The XijieDong Model of Particles

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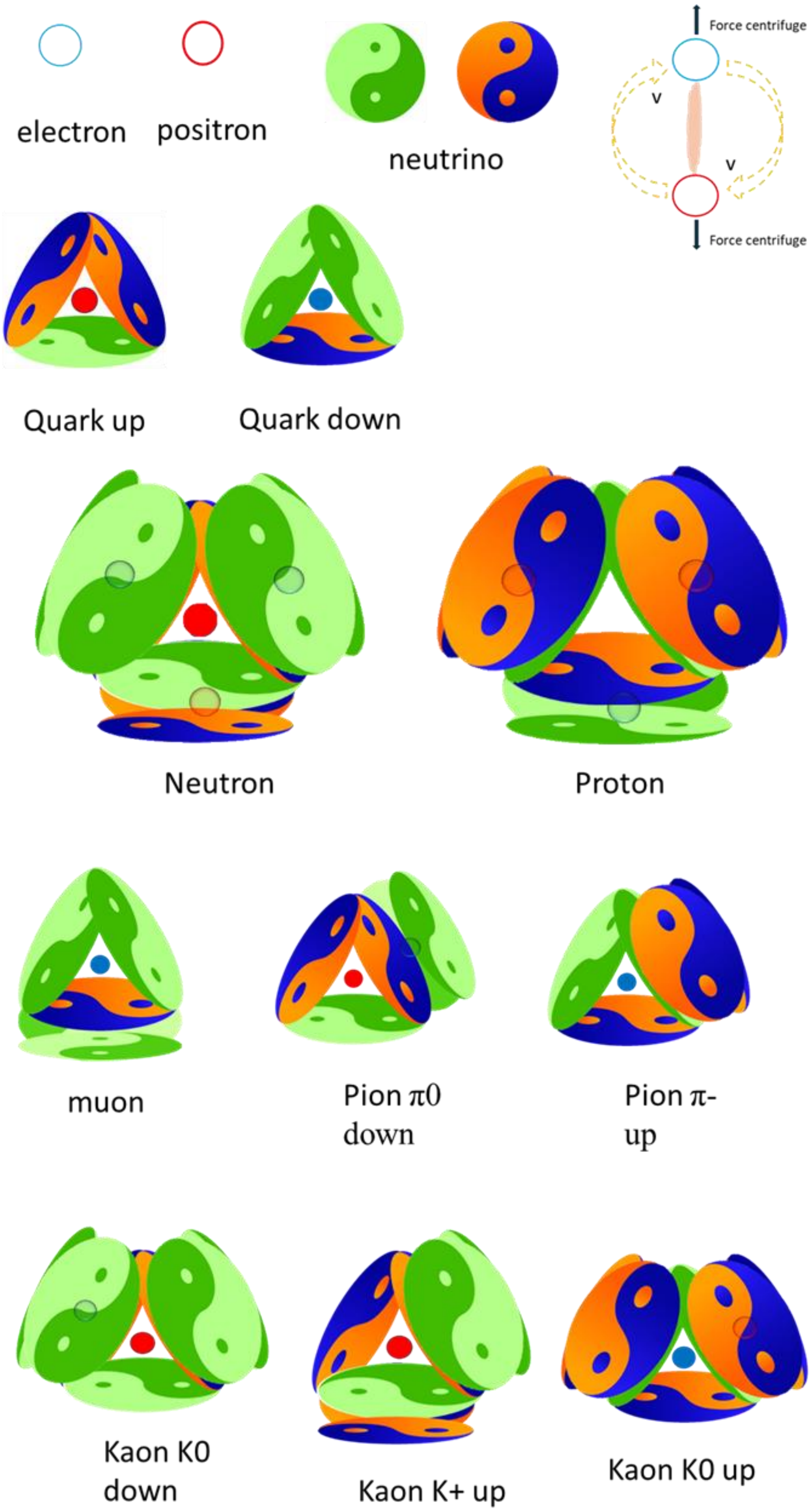


Table of Contents

1 Summary

The Standard Model (SM) of particles [1] does not explain dark matter and models mass by the overly artificial Higgs field. Another model has been long awaited. The present model reinterprets the experimental results by strictly respecting the conservation of matter. The result obtained is a family of neutral particles corresponding to dark matter.

Two elementary particles are enough to build the universe.

2 Introduction

SM automatically admits the existence of Higgs field [2] whose potential is characterized by:

$$V(\psi) = \mu^2|\psi|^2 + \lambda|\psi|^4$$

From a physical point of view, this amounts to admitting the existence of ETHER by giving it another name and that it has the above speculative characteristic.

SM considers that photon has wave and corpuscle duality. But these two states are physically incompatible.

SM attributes an electric charge of one third or two thirds to a quark. This is in contradiction with the smallest electric charge which is worth one.

SM models the result of an electron and a positron neutralization as two photons [9][15]. There is a clear violation of the principle of the conservation of matter. Indeed, a photon is different from an electric charge. Why couldn't this neutralization give an invisible particle by releasing the photons?

This XijieDong model will be referred to by the short name: XM.

XM gives a different modeling from SM, simpler, more intuitive and easier to understand. XM uses Galilean referential.

The main topics are summarized as follows:

1. Description of 3 elementary materials
2. Description de 8 compound particles
3. Modeling of 4 fundamental forces
4. Modeling of the ether
5. Demonstration of the stability of 8 compound particles
6. Announcement of some predictions as a result of the present model

Convention :

> **For the sake of simplicity and overuse of language, this document uses the name of an atom to refer to its nucleus. Indeed, the main subject of this study is the atomic nucleus. Unless, of course, the context requires otherwise.**

3 Materials and methods

3.1 Materials

The materials used are:

- A Personal Computer (PC)
- A connection to the Internet
- Operating system software: Windows 7 or higher
- Matlab software: version 2019a or higher

3.2 Methods

3.2.1 Method for particle construction

The methods used consist of using the following procedure:

1. Consult the documents cited in reference
2. Review the analyses and conclusions
3. Mass requires a field, which leads to existence of the ether
4. Reexamine the transformation equations while strictly respecting matter conservation.
5. This requires introduction of a new particle (charginette) not described in SM.
6. Looking at the inverse of the equations, the obligation of the ocean of neutral particles appears.
7. Taking chromo dynamics, the fractions one third and two thirds of electric charges for quarks are shocking. This leads to rethinking the structure of quarks.
8. Looking at all particles in the SM, almost all of them are electrically charged. Which means they are not elementary.
9. By elimination, only the photon and the electric charge remain as elementary particles.
10. Trying to combine these two, we only get electrinettes and charginettes.
11. By trying all possible combinations with the charginettes, we obtain the triangular structure of the chrominette.
12. And continuing the construction with the same process, we obtain the nucleonette.
13. Luckily, the structure of chrominette allows an electrinette to be housed in its center. Which gives the quarks and the nucleons.
14. The existence of potential energy also leads to the existence of medium in the environment.
15. The existence of neutral particles ocean allows us to rethink the wave phenomenon of particles.

The most difficult operation lies in the demonstration of the stability of compound particles. Indeed, the larger the particle, the more difficult the demonstration. These are the following particles: the charginette, the chrominette and the nucleonette. The methods used are detailed for each particle.

3.2.2 Method for Charginette ☯

A charginette is composed of two electrinettes. This is a 2-body problem. The solution to a 2-body problem has been known for a long time in astronomy. So, this is the method used here.

The only difference is that here, it is the electric force instead of the gravitational force.

The solution will be an algebraic expression. Charginette radius r is a function of the orbital speed and the mass of the electrinettes.

The graphical representation will be made with Matlab software tool.

3.2.3 Method for Chrominette Δ

A chrominette is a particle composed of 3 charginettes. Therefore, there are 6 electrinettes. The 6-body problem has no known solution today.

The resolution consists of the following steps:

1. Model a charginette as a solid disk because of its small size and high rotational speed.
2. The introduction of energy field and magnetic remanence also supports this model of the solid.
3. The 2 electrinettes continue to turn at the edge of the disc.
4. Choose a triangular structure in order to obtain 3 points of contact for the 3 charginettes. It is of course necessary to choose the rotation frequencies of the charginettes so that the electric force is attractive at the 3 points of contact.
5. Modify Coulomb's formula so that the energy tends to a finite value as the distance tends to 0. Because infinite energy is physically absurd.
6. This modified formula allows 2 electrinettes to come closer together without neutralizing each other. True neutralization requires more conditions.
7. With the rotation of the charginettes, the electric force periodically maintains the bonding of the charginettes.
8. This is only valid with one condition. Outside the neighborhoods of the 3 contact points, the cumulative displacement of the charginettes does not move too far away.
9. The displacements of each charginette are assumed to be parallel to its rotation axis. Other displacements are assumed to be negligible.
10. This condition is guaranteed by the neutralization of the electric fields within each charginette caused by the rotation of two electrinettes of opposite signs on the same circle.
11. Establish the differential equations taking into account the previous hypotheses.
12. Solve the system of differential equations with Matlab Simulink.

3.2.4 Method for Nucléonette 品

A nucleonette is a particle composed of 3 chrominettes. Therefore, there are 18 electrinettes. The 18-body problem has no known solution today.

The resolution consists of the following steps:

1. Start by taking a chrominette named the core.
2. Then take two charginettes, combine with one of the three charginettes of the core to make a second chrominette.
3. So, there are two chrominettes that share a charginette. On this adjoining charginette, the 4 points of contact are evenly distributed on its circle.
4. Repeat steps 2 and 3 above to make the third chrominette on one of the 2 free sides of the core.
5. Repeat steps 2 and 3 above to make the fourth chrominette on the last free side of the core.
6. Establish the differential equations in the same way as for the chrominette.

7. The rule of electric screens will be used here. When two electrinettes are separated by a charginette, their electric force will be neglected.
8. Solve the system of differential equations with Matlab Simulink.

4 Results

4.1 Basic materials of the universe

This paragraph describes the basic materials from which the universe can be built.

XM uses the following 3 basic materials:

1. photon 中 : an elementary particle of type 1
2. electro 口 : an elementary particle of type 2
3. field 古 : an energy field

4.2 Modeling of the 3 basic materials

This paragraph describes the modeling of each basic materials.

4.2.1 Photon 中

The photon is a material grouping together elementary particles of type 1. It has the following characteristics:

- 中 : a photon has a neutral charge 中. The physical meaning of this neutral charge is equivalent to a mass. Its unit is kg. 中 can take any positive real value.
- c : a free photon has a linear displacement speed c which is SM's c.
- $中^+$: a photon has a rotation around its direction of displacement. If it is in the right-hand direction, it will be noted as polarity +.
- $中^-$: if this rotation is in the direction of the left-hand, it will be noted polarity -.
- A photon is modeled as a corpuscle. It is not a wave.
- m_l : a photon has a linear inertial mass m_l in the direction of displacement. $m_l = \infty$.
- $m_{\perp}$: a photon has an inertial mass $m_{\perp}$ perpendicular to the direction of movement. $m_{\perp} =$ 中.
- $中^+中^-$: Two photons of opposite polarities can stick together to become a compound particle $中^+中^-$. It is called: photonette. Once formed as a couple, the two photons are linked. The behavior of one is linked to that of the other by the 古 energy field (described later). Even if they are separated afterwards. This phenomenon is called entanglement.
- $\overrightarrow{重}$: A photon 中 placed in the field 古, interacts with this field and generates a gravitational field $\overrightarrow{重}$. This vector can be illustrated by the following diagram:

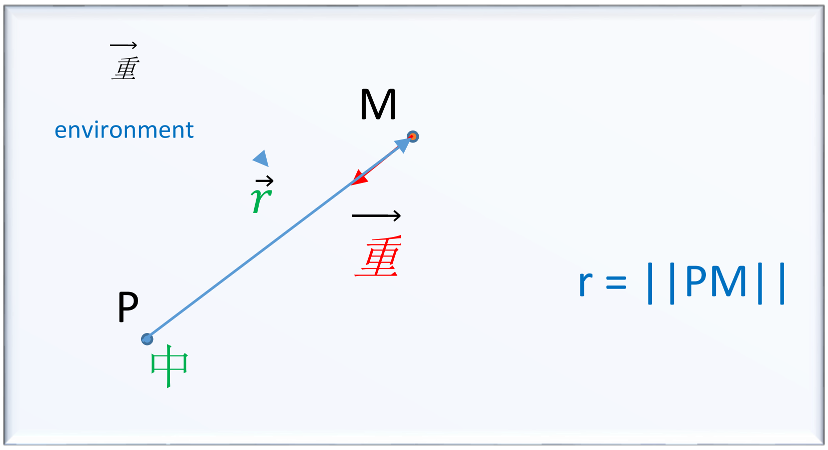


Figure 1 - Gravitational field of photon

The vector $\overrightarrow{重}$ at a point M in space can be expressed as follows:

$$\overrightarrow{重} = -G \cdot \frac{中\,\vec{r}}{r^3 + \gamma^3}$$

Equation 1 - Formula of gravitational field

With:

- G : the gravitational coefficient = 6, 674 08 *10^{-11} m^3 kg^{-1} s^{-2}.
- 中 : the neutral charge of the photon.
- r : the distance separating the photon and the point M. $\vec{r}$ is its vector.
- γ : is a constant = 1 * 10^{-18} meter.

