}$)$\underline{R}$, with a mass of 103.22 MeV/c², formed by the D$\underline{D}$ quarks.

We wonder why the down quark and its antiparticle are not destroyed; the answer is the following:

When we developed the theory of the generalization of the Boltzmann constant in curved space-time, we used examples of how electrons, the down quark and the top quark are created; in the example of the origin of the down quark, with the frequency of the down quark we calculate the corresponding wavelength, and to calculate the diameter of the down quark we divide the wavelength $\lambda / 2$ by the contraction factor of the Boltzmann constant corresponding to the down quark temperature.

$$Dd = (\lambda/2) / fc$$

Where Dd is the diameter of the down quark, $\lambda/2$ is the wavelength of the down quark divided by 2 and fc is the contraction factor of the down quark that corresponds to its temperature.

For the up and down quarks, the contraction factor fc is so large on the order of $10^6$ times, similar to that of neutron stars, in other words, the gravity in the down and up quarks, is so large, that it contracts the space-time in the order of $10^6$ times, acting as a shield or protection, preventing quarks and antiquarks from annihilating each other.

Precisely, this allows us to propose our electric-quantum model of the neutron and the proton as a three-phase electric generator, as Quark-antiquark dipole pairs.

At the quark level, the contraction of space-time is so great, preventing quark-antiquark annihilation, as matter forms more complex structures, that protection disappears, allowing matter-antimatter annihilation.

Although I work on it directly in my articles, I have never mentioned it, the contraction of space-time is directly proportional to the temperature, the higher the temperature, the greater the contraction of space-time, and vice versa. The maximum contraction of space-time occurs when a black hole forms. As a black hole grows, the Planck length begins to decrease inside a black hole, to a limit at which the black hole explodes, producing the Big Bang.

We are going to perform the same calculations for the interaction 1, in a proton and we are going to show them in the Figure 31:

| PROTON | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R B G | | R | B | G | | R | R | B | B | G | G |
| D U U | | D | U | U | | D | D | U | U | U | U |
| D U U | | D | U | U | | U | U | D | U | D | U |
| R B G | | R | B | G | | B | G | R | G | R | B |
| m(Mev/c²) | 938.26 | | 199.90 | | | | | 738.36 | | | |
| | | 103.22 | 48.34 | 48.34 | | 48.34 | 122.55 | 161.23 | 103.22 | 199.80 | 103.22 |
| $T_0$ (N/m) | | $97.51\ 10^{14}$ | $10.48\ 10^{14}$ | $10.48\ 10^{14}$ | | | | | | | |
| $\ell s$ (m) | | $7.18\ 10^{-22}$ | $21.91\ 10^{-22}$ | $21.91\ 10^{-22}$ | | | | | | | |

**Figure 31.** - Representation of $\ell s$ and $T_0$ of interaction 1, proton.

In Figure 31, we observe for the three quark-antiquark dipoles, interaction 1, the tension of the string $T_0$ is of the order of $10^{14}$ n/m and the length of the string $\ell s$ is of the order of $10^{-22}$ m

If we extrapolate the values of $T_0$ and $\ell s$, to the dipoles of interaction 2, due to the mass values that the interactions take, we conclude that the values of $T_0$ will be in the order of $10^{14}$ n/m and the values of $\ell s$ They will be found in the order of $10^{-22}$ m.

We are going to perform the same calculations for the interaction 1, in a neutron and we are going to show them in the Figure 32:

| NEUTRON | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | B | G | | R | R | B | B | G | G |
| R B G | | D | D | U | | D | D | D | D | U | U |
| D D U | | D | D | U | | D | U | D | U | D | D |
| D D U | | D | D | U | | D | U | D | U | D | D |
| R B G | | R | B | G | | B | G | R | G | R | B |
| m( Mev/c²) | 939.5 | 211.7 | | | | 727.8 | | | | | |
| | | 85.7 | 85.7 | 40.3 | | 99.00 | 99.00 | 99.00 | 99.00 | 165.9 | 165.9 |
| $T_0$ (N/m) | | $80.55\,10^{14}$ | $80.55\,10^{14}$ | $8.74\,10^{14}$ | | | | | | | |
| ℓs (m) | | $7.90\,10^{-22}$ | $7.90\,10^{-22}$ | $23.98\,10^{-22}$ | | | | | | | |