4.2.2 Electro 口

Electro is a material that groups together elementary particles of type 2. It has the following characteristics:

- 口 : an electro has a pure electric charge 口. The physical meaning of this electric charge is equivalent to that of the SM [3] [4], but devoid of photon. 口 can take 2 integer values: +1e or -1e. e represents the smallest electric charge.
- An electro is modeled as a corpuscle. It is not a wave.
- It has neither inertial mass, nor gravitational mass.
- Two electros of opposite signs can be put together to get a compound particle $口^{+}口^{-}$.
- Two electros with the same sign cannot be put together.
- An electro can capture a photon via the following mechanism: $口^{+}口^{-} + 中^{+}中^{-} = e^{+} + e^{-}$ (The combination of a pair of electros and a pair of photons gives an electron plus a positron. These last 2 are also called: electrinettes.)

4.2.3 Field 古

The 古 field is a material constituting the origin of energies [8]. It has the following characteristics:

- 古 : the 古 field is an energy field supposedly distributed in the space of the universe. It has 4 components: 电, 磁, 重 and 山.
- 电 : the component 电 is an electric field. In the presence of an electrinette, the density of this field is disturbed. The value of the 电 field is modified in space depending on the distance from this electrinette.
- 磁 : the 磁 component is a magnetic field. In the presence of an electrinette, the density of this field is disturbed by the rotation of this electrinette. The value of the 磁 field is modified in space depending on the distance from this electrinette.
- 重 : the 重 component is a gravitational field. In the presence of a photon, the density of this field is disturbed. The value of the 重 field is modified in space depending on the distance from this photon.
- 山 : the 山 component is a field sensitive to the density of materials constituting the 古 field. In the presence of a photon or an electro, the density of matter is modified. The value of the 山 field is modified in the vicinity of this material. The 山 field is also called a potential field.
- The 古 field has a privileged link with the photon which moves at a constant linear speed c when this photon is alone in the 古 field. For a photonette, the 古 field also reserves a privileged link between its two photons. A bit like an elastic cord that attaches them together. This link remains active even when the 2 photons are separated by a great distance.
- The 古 field is not static. The substances supporting the underlying mechanism of the 古 field are sensitive to gravitation. These substances are constantly in motion. This means that in an absolute referential, the 古 field follows the motion of large masses.

4.3 Modeling of the 8 compound particles

This paragraph describes the modeling of 8 composite particles.

4.3.1 Electrinette e

The electrinette groups together the compound particles: electron and positron. It has the following characteristics:

- e : An electrinette is composed of a unit electric charge +1e or -1e and a photon [6].
- 中 : The neutral charge of the photon within the electrinette depends on the creation conditions of the electron-positron pair.
- In interaction with the 古 field, an electrinette generates a vector electric field: $\overrightarrow{电}$.

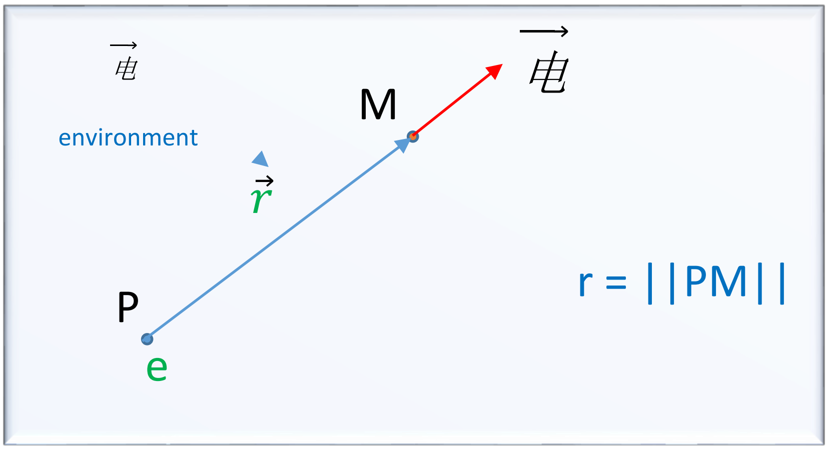


Figure 2 - electrical field of electrinette

The vector $\overrightarrow{电}$ at a point M in space can be expressed as follows:

$$\overrightarrow{电} = k_e \frac{q\,\vec{r}}{r^3 + \beta^3}$$

Equation 2 - Formula of electrical field

With :

- k_e : the electrical coefficient = $1/(4\pi\varepsilon_0)$
- ε_0 : represents the dielectric permittivity of the reference vacuum = 8,854 187* 10^{-12} F m^{-1}.
- r : the distance between point P and point M.
- β : is a constant = 1 * 10^{-18} meter.
- q : the weighted electric charge:

$$q = e\frac{中}{中_{ref}}$$

Equation 3 - Formula of weighted electric charge

- e : the unit electric charge
- 中 : the neutral charge of the electrinette at rest.
- $中_{ref}$: the neutral charge of the reference electron used to determine ε_0.

- An electrinette has a rotation around an axis passing through its center. This rotation is at the origin of the magnetic field [18].
  The rotation direction of a positron is illustrated by the following diagram according to the right-hand convention:

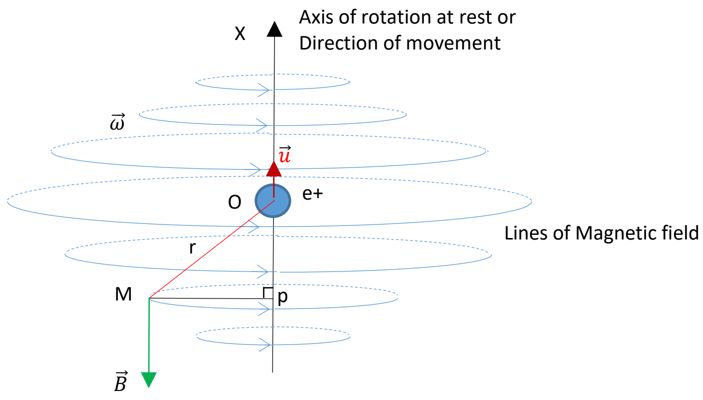


Figure 3 - magnetic field of electrinette

The rotation direction of an electron is in the opposite direction.

The magnetic field $\vec{B}$ is expressed as follows using the Biot and Savart law:

$$\vec{B} = \frac{\mu_0}{4\pi} \cdot \frac{q \cdot \vec{u} \wedge \vec{r}}{r^3 + \beta^3}$$

Equation 4 - Formula of magnetic field

Where:

- μ_0 : magnetic coefficient
- q : the weighted electric charge defined as for the electric field.
- $\vec{u}$: the unit vector of the rotation axis.
- $\wedge$: is the vector product operator.
- r : the distance between the point O where the electrinette is located and any point M in space outside the rotation axis. $\vec{r}$ is its vector.
- β : is the same constant as for the electric field.

- The magnetic field of an electrinette at rest is not detectable. The reason is that the rotation axis does not have a fixed direction. When an electrinette is in linear motion, the motion direction also becomes the rotation axis. At this point, the magnetic field becomes detectable.
- When an electrinette moves from a point P, it leaves a hole in the 古 field at point P. This hole does not disappear immediately. There is a small delay t_R. The magnetic field also remains during this delay t_R. This leads to the multiplication of the magnetic field generated by an electron passing through a coil of copper wire.

4.3.2 Charginette ☯

A charginette is a particle composed of an electron having the neutral charge 中⁻ and a positron having the neutral charge 中⁺. It has the following characteristics:

- r : The 2 electrinettes rotate around each other. Their trajectory is a circle whose radius is r. This radius is measured between the center of symmetry and the center of an electrinette.

- v : the orbital rotation speed of the electrinettes around their axis of symmetry.
- 中 $_0$: the neutral charge of one of the 2 electrinettes at rest. The other electrinette has strictly the same neutral charge.
- 中 $_g$: the overall neutral charge of the charginette. 中 $_g$ > 2*中 $_0$.
- The rotation of two electric charges of opposite signs on the same circle makes the charginette neutral if the measurement is made at a sufficiently great distance.
- O : The structure of a charginette can be compared to a circle. It is illustrated by the following diagram:

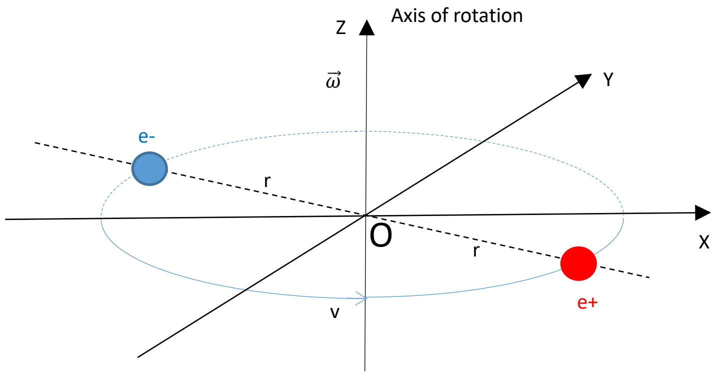


Figure 4 - Charginette structure

- D_s : although the structure of the charginette can be assimilated to a circle. But the physical properties of the 古 field will make a charginette like a solid disk (see figure below). This prevents an electrinette from crossing the disk delimited by the circle.

- ? : the neutralization of the two electrinettes of opposite signs renders De Broglie's rule not applicable here [5]. (Reminder of this rule: the orbital rotation period of the charginette must be a multiple of the own period of each of the 2 electrinettes given by the formula E = h/T where E is the energy of each of the electrinettes. T is the own period. The coefficient h is Planck's constant)
- k_n : the electric field generated by the 2 electrinettes is greatly attenuated by their orbital rotations. This attenuation k_{n0} is estimated to be proportional to the rotation frequency f. This is the number of revolutions per second. The attenuation coefficient is estimated as follows:

$$k_{n0} = \frac{10^3}{f}$$

Equation 5 - Formula of charginette attenuation coefficient k_{n0}

With:

f : the number of revolutions per second. f > 1000. If f <= 1000, the coefficient k_{n0} remains at 1. If f > 10^{14}, then, k_{n0} remains at 10^{-11}.

But this attenuation is not applicable in the vicinity of an electrinette. It is estimated that k_n tends towards 1 when the distance tends towards 0. Hence the attenuation formula for the whole space and for each electrinette:

$$k_n = 10^{-\frac{D}{r}\cdot 100} + k_{n0} = 10^{-\frac{D}{r}\cdot 100} + \frac{10^3}{f}$$

Equation 6 - Formula of attenuation coefficient form 1

Where:

- r : is the radius of the charginette.
- D : is the distance between the intervening electrinette and the point considered.

For electric force, two cases arise:

1. the external electrinette is free without its own internal attenuation, k_{n02} = 1 :

$$k_n = 10^{-\frac{D}{r_1}\cdot 100} + k_{n01}\cdot k_{n02} = 10^{-\frac{D}{r_1}\cdot 100} + k_{n01} = 10^{-\frac{D}{r_1}\cdot 100} + \frac{10^3}{f_1}$$

Equation 7 - Formula of attenuation coefficient form 2

Where:

- r_1 : is the radius of the charginette having the electrinette 1.
- f_1 : is the rotation frequency of the charginette having the electrinette 1.
- D : is the distance between the 2 electrinettes.

2. the external electrinette is not free with its own internal attenuation, $k_{n02} = 10^3/f_2$:

$$k_n = 10^{-\frac{D}{r_1+r_2}\cdot 200} + k_{n01}\cdot k_{n02} = 10^{-\frac{D}{r_1+r_2}\cdot 200} + \frac{10^3}{f_1}\cdot\frac{10^3}{f_2} = 10^{-\frac{D}{r_1+r_2}\cdot 200} + \frac{10^6}{f_1\cdot f_2}$$

Equation 8 - Formula of attenuation corfficient form 3

Where:

- r_2 : is the radius of the charginette having the electrinette 2.
- f_2 : is the rotation frequency of the charginette having the electrinette 2.

4.3.3 Chrominette Δ

A chrominette is a particle composed of 3 charginettes. It has the following characteristics:

- Δ : The 3 charginettes form a sort of triangle. The structure can be illustrated by the following diagram:

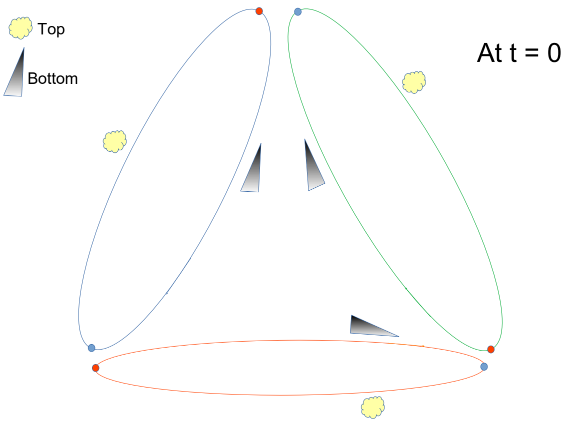
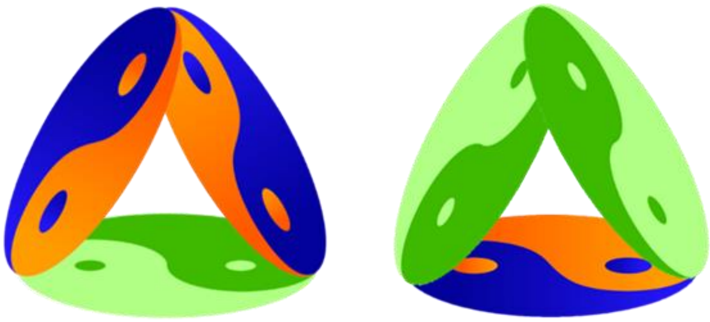


Figure 5 - a chrominette structure at t = 0

- 3 : 3 points of contact appear. Everything happens as if we attach the 3 circles in a chain. We therefore obtain 2 points of contact. Then, we attach the two circles of the 2 ends. Thus, the loop is closed.
- T : A necessary condition is that the rotation periods of the 3 charginettes are equal or multiples of 3. Consider the smallest period T_0. For each of the other 2 periods, it is either equal to T_0 or to $3nT_0$. Where n is a positive integer.
- E : Another condition is that the 3 charginettes cannot all have the same energy level. Indeed, the exclusion rule only allows two electrons of the same energy. They are distinguished by their direction of rotation around themselves. Which implies that at the maximum, two charginettes can have the same energy level. The electrinettes of the third charginette must have a different energy level.
- 0 : A chrominette has an electrically neutral appearance. There are 2 reasons for this. The first is that each of the 3 charginettes is already almost neutral with its orbital rotation. The second is that the chrominette does not have a fixed direction, just like an electrinette which does not show its magnetic field.
- r : a special case is that the 3 charginettes have the same radius r. In this case, keeping it as simple as possible, we take 2 charginettes of the same energy level. This necessarily gives the same orbital rotation radius r and the same orbital speed v_1. The third charginette must have a rotation speed either 3 times v_1, or a third of v_1.
- Δ^u Δ^d : depending on the energy levels of the 3 constituent charginettes. There are two types of chrominette. We note v_i the speed of the charginette ch_i. When $v_3 = 3\ v_1$, and $v_2 = v_1$, the chrominette is of the Up type. When $v_3 = (1/3)\ v_1$, and $v_2 = v_1$, the chrominette is of the Down type.
- The following figure shows an artist's view of the chrominettes:



- Inspiration source [19].

For the 3 contact points of the chrominette, there is a quasi-neutralization. This introduces a potential energy called binding energy. This binding energy induces by equivalence between mass and energy a binding mass.

It is this binding energy that explains the fact that the mass of a compound particle is much greater than the sum of the masses of all the components.

4.3.4 Nucleonette 品

A nucleonette is a particle composed of 3 chrominettes. It has the following characteristics:

- 品 : The 3 chrominettes form a sort of looped chain, a bit like the chrominette. The structure can be illustrated by the following diagram:

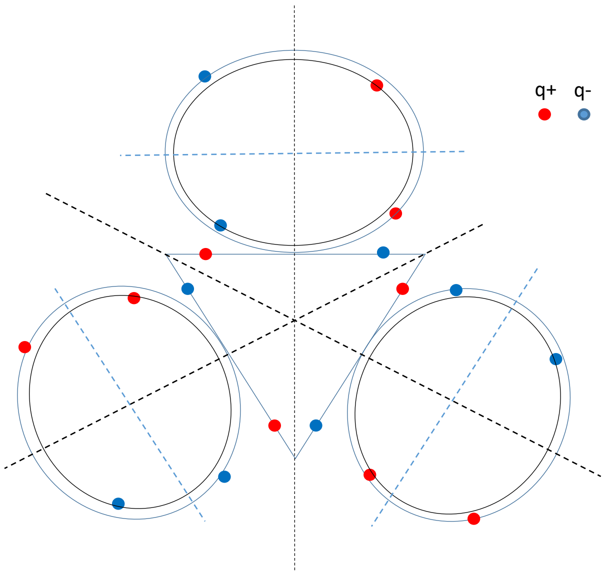


Figure 6 - a nucleonette structure

- To understand the diagram above, we must first take a chrominette as a starting point. This is the central triangle, also called core. For each side of the core which is a charginette, therefore a circle, we can add two charginettes to form a new chrominette. On the middle circle, the 4 contact points are placed so that they are uniformly distributed.
- X : The exclusion rule applies within each chrominette.

- !X : the exclusion rule does not apply to inter-chrominette charginettes. The reason is that the inter-chrominette charginettes are either sufficiently far apart or separated by an electric screen formed by a charginette of different energy level.
- 0 : a nucleonette has an electrically neutral appearance. The reasons are the same as for the chrominette.
- r : a special case is that all charginettes have the same radius r.
- 品 ᵘ 品 ᵈ : Depending on the type of nucleonette core, two types of nucleonette are distinguished. A nucleonette is up type if its core is down type. Conversely, a nucleonette is down type if its core is up type.
- The following figure shows an artist's impression of the nucleonettes:

- Inspiration source [20].

4.3.5 Quark U^+

The Up quark is a particle composed of an Up chrominette and a positron. It has the following characteristics:

- e^+ : The positron is nestled within the chrominette. The structure can be illustrated by the following diagram:

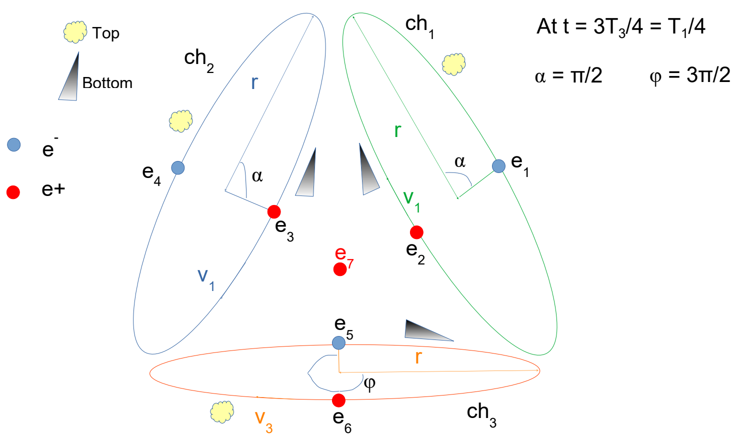


Figure 7 - a Up quark structure

- The operation of the chrominette induces a potential energy hole at the center. The positron is stable there. But this stability is relative. Indeed, the difference in energy potential between the center and its neighborhood is not very large. So, if the quark undergoes a too rapid acceleration, the positron at the center cannot attach itself to the chrominette. And the quark transforms into a chrominette and a positron.

- An artist's view:

- Inspiration source [20].

4.3.6 Quark D⁻

The Down quark is a particle composed of a Down chrominette and an electron. It has the following characteristics:

- e^- : the electron is nestled within the chrominette. The structure can be illustrated by the following diagram:

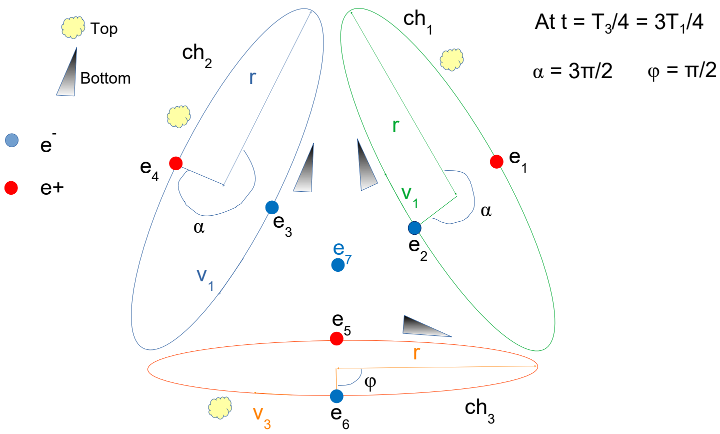


Figure 8 - a Down quark structure

- As for the Up quark, the Down quark has relative stability.
- The following figure shows an artist's impression of the D- quark:

- Inspiration source [20].

4.3.7 Proton H^+

The proton is a particle composed of a Down-type nucleonette and 3 electrinettes. It has the following characteristics:

- 品 b : The proton center chrominette is of the Up type. There is no electrinette nested in its center.
- e^-e^+ : There are two Down chrominettes and one Up chrominettes on the periphery of the proton. An electron is nested in the center of the Up chrominette. 2 positrons are each nested in the centers of each down chrominette. The distribution of the electrinettes can be illustrated by the following diagram:

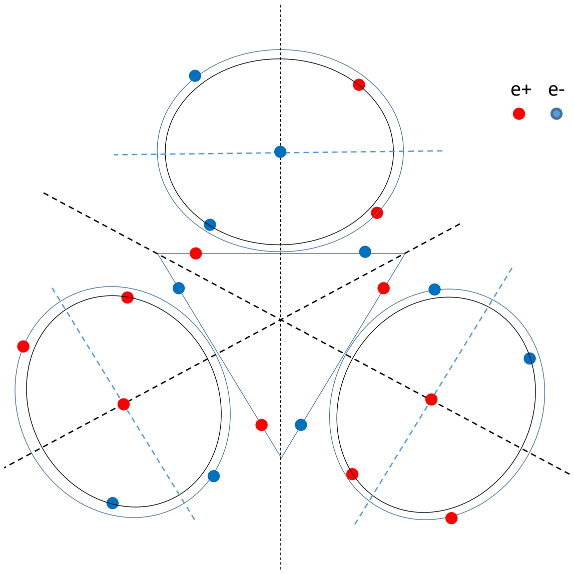
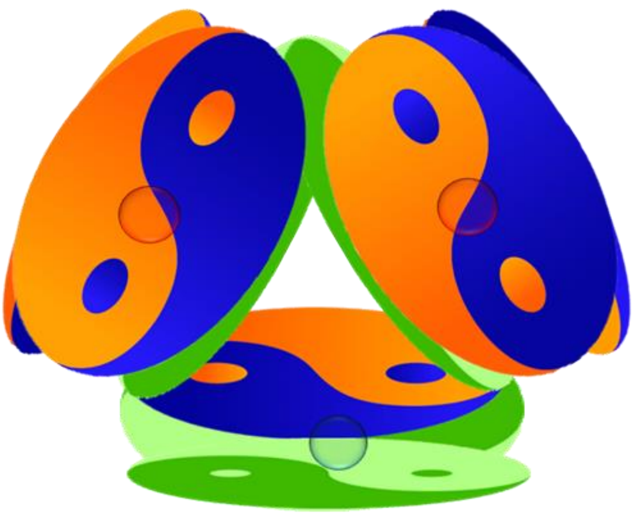


Figure 9 - a proton structure

- The addition of electric charges of the 3 electrinettes is equal to: +1e.
- The following figure shows an artist's impression of the p+ proton:



- Inspiration source [20].