**Figure 32.** - Representation of ℓs and $T_0$ of interaction 1, neutron.

In Figure 32, we observe for the three quark-antiquark dipoles, interaction 1, the tension of the string $T_0$ is of the order of $10^{14}$ n/m and the length of the string ℓs is of the order of $10^{-22}$ m

If we extrapolate the values of $T_0$ and ℓs, to the dipoles of interaction 2, due to the mass values that the interactions take, we conclude that the values of $T_0$ will be in the order of $10^{14}$ n/m and the values of ℓs They will be found in the order of $10^{-22}$ m.

The most important thing that we can rescue or emphasize using the theory of Electrical-quantum modelling of the neutron and proton as a three-phase alternating current electrical generator, is that we can predict the typical values, that is, the order of the values for $T_0$ and ℓs, in the interactions 1 & 2, in the protons and neutrons.

### 4.3. Electrical-quantum modelling of the black hole as a three-phase alternating current electrical generator.

Let us remember the following, in the LHC particle accelerator, it has been successfully isolated antimatter, that is, matter (-).

We will also remember, when a black hole forms, a star of more than 25 solar masses explodes in a supernova and collapses due to gravity, giving rise to a black hole of approximately 3 solar masses. It is important to note that the star loses 22 solar masses to produce a black hole of 3 solar masses.

Let's also remember the following definition of a black hole:

A black hole is a plasma of quarks and gluons, a superfluid or a super-solid, which forms a high-temperature bosonic-fermionic condensate, characterized because the matter is in its state of maximum energy, that is, as a whole it behaves like an isolated quark.

This definition is in the paper: Rlc Electrical Modelling of Black Hole and Early Universe. Generalization of Boltzmann's Constant in Curved Space-Time.

In the definition of a black hole, we are going to highlight the word isolated quark, we could interpret this as meaning that inside a black hole there is no quarks - antiquarks - gluons interaction, only the quarks - gluons interaction exists.

With this we are proposing that inside a black hole there is no antimatter (-), that is, the interior of a black hole is made up only of matter.

Recalling again that at the LHC it was possible to isolate antimatter, that is, matter (-) and also remembering that to form a black hole a star of 25 solar masses explodes in a supernova and by gravitational collapse forms a black hole of 3 solar masses, We are wondering!!!!!!

Could it happen that the gravitational collapse process separates matter from anti-matter in analogy to what happens at the LHC?

The explosion of a supernova goes beyond chemical energy or nuclear energy; That is why we propose that a supernova when it explodes separates matter from antimatter, in other words, the black hole that remains would be made up of matter and the antimatter expands in the space-time that surrounds the black hole.

Let us remember that for temperatures greater than $10^{14}$ kelvin, the symmetry breaking of the electro-weak force occurs and consequently the separation of the electromagnetic force field and the

weak force field; For higher temperatures, the interactions of the electromagnetic force field and those of weak force do not exist.

According to what is stated in the theory Rlc Electrical Modelling of Black Hole and Early Universe. Generalization of Boltzmann's Constant in Curved Space-Time, a black hole has a temperature of $10^{13}$ K, that is, the supernova explosion to form a black hole produces a temperature higher than $10^{13}$ K, in this way, it is possible to reach at the temperature of symmetry breaking, which would mean that a black hole would form a high-temperature Bose-Einstein condensate, a single primordia atom.

**Hypothesis**. *the disappearance of the interactions of the electromagnetic force field and the weak force field together with the gravitational collapse of a star of more than 25 solar masses due to the explosion of a supernova generates a black hole of mass (+), matter; that is, a black hole without antimatter, without mass (-).*

Taking the above into account, we are going to propose the following vector model of a black hole and we are going to compare it with the vector model of a neutron.