4.3.8 Neutron n^0

The neutron is a particle composed of an Up-type nucleonette and 4 electrinettes. It has the following characteristics:

- 晶 h+ : The proton center chrominette is of the Down type. There is a positron nested at its center.
- e^-e^+ : There are two Up chrominettes and one Down chrominette on the periphery of the neutron. A positron is nested in the center of the Down chrominette. 2 electrons are each nested in the centers of each up chrominette. The distribution of the electrinettes can be illustrated by the following diagram:

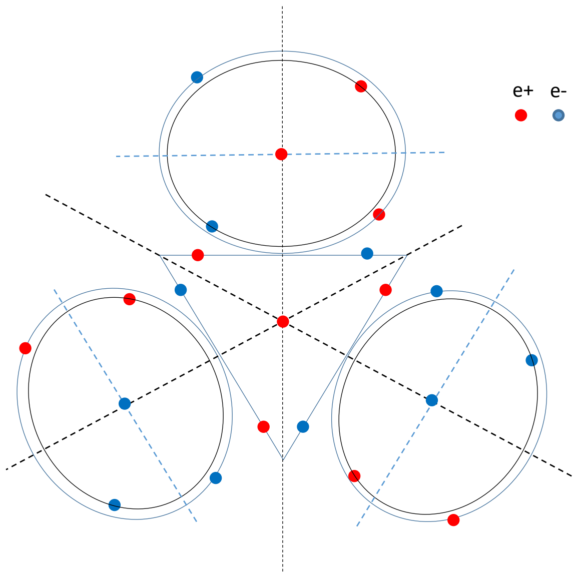
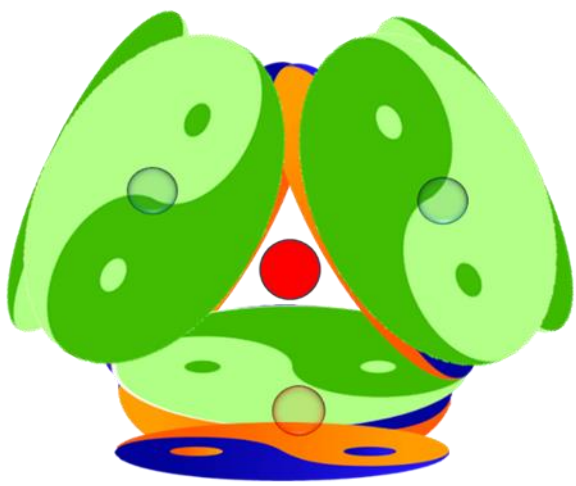


Figure 10 - Neutron structure

- The addition of electric charges of the 4 electrinettes is equal to: 0.
- The geometric distribution of the 4 electrinettes reveals an electric moment and a magnetic moment during the rotation of the neutron around its axis of symmetry. Therefore, the neutron is visible despite its apparent electric charge 0.
- The following figure shows an artist's impression of neutron n0:



- Inspiration source [20].

4.4 Modeling of other compound particles

4.4.1 Neutral particles

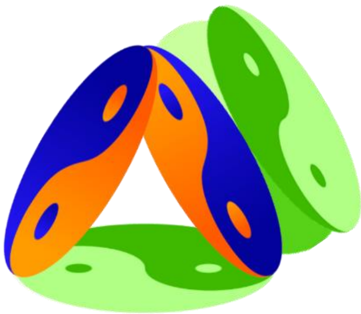
The previous paragraph described 4 neutral compound particles. Other neutral particles can be obtained by combining charginettes of different energy levels.

For example:

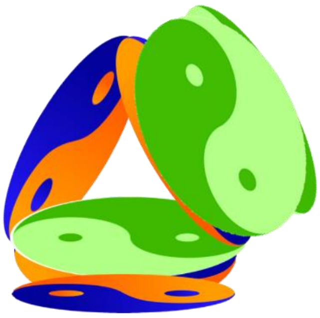
> By following the method of construction of the nucleonette, and starting from a chrominette, it is possible to add each time two charginettes of the same energy level E_2 on a charginette of energy level E_1. And we thus obtain a new neutral compound particle.
>
> The particles thus obtained are theoretically stable. Especially if they form looped chains.
>
> But if the chain is too big, they can be unstable.

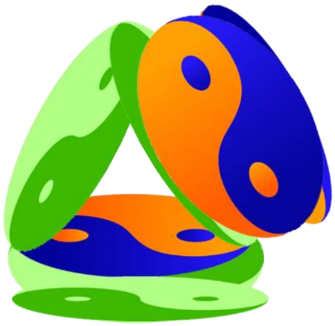
4.4.1.1 Twin Chrominette up and down

4.4.1.2 Chrominettes Double up and down

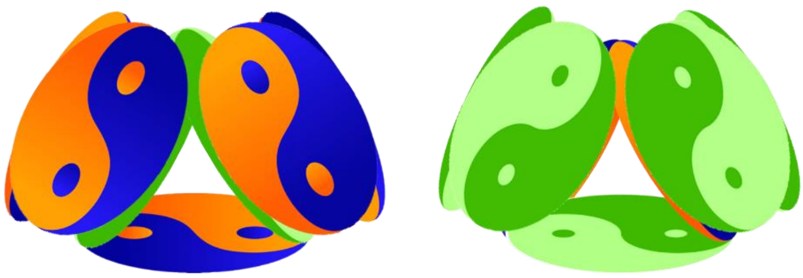


4.4.1.3 triple chrominette up 4-3 and down 3-4





4.4.1.4 *triple chrominette up 5-2 and down 2-5*



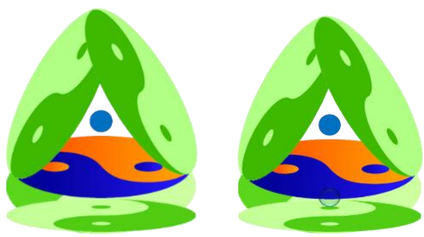
4.4.2 Visible particles

For a compound particle to be visible, it is sufficient that it contains a set of non-zero electric charges. Or, the distribution of electric charges is not symmetrical. Which causes an electric moment to appear, as well as a magnetic moment.

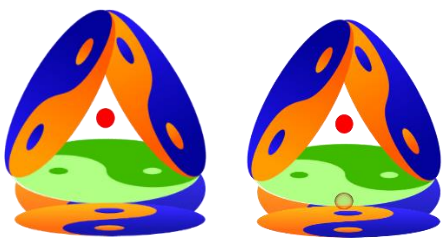
For example:

> For each neutral particle previously obtained, it is sufficient to add a number of electrinettes by distributing them one per chrominette center so that the sum of these electrinettes is not zero.
>
> Or so that the distribution of these electrinettes is geometrically asymmetrical.
>
> The particles thus obtained are generally unstable for the same reasons as those of the Up and down quarks.
>
> A concrete example, the particles of the pion [13] group are composed of two chrominettes sharing a neighboring charginette, with within each chrominette, one or 0 electrinette. If there is only one electron, we have a π^-. If there is only one positron, we have a π^+. If there are an electron and a positron, we have a π^0. Theoretically, there should also be π^{2-}, if there are 2 electrons, and π^{2+}, if there are 2 positrons. But in practice, it is difficult to differentiate π^- from π^{2-}, and π^+ from π^{2+}, because of the short lifetime of these particles.

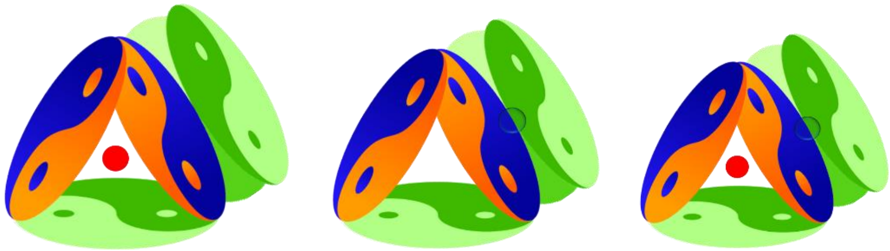
4.4.2.1 *Muon μ^- and μ^{--}*



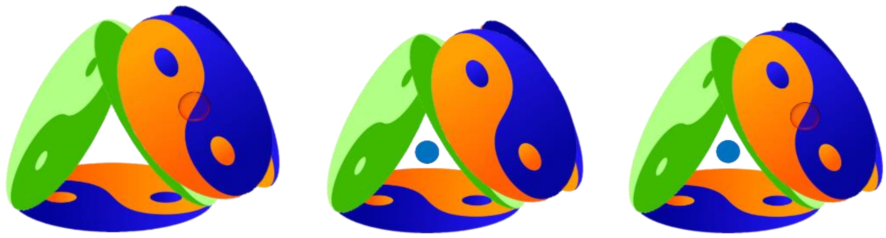
4.4.2.2 *Muon μ^+ and μ^{++}*



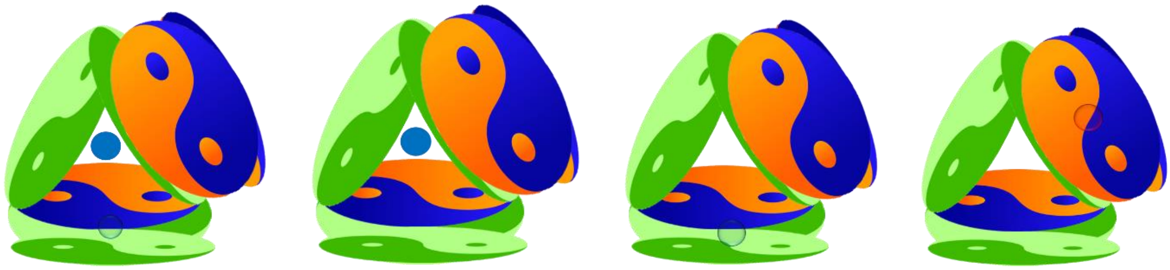
4.4.2.3 Pion π^{+} down, π^{-} down, π^{0} down



4.4.2.4 Pion π^{+} up, π^{-} up, π^{0} up

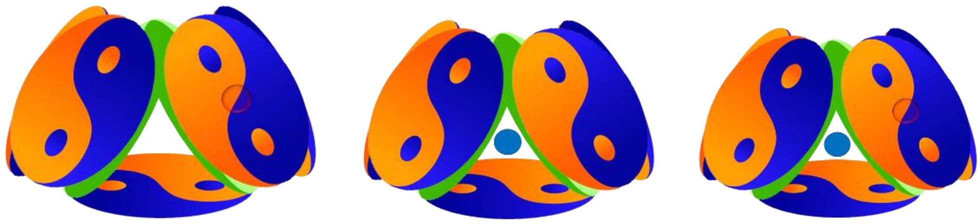


4.4.2.5 Kaon k^{--}, K^{-} down 3-4 and K^{+} down 3-4

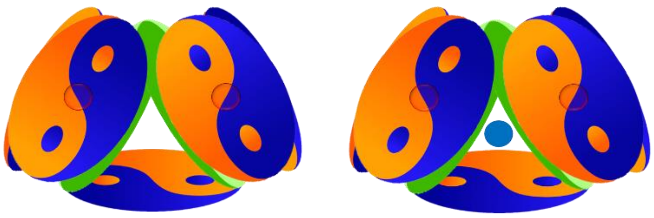


4.4.2.6 Kaon K^{0} down 3-4 and K^{-+} down 3-4

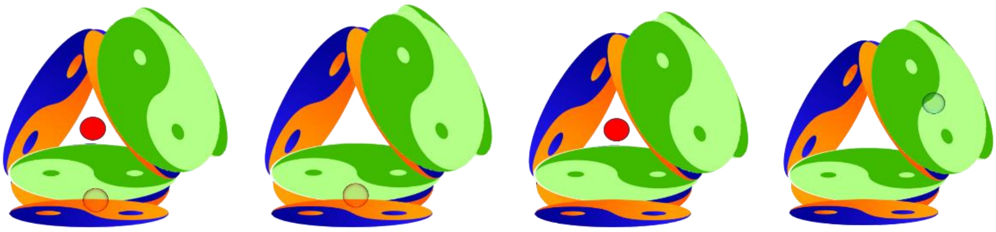
4.4.2.7 Kaon K^{+}, K^{-} and K^{0} up 5-2



4.4.2.8 Kaon K^{++} and K^{-++} up 5-2

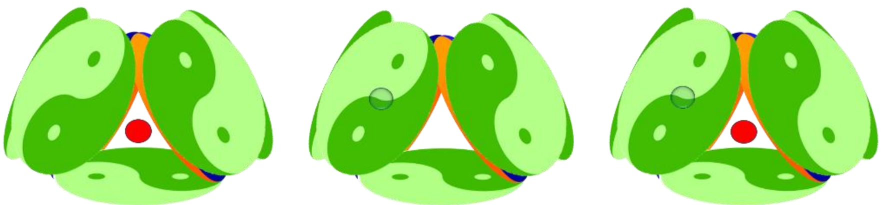


4.4.2.9 Kaon K^{++}, K^{+} and K^{-} up 4-3

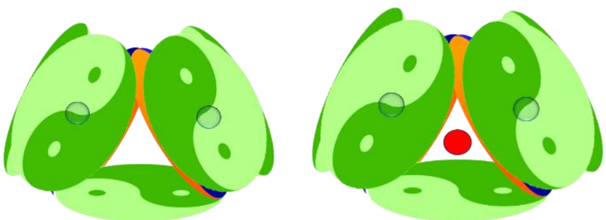


4.4.2.10 Kaon K^{++-}, K^{0} up 4-3

4.4.2.11 Kaon K^{+}, K^{-}, K^{0} down 2-5



4.5.2.12 Kaon K^{--} and K^{+--} down 2-5



4.5 Modeling four fundamental forces

4.5.1 Electric force

When 2 electrinettes are placed in the field 古, each undergoes an electric force caused by the electric field of the other in the axis which connects them [21]. It can be illustrated by the following diagram:

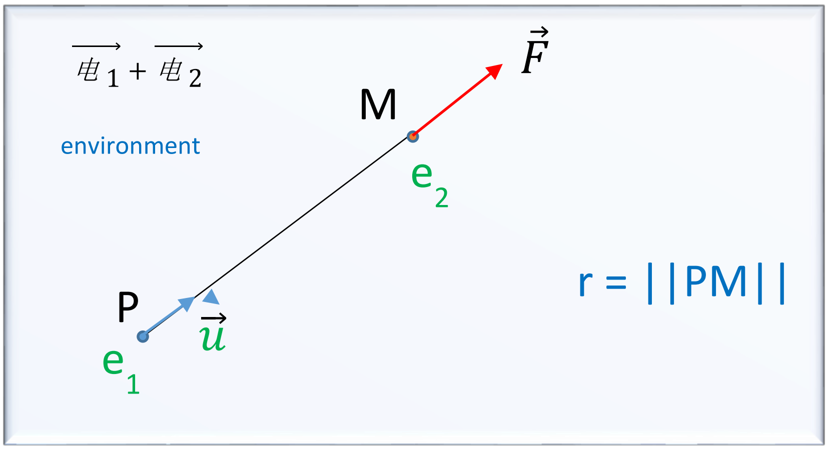


Figure 11 - Electrical force

The electric force F experienced by the electrinette e_2, exerted by e_1 is expressed as follows:

$$\vec{F} = k_e \frac{q_1 q_2 r \, \vec{u}}{r^3 + \beta^3}$$

Equation 9 - Formula of electrical force

Where:

- q_i : the weighted electric charge of the electrinette e_i (with i = 1 or 2) :

$$q_i = e \frac{中_i}{中_{ref}}$$

Equation 10 - Formula of weighted electrical charge i

- $中_i$: the neutral charge of the electrinette e_i at rest.
- r : the distance separating points P and M where e_1 and e_2 are located respectively.
- $\vec{u}$: the unit vector of the axis connecting points P and M.
- ? : the other parameters are described in the paragraph describing the electrinette.

This force has a maximum value when:

$$r = \frac{\beta}{\sqrt[3]{2}} = 0.7937 \cdot 10^{-18} \, m$$

Equation 11 - Formula of maximum electrical force distance

When r >> β, β can be eliminated from the formula. We find the classical form of the Coulomb force. But when r << β, the overall energy caused by the force as r tends to 0 tends to a finite constant instead of tending to infinity with the classical form.

4.5.2 Magnetic force

When 2 electrinettes are placed in the field 古, each undergoes a magnetic force caused by the magnetic field of the other whose direction depends on 2 vector products [3] [4]. It can be illustrated by the following diagram:

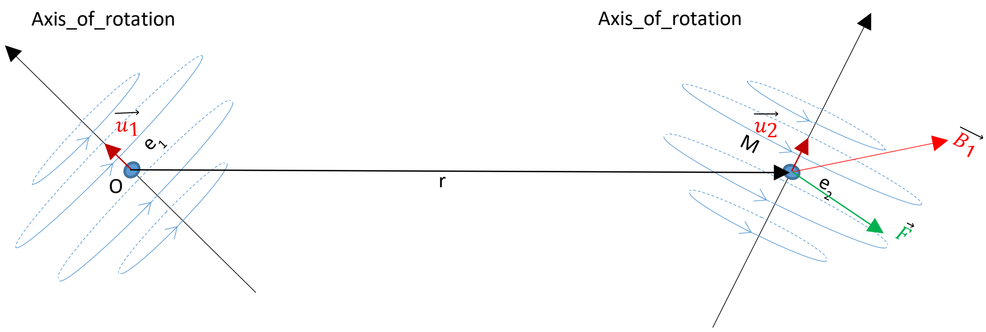


Figure 12 - Magnetic force

The magnetic force F experienced by the electrinette e_2, exerted by e_1 is expressed as follows:

$$\vec{F} = q_2 \cdot \overrightarrow{u_2} \wedge \overrightarrow{B_1}$$

Equation 12 - Formula of magnetic force

Where:

- q_2 : the weighted electric charge of the electrinette e_2.
- $\overrightarrow{u_2}$: the unit vector of rotation axis of the electrinette e_2.
- $\wedge$: the vector product operator.
- $\overrightarrow{B_1}$: the magnetic field generated by the electrinette e_1 at point M located at a distance r from point O where the electrinette e_1 is located.

It should be noted that this formula is applicable to 2 electrinettes at rest. In practice, the electrinettes are in motion. Magnetic remanence must be taken into account. This amounts to adding a succession of electrinettes by equivalence interacting with another succession of electrinettes by equivalence.

4.5.3 Gravitational force

When 2 particles with at least one photon are placed in the field 古, each one experiences a gravitational force caused by gravitational field of the other in the axis that connects them [22]. It can be illustrated by the following diagram:

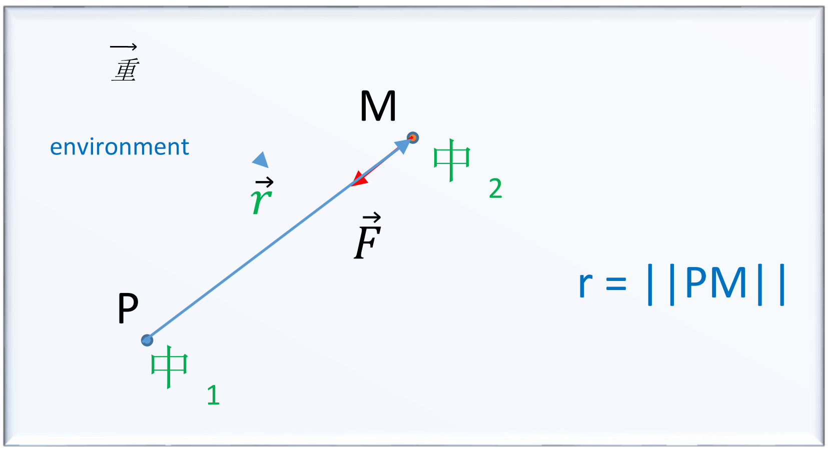


Figure 13 - Gravitational force

The gravitational force F experienced by the photon 中 2, exerted by 中 1 is expressed as follows:

$$\vec{\mathrm{F}} = -G \cdot \frac{中_1 中_2 \vec{r}}{r^3 + \gamma^3}$$

Equation 13 - Formula of gravitaional force

Where:

- 中 i : the neutral charge of the photon i (with i = 1 or 2).
- r : the distance separating the two particles. $\vec{r}$ is its vector.
- ? : Other parameters are described in the Photon 中 paragraph.

When r >> γ, γ can be eliminated from the formula. We find the classical form of Newton's force. But when r << γ, the overall energy caused by the force as r tends to 0 tends to a finite constant instead of tending to infinity with the classical form.

4.5.4 The potential force

The potential force comes from the potential field $\overrightarrow{山}$. And this field is expressed as follows:

$$\overrightarrow{山} = -\vec{\nabla}土$$

$$\vec{F} = D_m \cdot \overrightarrow{山}$$

Equation 14 - Formula of potential field and force

Where:

- $\vec{\nabla}$: is the Nabla gradient operator.
- 土 : is the density of the materials.
- $\vec{F}$: the potential force
- D_m : the density of potential matter for a particle

For a space point M, the presence of a photon or an electro modifies the density of the materials. The interactions between the particles also modify this density. Especially the neutralization between 2 electrinettes of opposite signs which mobilizes a lot of energy. The energy density is greatly modified in the vicinity of the point M where the neutralization takes place. This point M will be called the active center.

Another important characteristic is the persistence of this field. Indeed, when the cause of the change in density disappears, the consequences do not disappear immediately. The 古 field takes a certain non-zero time to homogenize its medium. During this time, the $\overrightarrow{山}$ field continues to act.

This potential force is necessary to explain the capture of a photon by an electro. Indeed, the electric, magnetic and gravitational forces cannot explain this capture.

This field is similar to the gravitational field, but there are following differences:

- This field acts on both the photon and the electro. While the gravitational field only acts on the photon.
- The range of this field is shorter than the gravitational field. It is estimated to be: 10^{-10} m.
- .

4.6 Modeling the ether

4.6.1 Definition

A definition was already given thousands of years ago which considers that the universe is bathed in a substance called ether [8].

4.6.2 Composition of ether

Ether is not a pure, uniform substance. It contains at least two of the following components:

1. A previously defined energy field
2. An ocean of neutral particles
3. Perhaps other unidentified elements…?

The existence of component 1 is obvious because without this type of field, inert mass would not exist.

The existence of component 2 comes from the following reaction according to SM:

$$中^{+} + 中^{-} \rightarrow e^{+} + e^{-}$$

This reaction means: a + photon and a – photon collide to form a positron and an electron. This reaction is verified in the laboratory for a certain energy level of the photons.

There is a problem of interpretation: two photons have transformed into two electrinettes. The Compton Effect informs us that the electron is a particle composed of electro and photon. The above transformation makes two electro appear from nothing. Which is in contradiction with the law of conservation of matter.

The reality of the above reaction should be written as follows:

$$中^{+} + 中^{-} \rightarrow 中^{+}中^{-}$$

$$中^{+}中^{-} + ☯ \rightarrow e^{+} + e^{-}$$

This reaction means: first step: a photon + and a colliding photon - gives a pair of photons, photonette. Second step: a photonette + a weakly energized charginette in collision gives a positron and an electron [10] [16].

Thus, the law of conservation of matter is respected.

The question arises: where does the charginette come from?

Knowing that in the laboratory, the charginette is not provided. And in any case, the charginette is a neutral particle. There is currently no way to manipulate it.

So there is only one possibility: the charginette exists everywhere in space. At least, in space where there is visible matter. This is because neutral particles are attracted by gravity.

4.6.3 Consequences of the composition of ether

The fact that ether is not a pure and uniform substance immediately leads to a first consequence: the results of the experiments carried out previously involving ether must be called into question.