We compare it with a neutron because we assume that the net charge of a black hole is also zero.

| NEUTRON | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
| | | | | | | | | | | | |
| R B G | | R | B | G | | R | R | B | B | G | G |
| D D U | | D | D | U | | D | D | D | D | U | U |
| D D U | | D | D | U | | D | U | D | U | D | D |
| R B G | | R | B | G | | B | G | R | G | R | B |
| | | | | | | | | | | | |
| m( Mev/c²) | 939.5 | 211.7 | | | | 727.8 | | | | | |
| | | 85.7 | 85.7 | 40.3 | | 99 | 99 | 99 | 99 | 165.9 | 165.9 |

**Figure 33.** – Neutron.

| BLACK HOLE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | INTERACCION 1 | | | | INTERACCION 2 | | | | | |
| | | | | | | | | | | | |
| RBG | | R | B | G | | R | R | B | B | G | G |
| DDU | | D | D | U | | D | D | D | D | U | U |
| DDU | | D | D | U | | D | U | D | U | D | D |
| RBG | | R | B | G | | B | G | R | G | R | B |

**Figure 34.** – Equivalent Neutron / Black Hole.

We are going to carry out mathematical calculations to see if we can obtain important conclusions:

We will calculate the Schwarzschild´s radius for a black hole of 3 solar masses.

$M = 6 \times 10^{30}$ kg

$mn = 939.56$ MeV/c²

$mn = 1.675 \times 10^{-27}$ kg

Where mn is mass of the neutron.

$Rs = 2GM / c^2$

$Rs = (2 \times 6.67 \times 10^{-11} \times 6 \times 10^{30}) / 9 \times 10^{16} = 80.04 \times 10^{19} / 9 \times 10^{16}$

$Rs = 8.89 \times 10^3$ m

Where Rs is Schwarzschild´s radius.

We will calculate the volume of a black hole of three solar masses:

$V = 4/3 \, \pi \, R^3$

$V = 1.33 \times 3.14 \times (8.89 \; 10^3)^3$

$V = 1.33 \times 3.14 \times 702.59 \; 10^9$

$V = 2934.15 \; 10^9$

Where V is volume of the black hole.

We will calculate the volume of a neutron.

$Rn = 0.4 \; 10^{-15}$ m

Where Rn is radius of the neutron.

$Vn = 4/3 \, \pi \, R^3$

$Vn = 4/3 \, \pi \, R^3 = 4/3 \times 3.14 \times (0.4 \; 10^{-15})^3 = 0.267 \; 10^{-45}$ m³, volume of the neutron.

$Vn = 0.267 \; 10^{-45}$ m³,

Where Vn is volume of the neutron.

We will define D, a scale factor that represents the ratio of the volume of a black hole of 3 solar masses to the volume of the neutron.

$D = V / Vn$

Where D is scale factor.

$D = V / Vn$

$D = V / Vn = 2934.15 \; 10^9 / 0.267 \; 10^{-45} = 10989.34 \; 10^{54}$

$D = 10.98 \; 10^{57}$

We divide the mass of the black hole by the factor D.

$Mn = M/D$

$Mn = 6 \; 10^{30}$ kg $/ 10.98 \; 10^{57}$ kg

$Mn = 0{,}54 \; 10^{-27}$ kg

If we divide Mn by mn, we obtain:

$K = Mn / mn = 0.54 \; 10^{-27} / 1.67 \; 10^{-27} = 0.32$

$K = 0{,}32$

$Mn = 939.56 \times 0.32 = 300.65$ MeV/c

$Mn = 300.65$ MeV/c

Where Mn is the mass contained in a black hole, in a volume equivalent to that of the neutron.

This result that we obtained for Mn is very interesting, it is telling us that the mass content in a volume equivalent to that of a neutron inside a black hole is less than the mass of the neutron; precisely this coincides with our assumption that inside a black hole we do not have antimatter, a black hole is formed only by matter.

If the statement is true: a black hole is formed only by matter, the antimatter is expelled when the collapse of a star occurs and a supernova explosion occurs; This would explain the enigma of antimatter during the Big Bang, it would explain why the Big Bang produces matter and not antimatter.