Indeed, interpretations of experimental results are based on the assumption that ether is a pure and uniform entity.

Two following experiments will be reinterpreted here:

1. The duality of the photon
2. The Michelson and Morley experiment

4.6.3.1 The duality of the photon

Depending on the experimental conditions, the photon can behave like an electromagnetic wave or like a particle [1].

It is difficult to interpret these two phenomena without ether or with a pure ether. But with an ether containing an ocean of neutral particles, the interpretation becomes simple.

As it moves through space, the photon constantly encounters weakly energized charginettes. For each charginette encountered, the photon is captured and then released by one or the other electrinette of the charginette, making an electric arc. This gives the illusion of an electromagnetic wave whose frequency depends on the energy of the photon.

In the presence of other photons, the electrinettes energized by the capture of photons enter into electrical interaction leading to wave interference.

Hence: the wave-like aspect of the photon corresponds to the waves caused by the movement of the photon in the ocean of charginettes.

4.6.3.2 The Michelson and Morley experiment [17]

The prerequisite of this experiment was that the Earth moves at a speed v in the ether and that the ether is static in an absolute referential.

Now the 古 field follows the movement of the Earth, as well as the charginettes. Which means that the ether and the Earth are fixed in the local referential of the Earth. Which is consistent with the conclusion of the experiment.

This experiment reveals that in an absolute referential, the speed of the photon is not constant everywhere. If a local referential moves at a speed v_0 in an absolute referential. Then the speed of the photon in the absolute referential is:

$$\overrightarrow{v_a} = \overrightarrow{v_0} + \overrightarrow{v_c}$$

Where:

- v_a : is the speed of the photon in the absolute referential.
- v_0 : is the speed of the local referential in the absolute referential.
- v_c : is the speed of the photon in the local referential.

Which means that a photon passing through different areas that move in different directions does not have a straight trajectory. And that its absolute speed at each instant can be greater than or equal to c.

4.6.4 Potential energy

During an interaction between two particles, a quantity of potential energy is brought into play [14]. This energy is located neither in the first particle nor in the second, but in the space distributed in the field generating the interaction.

As an example, this paragraph illustrates the determination of electric potential energy.

The electric field caused at a point M in space by two electrinettes can be schematized as follows:

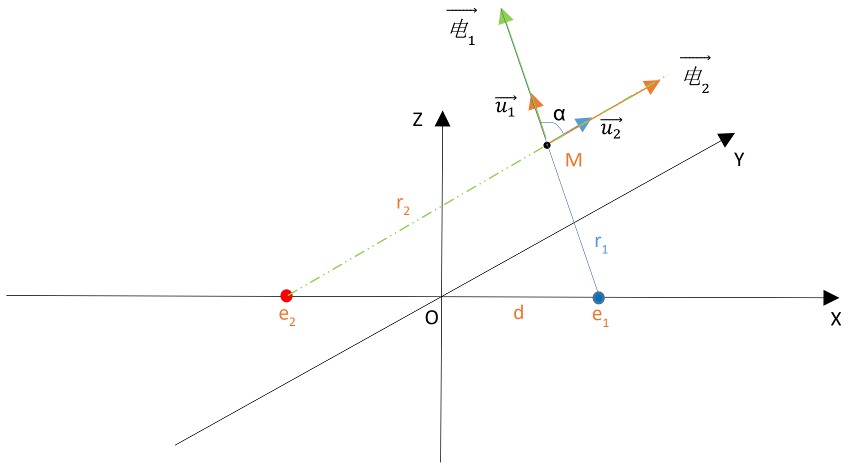


Figure 14 - potential energy scheme

Neglecting the parameter β, the resulting electric field can be expressed by the following formula:

$$\overrightarrow{电} = \overrightarrow{电_1} + \overrightarrow{电_2} = k_e \frac{q_1}{r_1^2} \overrightarrow{u_1} + k_e \frac{q_2}{r_2^2} \overrightarrow{u_2}$$

With:

$$q_1 = \frac{中_1}{中_{ref}} \cdot e$$

$$q_2 = \frac{中_2}{中_{ref}} \cdot e$$

The electrical energy density is written as:

$$\rho_e = \frac{1}{2} \varepsilon_0 电^2 = \frac{1}{2} \varepsilon_0 \left(k_e \frac{q_1}{r_1^2} \overrightarrow{u_1} + k_e \frac{q_2}{r_2^2} \overrightarrow{u_2} \right)^2$$

$$\rho_e = \frac{1}{2} \varepsilon_0 k_e{}^2 \left(\frac{q_1{}^2}{r_1^4} \overrightarrow{u_1}^2 + \frac{q_2{}^2}{r_2^4} \overrightarrow{u_2}^2 + 2 \frac{q_1}{r_1^2} \frac{q_2}{r_2^2} \overrightarrow{u_1} \cdot \overrightarrow{u_2} \right)$$

$$\rho_e = \frac{1}{2}\varepsilon_0 {k_e}^2 \left(\frac{{q_1}^2}{r_1^4} + \frac{{q_2}^2}{r_2^4} + 2\,\frac{q_1}{r_1^2}\,\frac{q_2}{r_2^2}\cos(\alpha) \right)$$

$$\rho_e = \rho_{e1} + \rho_{e2} + \rho_{e12}$$

With:

$$\rho_{e1} = \frac{1}{2}\varepsilon_0 {k_e}^2 \left(\frac{{q_1}^2}{r_1^4} \right)$$

$$\rho_{e2} = \frac{1}{2}\varepsilon_0 {k_e}^2 \left(\frac{{q_2}^2}{r_2^4} \right)$$

$$\rho_{e12} = \varepsilon_0 {k_e}^2 \left(\frac{q_1}{r_1^2}\,\frac{q_2}{r_2^2}\cos(\alpha) \right)$$

Equation 15 - Electrical energy density

The physical interpretation of these 3 terms is as follows:

1. ρ_{e1} : represents the energy density of the electrinette e_1 if it were alone.
2. ρ_{e2} : represents the energy density of the electrinette e_2 if it were alone.
3. ρ_{e12} : represents the energy density of the interaction between the 2 electrinettes e_1 and e_2.

We will model the interaction energy between the electrinettes e_1 and e_2 by integrating this density ρ_{e12} throughout the space:

$$E_{e12} = \iiint_0^\tau \rho_{e12} \cdot d\tau = \iiint_0^\tau \varepsilon_0 {k_e}^2\,\frac{q_1}{r_1^2}\,\frac{q_2}{r_2^2}\cos(\alpha) \cdot d\tau$$

Equation 16 - Definition of potential energy

In the following calculation, the case of 2 charges of the same sign is taken into account. e_1 is a positive charge. e_2 is also a positive charge. The vectors $\overrightarrow{r_1}$ and $\overrightarrow{r_2}$ take into account this polarity of electric charges. In coordinates, we have:

$$M(x, y, z) = M(r \cdot \sin\theta\cos\varphi\,, \qquad r \cdot \sin\theta\sin\varphi\,, \qquad r \cdot \cos\theta\,)$$

$$e_1\left(\frac{d}{2}, 0, 0\right) \qquad e_2\left(-\frac{d}{2}, 0, 0\right)$$

$$\overrightarrow{r_1}\left(x - \frac{d}{2}, y, z\right) \qquad \overrightarrow{r_2}\left(x + \frac{d}{2}, y, z\right)$$

$$r_1^2 = \left(x - \frac{d}{2}\right)^2 + y^2 + z^2 \qquad r_2^2 = \left(x + \frac{d}{2}\right)^2 + y^2 + z^2$$

$$\cos(\alpha) = \frac{\left(x - \frac{d}{2}\right)\left(x + \frac{d}{2}\right) + y^2 + z^2}{\sqrt{\left(x - \frac{d}{2}\right)^2 + y^2 + z^2} \cdot \sqrt{\left(x + \frac{d}{2}\right)^2 + y^2 + z^2}}$$

Let us set the integral:

$$\frac{E_{e12}}{\varepsilon_0 k_e^2 q_1 q_2} = \iiint_0^{\tau} \frac{\cos(\alpha)}{r_1^2 r_2^2} \cdot d\tau = \mathrm{I}$$

$$\mathrm{I} = \iiint_0^{\tau} \frac{\left(x-\frac{d}{2}\right)\left(x+\frac{d}{2}\right)+y^2+z^2}{\left[\sqrt{\left(x-\frac{d}{2}\right)^2+y^2+z^2}\right]^3\left[\sqrt{\left(x+\frac{d}{2}\right)^2+y^2+z^2}\right]^3} \cdot d\tau$$

In spherical coordinate:

$$\mathrm{I} = \int_{\varphi=0}^{2\pi}\int_{\theta=0}^{\pi}\int_{r=0}^{\infty} \frac{\left(x-\frac{d}{2}\right)\left(x+\frac{d}{2}\right)+y^2+z^2}{\left[\sqrt{\left(x-\frac{d}{2}\right)^2+y^2+z^2}\right]^3\left[\sqrt{\left(x+\frac{d}{2}\right)^2+y^2+z^2}\right]^3} \cdot r^2\sin\theta \cdot dr \cdot d\theta \cdot d\varphi$$

$$\mathrm{I} = \int_{\varphi=0}^{2\pi}\int_{\theta=0}^{\pi}\int_{r=0}^{\infty} \frac{-\frac{d^2}{4}+r^2}{\left[\sqrt{\left(r^2+\frac{d^2}{4}\right)^2-(xd)^2}\right]^3} \cdot r^2\sin\theta \cdot dr \cdot d\theta \cdot d\varphi$$

$$-\mathrm{I} = \int_{\varphi=0}^{2\pi}\int_{\theta=0}^{\pi}\int_{r=0}^{\infty} \frac{r^2-\frac{d^2}{4}}{\left[\sqrt{\left(r^2+\frac{d^2}{4}\right)^2-d^2\cdot r^2\cdot(\cos\varphi)^2\,[1-(\cos\theta)^2]}\right]^3} \cdot r^2\sin\theta \cdot dr \cdot dcos(\theta) \cdot d\varphi$$

The integral over θ can be written:

$$-I_\theta = \int_{\theta=0}^{\pi} \frac{a}{\left[\sqrt{b-c\cdot(1-(\cos\theta)^2)}\right]^3} \cdot d\cos(\theta)$$

By using: u $= \cos(\theta)$, we have:

$$-I_\theta = \int_{u=1}^{-1} \frac{a}{\left[\sqrt{b-c\cdot(1-u^2)}\right]^3} \cdot du$$

$$-I_\theta = \frac{a\cdot u}{(b-c)\sqrt{b+c\cdot u^2-c}}\Bigg|_{u=1}^{-1} = \frac{-2a}{(b\_c)\cdot\sqrt{b}}$$

With:

$$a = r^2\left(r^2-\frac{d^2}{4}\right)$$

$$b = r^2\left(r^2+\frac{d^2}{4}\right)^2$$

$$c = r^2 d^2[\cos(\varphi)]^2$$

$$u = \cos(\theta)$$

The integral I becomes:

$$I = \int_{\varphi=0}^{2\pi} \int_{r=0}^{\infty} \frac{2r^2\left(r^2 - \frac{d^2}{4}\right)}{\left[\left(\frac{d^2}{4} + r^2\right)^2 - d^2r^2(\cos\varphi)^2\right]\left(\frac{d^2}{4} + r^2\right)} \cdot dr \cdot d\varphi$$

The integral over ϕ can be written:

$$I_\varphi = \int_{\varphi=0}^{2\pi} \frac{s}{[b - w(\cos\varphi)^2]} \cdot d\varphi = \left. \frac{s \cdot \tan^{-1}\left(\frac{\sqrt{b} \cdot \tan(\varphi)}{\sqrt{b-w}}\right)}{\sqrt{b}\sqrt{b-w}} \right|_{\varphi=0}^{2\pi}$$

With:

$$s = \frac{2r^2\left(r^2 - \frac{d^2}{4}\right)}{\left(\frac{d^2}{4} + r^2\right)}$$

$$b = \left(\frac{d^2}{4} + r^2\right)^2$$

$$w = d^2r^2$$

We note that the tangent and arctangent functions are not continuous on the interval [0, 2π]. So, we must treat by sub-intervals]-π/2, π/2[et]π/2, 3π/2[.

By examining all the cases, we obtain:

$$I_\varphi = \frac{\pm 4\pi r^2}{\left(\frac{d^2}{4} + r^2\right)^2}$$

So the solution is divided into 2 intervals for r: [0, d/2[and [d/2, ∞[

$$I = \int_{r=0}^{\frac{d}{2}} \frac{-4\pi r^2}{\left(\frac{d^2}{4} + r^2\right)^2} \cdot dr + \int_{r=\frac{d}{2}}^{\infty} \frac{4\pi r^2}{\left(\frac{d^2}{4} + r^2\right)^2} \cdot dr$$

$$I = \frac{4\pi}{d} = \frac{E_{e12}}{\varepsilon_0 k_e^2 q_1 q_2}$$

So:

$$E_{e12} = I\varepsilon_0 k_e^2 q_1 q_2 = \frac{4\pi\varepsilon_0 k_e^2 q_1 q_2}{d} = \frac{k_e q_1 q_2}{d}$$

Recall:

$$q_i = \frac{中_{i0}}{中_{ref}} \cdot e$$

Hence the formula for the potential energy resulting from the interaction between 2 electrinettes:

$$E_{e12} = k_e \frac{中_{10} 中_{20}}{中_{ref}^2} \cdot \frac{e^2}{d}$$

Equation 17 - Formula of potential energy

4.7 Modeling of inert mass

4.7.1 Definition

Inertial mass measures the resistance that the body opposes to any acceleration or change in the state of motion. While the gravitational mass is modeled as the neutral charge.

There is a relationship between these two masses.

4.7.2 The origin of inert mass

The origin of the inert mass is a consequence of the interactions of particles with the energy field 古. The first observable cause is through magnetic remanence. The second is measured through the inert mass of the compound particles due to potential energy (the proton for example). The common point of these two phenomena is the energy field 古. But the law governing this inert mass is unknown.

A clue is the photon. To accelerate an electron, energy is needed, therefore photons. To accelerate a compound particle, we could assimilate each potential energy to its point of contact. Indeed, each potential energy participating in the mass is made up of a pair of electrinettes of opposite signs and they approach very closely to give a point of contact. This point of contact is assimilated to an electrinette. Its movement also introduces afterglow holes analogous to magnetic remanence.

4.7.3 Moving an electrinette

An electrinette is composed of an electric charge and a photon. Its movement can be represented by the following diagram:

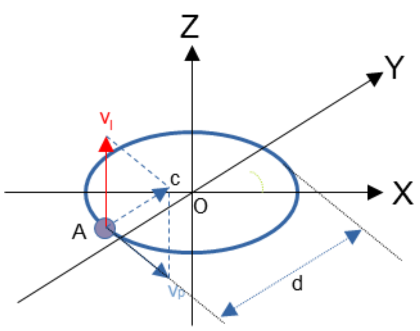


Figure 15 - Electrinette moving vector

The photon captured by the electric charge makes a circular motion in the cavity of the charge. When the electrinette moves linearly, the speed of the photon $\vec{c}$ can be represented by two perpendicular vectors $\vec{v_l}$ and $\vec{v_p}$. And:

$$\vec{c} = \overrightarrow{v_l} + \overrightarrow{v_p}$$

Intuitively, the inert mass is proportional to the linear velocity v_l and inversely proportional to the perpendicular velocity v_p. The simplest expression for the mass is written as:

$$m = m_0 + m_0 \cdot \frac{v_l}{v_p}$$

Replacing the speed v_p by its expression (v_l), we have:

$$m = m_0 + m_0 \cdot \frac{v_l}{\sqrt{c^2 - v_l^2}}$$

When the speed is much lower than c, the inert mass is almost equal to the rest mass. Since at rest the mass is equal to the neutral charge, we therefore have that the inert mass is equal to the gravity mass at low speed.

4.7.4 The relationship between inert mass and gravitational mass

The energy E acquired during the acceleration of an electrinette can be expressed as a function of the inert mass according to the following formula:

$$E = \int_0^x F dx = \int_0^x madx = \int_x^x m \cdot \frac{d^2x}{dt^2} \cdot dx$$

Where:

- F represents the acceleration force
- x represents the displacement
- m represents the inert mass
- a represents acceleration
- t represents time

The total energy of the electrinette can be expressed by the following equation:

$$E_0 + \int_0^x madx = k \cdot 中 \cdot c^2$$

Where:

- E_0 is the initial rest energy of the electrinette.
- 中 represents the total neutral charge associated with the electrinette.
- k is a coefficient allowing to have the same unit of energy.

By deriving this equation with respect to x, we obtain:

$$m \cdot a = kc^2 \cdot \frac{d中}{dx}$$

So:

$$m \cdot \frac{dv}{dt} = kc^2 \cdot \frac{d中}{dx}$$

$$m \cdot \frac{dv}{dt} \cdot dx = kc^2 \cdot d中$$

$$m \cdot v \cdot dv = kc^2 \cdot d中$$

$$\int_0^v m \cdot v \cdot dv = \int_{中_0}^{中} kc^2 \cdot d中$$

Replacing m with its expression and v_l with v, we obtain:

$$\int_0^v \left(m_0 + m_0 \cdot \frac{v}{\sqrt{c^2 - v^2}}\right) \cdot v \cdot dv = \int_{中_0}^{中} kc^2 \cdot d中$$

We obtain the equality:

$$k中c^2 - k中_0 c^2 = \frac{1}{2}m_0 v^2 + \frac{1}{2}m_0 c^2 \cdot \tan^{-1}\left(\frac{v}{\sqrt{c^2 - v^2}}\right) - \frac{1}{2}m_0 v\sqrt{c^2 - v^2}$$

To have the same unit of energy for both sides of the equality, k = ½.

Because of $中_0 = m_0$, so:

$$中 = 中_0 + 中_0 \cdot \left(\frac{v}{c}\right)^2 + 中_0 \cdot \tan^{-1}\left(\frac{\frac{v}{c}}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}\right) - 中_0 \cdot \frac{v}{c} \cdot \sqrt{1 - \left(\frac{v}{c}\right)^2}$$

Equation 18 - Formula neutral charge

Hence the mass m as a function of the neutral charge 中:

$$m = 中 \cdot \frac{1 + \frac{\frac{v}{c}}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}}{1 + \left(\frac{v}{c}\right)^2 + \tan^{-1}\left(\frac{\frac{v}{c}}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}\right) - \frac{v}{c} \cdot \sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

Equation 19 - Formula between inert mass and gravitational mass

Notice:

> The reciprocal function of the tangent is not unique. It must therefore be adapted so that the values obtained correspond to reality.

When v = 0, m = 中.

When v = c, m = ∞. 中 = [2 + (2n+1)π/2]$中_0$. With n = an integer in [0, ∞[.

Conclusion:

> Although the inertia of a particle tends to infinity as its velocity tends to c, its gravitational mass tends to a finite quantity. But this finite quantity could become infinite if physical sense requires it.

4.7.5 Vectorization of inert mass

The vector modeling of the photon shows two components: a vector in the direction of linear displacement and a vector in the perpendicular direction. This gives the following two inert masses:

1. m_l : the linear inert mass, observable in the direction of displacement
2. m_p : the perpendicular inert mass

In the particular case of a particle at rest, the linear mass coincides with the perpendicular mass: $m_l = m_p = m_0 =$ 中 $_0$.

In the particular case of the photon 中, its linear speed being equal to c, the linear mass $m_l = \infty$. The perpendicular mass $m_p =$ 中.

Linear inert mass is dependent on the speed of movement. Perpendicular inert mass is independent of the speed of movement.

4.8 Modeling the stability of 8 compound particles

In collider experiments, there are a large number of observable particles. But very few are stable. Therefore, in any model of fundamental particles, the demonstration of particle stability is a central element that deserves to be detailed. This chapter describes the stability models of the 8 compound particles listed above.

4.8.1 Stability of the electrinette e

An electrinette is composed of 1 pure electric charge and a photon. Their stability is no longer to be demonstrated. Indeed, electrons appear in many electrical equipment of everyday life.

The structure of a pure electric charge is modeled as a hollow ball where a photon can be captured inside this cavity. Thus, an electrinette is born.

The cavity of the pure electric charge can contain a photon whose energy level depends on its environment and its linear speed. When the electrinette is in linear motion, not all of its energy is contained in its cavity. There is a part that remains in the groove left by its movement. The following diagram illustrates the motion of a pair of electrinettes:

Figure 16 - Electrinette Movement

When an electrinette is accelerated, additional photons must be supplied. When it is decelerated, some photons will be released. This is the Compton Effect [6].

The holes left behind the electrinette are verifiable by the magnetic remanence effect. The number of holes is proportional to the speed v. The lifetime of these holes is equal to the magnetic remanence duration. When an old hole disappears, the corresponding energy will be returned via the 古 energy field to a newly created hole.

4.8.2 Stability of the charginettes ☯

A charginette is composed of 2 electrinettes having opposite signs. Comparing the intensities of the 4 forces leads to retaining only the electric force: $\overrightarrow{F_e}$.

The general behavior of such a binary system is the rotation of one around the other in a plane (OXY) according to two periodic trajectories. The following diagram illustrates the trajectories of the two electric charges as well as the Cartesian (O, X, Y) and polar (O, r, α) coordinate systems:

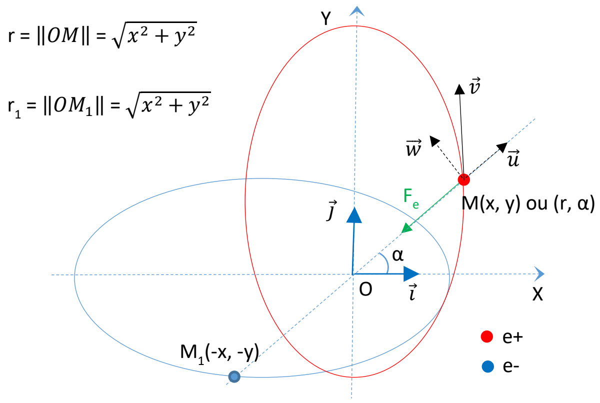


Figure 17 - Charginette dynamic

According to the fundamental law of dynamics, we have the following equation for the electrinette e+ at point M, of inert mass m:

$$-\overrightarrow{F_e} = m \cdot \vec{a} = m \cdot \ddot{\vec{r}}$$

Now according to the relationship between the two referential, we have:

$$\vec{u} = \cos(\alpha)\,\vec{\imath} + \sin(\alpha)\,\vec{\jmath}$$

$$\vec{w} = -\sin(\alpha)\,\vec{\imath} + \cos(\alpha)\,\vec{\jmath}$$

So, by first differentiating the vector once $\vec{r} = \overrightarrow{OM}$, we have:

$$\dot{\vec{r}} = (r\vec{u})' = \dot{r} \cdot \vec{u} + r \cdot \dot{\vec{u}} = \dot{r} \cdot \vec{u} - r\dot{\alpha} \cdot \sin(\alpha)\,\vec{\imath} + r\dot{\alpha} \cdot \cos(\alpha)\,\vec{\jmath} = \dot{r} \cdot \vec{u} + r\dot{\alpha} \cdot \vec{w}$$

Then, by differentiating the vector a second time $\dot{\vec{r}}$, we have:

$$\ddot{\vec{r}} = \ddot{r}\vec{u} + \dot{r}\dot{\vec{u}} + \dot{r}\dot{\alpha}\vec{w} + r(\dot{\alpha}\vec{w})'$$

$$\ddot{\vec{r}} = \ddot{r}\vec{u} + \dot{r}(\dot{\alpha}\vec{w}) + \dot{r}\dot{\alpha}\vec{w} + r\left[\ddot{\alpha}\vec{w} + \dot{\alpha}(\dot{\vec{w}})\right]$$

$$\ddot{\vec{r}} = \ddot{r}\vec{u} + 2\dot{r}\dot{\alpha}\vec{w} + r[\ddot{\alpha}\vec{w} + \dot{\alpha}(-\dot{\alpha} \cdot \cos(\alpha)\,\vec{\imath} - \dot{\alpha} \cdot \sin(\alpha)\,\vec{\jmath})]$$

$$\ddot{\vec{r}} = \ddot{r}\vec{u} + 2\dot{r}\dot{\alpha}\vec{w} + r\ddot{\alpha}\vec{w} - r\dot{\alpha}^2\vec{u}$$

$$\ddot{\vec{r}} = (\ddot{r} - r\dot{\alpha}^2)\vec{u} + (2\dot{r}\dot{\alpha} + r\ddot{\alpha})\vec{w}$$

In the polar referential (O, r, α), we identify the forces by taking into account the inert masses m_l for $\vec{w}$ and $m_{\vdash}$ for $\vec{u}$:

$$-F_e = m_l \cdot (\ddot{r} - r\dot{\alpha}^2) \tag{1}$$

$$0 = m_{\text{卜}} \cdot (2\dot{r}\dot{\alpha} + r\ddot{\alpha}) \tag{2}$$

Assuming that the orbital speed v of the charginette is much lower than the speed of the photon c, the linear inert mass will be equal to the neutral charge 中 of the electrinette at point M:

$$m_l = \text{中}$$

The mass induced by the potential energy is negligible here. Indeed, there is no neutralization point, and no variation of potential energy.