Vector diagram corresponding to Figure 34, black hole:
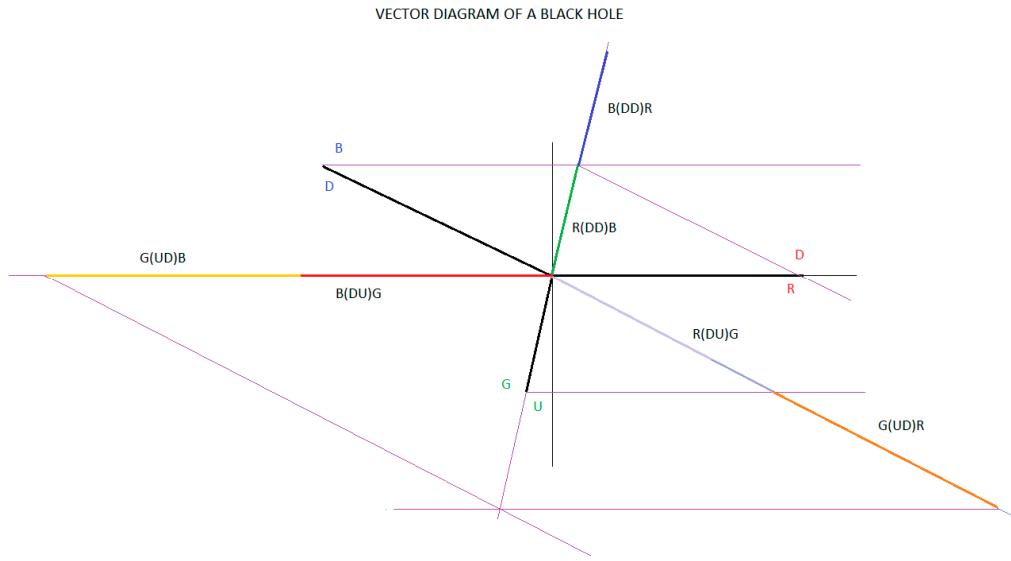
**Figure 35.** – Vector Diagram of a Black Hole.

Considering the conversion factor, we calculate the value of interaction 2, for the six corresponding dipoles, which we will represent below:

R(DD)B = 28.54 MeV/c²

R(DU)G = 60.88 MeV/c²

B(DD)R =28.54 MeV/c²

B(DU)G = 60.88 MeV/c²

G(UD)R = 60.88 MeV/c²

G(UD)B = 60.88 MeV/c²

We are going to represent these values in Figure 36:

| BLACK HOLE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | INTERACTION 1 | | | | INTERACTION 2 | | | | | |
| | | | | | | | | | | | |
| RBG | | R | B | G | | R | R | B | B | G | G |
| DDU | | D | D | U | | D | D | D | D | U | U |
| DDU | | D | D | U | | D | U | D | U | D | D |
| RBG | | R | B | G | | B | G | R | G | R | B |
| | | | | | | | | | | | |
| m( Mev/c^2) | 300.60 | | 0 | | | | | 300.60 | | | |
| | | 0 | 0 | 0 | | 28.54 | 60.88 | 28.54 | 60.88 | 60.88 | 60.88 |

**Figure 36.** - Equivalent Neutron/ Black Hole.

In Figure 36, we see that the equivalent mass of the neutron inside a black hole is approximately one-third of the mass of the neutron.

We observe that the direct interaction, interaction 1, is null.

We observe that the cross interaction, interaction 2, the scalar sum is equal to 300.60 MeV/c² and the vector sum is zero

## 7. Conclusions:

Using the theory of three-phase alternating current electric generators, we have demonstrated how neutrons and protons behave as true energy generators due to quarks-antiquarks-gluon interactions. We have demonstrated how our quarks-antiquarks-gluons model, through their interactions, produces the mass for the neutron of 939.56 MeV/c² and for the proton of 938.27 MeV/c². A very important characteristic that we must emphasize is that in our theory, we consider the UU̲

and D<u>D</u> dipoles, in other words, we consider antimatter in order to carry out our calculations, as shown in Figure 1 & 2.

We also calculate for neutrons, using quantum mechanics and the theory of the generalization of the Boltzmann constant in curved space-time, the number of quark-antiquarks-gluons inside a neutron, for a temperature of $10^5$ K, also We calculate the number of gravitons inside a neutron, for a temperature of $10^{12}$ K. To confirm that the calculated values are correct, we calculate the volume of the neutron and the volume of a quark and divide them, confirming that the calculated value is in order.

In section 4.1) we analyse $\beta^-$ decay using vector diagrams and show that the final energy Q involved in the decay is between 3.1 MeV to 3.73 MeV, within the order of the decay calculated by scientists. Also, for the first time, through vector diagrams, we can observe in a discriminated way the interactions 1 & 2, which occur during the decay process of a neutron to a proton, that is, $W^-$. This does prove that the $W^-$ boson is an ideal particle, which results from quark-antiquark-gluon interactions, which we show through vector diagrams.

In section 4.2) we calculate the tension and length of the string, which exists between the U<u>U</u> and D<u>D</u> quarks inside a proton and a neutron. The values calculated for the tension of the string $10^{14}$n/m and the values calculated for the spatial length of the string $10^{-22}$ m are in the order of the values calculated by scientists.

In section 4.3) we model a black hole using the equivalent model of a neutron. We show that the equivalent mass of a neutron is one-third (1/3) of the mass of a neutron, inside of a black hole. All these calculations are under the assumption that antimatter does not exist inside a black hole, thus fulfilling the hypothesis that when a black hole disintegrates, Big Bang, produces only a universe with matter, solving the enigma of antimatter.

**About the authors**

HECTOR GERARDO FLORES (ARGENTINA, 1971). I studied Electrical Engineering with an electronic orientation at UNT (Argentina); I worked and continue to work in oil companies looking for gas and oil for more than 25 years, as a maintenance engineer for seismic equipment in companies such as Western Atlas, Baker Hughes, Schlumberger, Geokinetics, etc.

Since 2010, I study theoretical physics in a self-taught way.

In the years 2020 and 2021, during the pandemic, I participated in the course and watched all the online videos of Cosmology I and Cosmology II taught by the Federal University of Santa Catarina UFSC (graduate level).

MARIA ISABEL GONÇALVEZ DE SOUZA (Brazil, 1983). I studied professor of Portuguese language at the Federal University of Campina Grande and professor of pedagogy at UNOPAR University, later I did postgraduate, specialization. I am currently a qualified teacher and I work for the São Joao do Rio do Peixe Prefecture, Paraiba. I am Hector's wife and my studies served to collaborate in the formatting of his articles, corrections, etc; basically, help in the administrative part with a small emphasis in the technical part analyzing and sharing ideas.

**Conflicts of Interests:** The authors declares that there are no conflicts of interest.

## References

1. Flores, H.G. Rlc Electrical Modelling of Black Hole and Early Universe. Generalization of Boltzmann's Constant in Curved Space-Time. Preprints 2023, 2023052246. https://doi.org/10.20944/preprints202305.2246.v1

2. Flores, H.G.; Gonçalvez de Souza, M.I. Theory of the Generalization of the Boltzmann's Constant in Curved Space-Time. Shannon-Boltzmann Gibbs Entropy Relation and the Effective Boltzmann's Constant. Preprints 2023, 2023090301. https://doi.org/10.20944/preprints202309.0301.v1

3. GERADORES DE CORRENTE ALTERNADA
   Universidad Federal Rio Grande do Norte UFRN – Apostille.

4. https://docente.ifrn.edu.br/heliopinheiro/Disciplinas/maquinas-acionamentos-eletricos/apostila-de-maquinas-de-cc

5. Eisberg Resnick, Física Cuántica.

6. Eyvind H. Wichmann. Física cuántica.

7. Sears – Zemansky. Física Universitaria con Física Moderna Vol II.

8.    Aula 02: circuitos Trifásicos
9.    Universidad Federal de Parana, UFPR
10.   https://www.eletrica.ufpr.br/sebastiao/wa_files/te344%20aula%2002%20-%20circuitos%20trifasicos_(2).pdf
11.   Circuitos Trifasicos
12.   Universidad de São Paulo, USP.
13.   https://edisciplinas.usp.br/pluginfile.php/5335698/mod_resource/content/1/Slides%231.pdf