As $m_{\text{卜}} > 0$, equation (2) gives:

$$0 = 2\dot{r}\dot{\alpha} \ + r\ddot{\alpha} \ = \frac{1}{r} \cdot (r^2\dot{\alpha})'$$

As r > 0, we deduce that:

$$(r^2\dot{\alpha})' = 0$$

So:

$$r^2\dot{\alpha} = constante = \ C_a = \ r_0 v_0$$

Which allows the tangential speed to be transformed so that it depends only on r:

$$v^2 = \dot{r}^2 + (r\dot{\alpha})^2 = \dot{r}^2 + \frac{C_a^2}{r^2}$$

Equation (1) becomes an equation that depends on only one variable r:

$$-\frac{F_e}{m_l} = \ddot{r} - \frac{C_a^2}{r^3} \tag{3}$$

Let us solve this equation algebraically in the following special case:

1. $\ddot{r} = \dot{r} = 0$
2. $\ddot{\alpha} = 0$

Under this assumption, v^2 becomes:

$$v^2 = \frac{C_a^2}{r^2}$$

Equation (3) becomes:

$$\frac{F_e}{m_l} = \frac{v^2}{r} \tag{4}$$

The trajectory of the charginette is a circle of constant radius r and constant orbital speed v. Under these conditions, the electrinettes of opposite signs of the charginette will cause a neutralization of the electric force noted k_n.

Equation (4) becomes:

$$k_n F_e = \frac{v^2}{r} \cdot m_l$$

Either by neglecting the parameter β:

$$k_n k_e \frac{\text{中}^2 \cdot e^2}{\text{中}_{ref}^2 \cdot 4r^2} = \frac{v^2}{r} \cdot (\text{中})$$

Equation 20 - Charginette equation

It was assumed that orbital speed v of the charginette is much lower than photon speed c. In this case:

$$\text{中} = \text{中}_0$$

So:

$$k_n k_e \frac{\text{中}_0^2 \cdot e^2}{\text{中}_{ref}^2 \cdot 4r^2} = \frac{v^2}{r} \cdot \left(\text{中}_0\right)$$

$$k_n \frac{k_e}{v^2} \cdot \frac{\text{中}_0 \cdot e^2}{\text{中}_{ref}^2 \cdot 4r} = 1$$

$$r = \frac{k_e \text{中}_0 e^2}{4\text{中}_{ref}^2} \cdot \left(\frac{k_n}{v^2}\right)$$

Equation 21 - Charginette characteristic

If $k_n = 10^{-11}$, then:

Change of scale:

$v = v_x * 10^2$ m/s

$k_n = 10^{-11} = k_{nx} * 10^{-12} = 10 * 10^{-12}$

$r = r_x * 10^{-15}$ m

$e = 1.602\,176\,565 * 10^{-19}$ C $= e_x * 10^{-19}$ C

$c = 2.\,997\,524\,58 * 10^8$ m/s $= c_x * 10^8$ m/s

$k_e = 8.987\,551\,787\,368\,176 * 10^9$ kg^{-1} m^{-1} A^{-2} $= k_{ex} * 10^9$ kg^{-1} m^{-1} A^{-2}

$\varepsilon_0 = 8.854\,187 \times 10^{-12}$ F m^{-1} $= \varepsilon_{0x} * 10^{-12}$ Fm^{-1}

$\text{中}_{ref} = 9.109382 * 10^{-31}$ kg $= \text{中}_{refx} * 10^{-31}$ kg

$\text{中}_0 = \text{中}_{0x} * 10^{-31}$ kg

$$r_x = \frac{k_{ex} \text{中}_{0x} e_x^2 \cdot 10^9 \cdot 10^{-38}}{4\text{中}_{refx}^2 \cdot 10^{-31}} \cdot \left(\frac{10 \cdot 10^{-12}}{v_x^2 \cdot 10^4}\right) \cdot 10^{15} = \frac{5k_{ex} \text{中}_{0x} e_x^2}{2\text{中}_{refx}^2} \cdot \left(\frac{10}{v_x^2}\right)$$

Equation 22 - Charginette scaled characteristic

Let's draw the surface using Matlab:

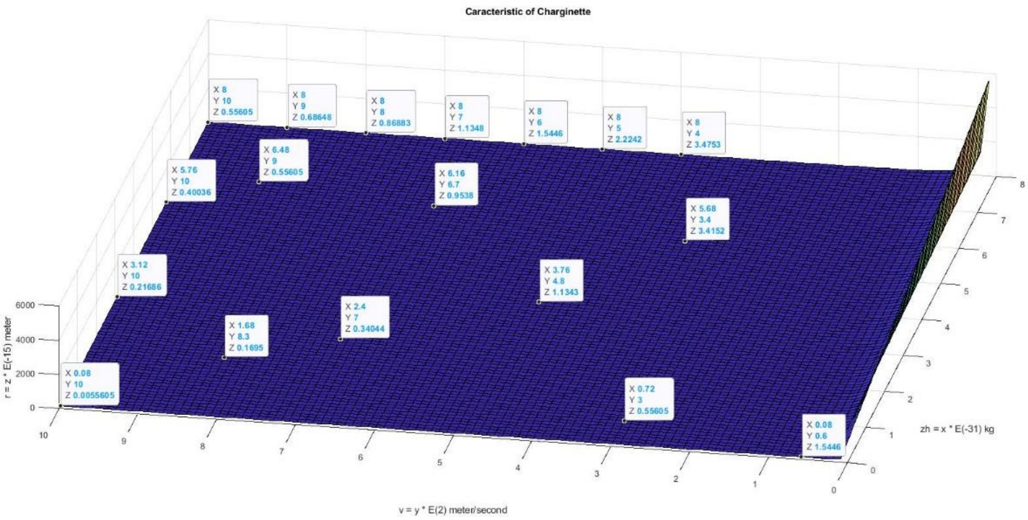


Figure 18 - Characteristic of charginettes

Further details are given in: Appendix A.1.

Conclusion:

> There are a large number of charginettes with different energy levels. The smaller the radius of a charginette, the more stable it is.

4.8.3 Stability of the chrominettes Δ

For the purpose of the demonstration, let us take a chrominette whose 3 charginettes have same radius r = 0.55605*10^{-15} m. The speed $v_3 = 3v_1 = 9.0 * 10^2$ m/s. Assuming that approximately the charginette formula is applicable here, let us determine their respective energies.

$$中_{H0x} = \frac{2r_x {中}^2_{refx}}{5k_{ex}e_x^2\left(\frac{10}{v_x^2}\right)} = \frac{2 * 0.55605 * 9.109382^2}{5 * 8.98755 * 1.602176^2\left(\frac{10}{9.0^2}\right)} = 6.478$$

$$中_{F0x} = \frac{2r_x {中}^2_{refx}}{5k_{ex}e_x^2\left(\frac{10}{v_x^2}\right)} = \frac{2 * 0.55605 * 9.109382^2}{5 * 8.98755 * 1.602176^2\left(\frac{10}{3.0^2}\right)} = 0.72$$

($中_{H0x}$, v_{3x}, r_x) = (6.478, 9.0, 0.55605).

($中_{F0x}$, v_{1x}, r_x) = (0.72, 3.0, 0.55605).

The geometry and fixed referential can be illustrated by following figure:

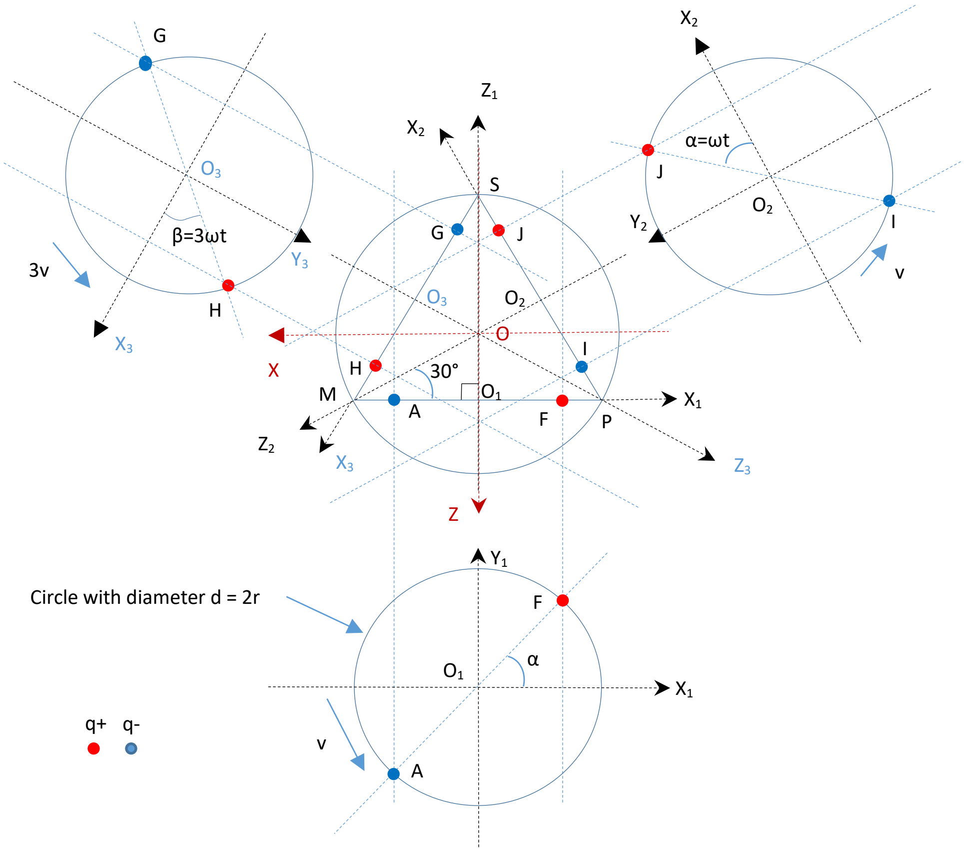


Figure 19 - Chrominette structure scheme

To establish dynamic behavior of the 3 charginettes within the chrominette, we will proceed in following 5 steps:

1. Determine coordinates of the electrinettes and the distances between them
2. Determine mass of each electrinette
3. Determine electrical interactions between the electrinettes
4. Establish the dynamic equations governing each electrinette
5. Solving Differential Equations Using Matlab-Simulink Software Package Tool

4.8.3.1 Determine coordinates of the electrinettes and the distances between them

Let us establish the relationships between global and local coordinates of the electrinettes.

In global referential (O, X, Y, Z):

$$O_1[0, 0, z_0]$$

$$O_2[-z_0 \cdot \cos(\psi), 0, -z_0 \cdot \sin(\psi)]$$

$$O_3[z_0 \cdot \cos(\psi), 0, -z_0 \cdot \sin(\psi)]$$

In local referential (O_1, X_1, Y_1, Z_1):

$$F[r * \cos(\omega t), r * \sin(\omega t), z_1]_{R_1}$$

$$A[-r * \cos(\omega t), -r * \sin(\omega t), z_1]_{R_1}$$

In local referential (O_2, X_2, Y_2, Z_2):

$$I[-r*\cos(\omega t)\,,-r*\sin(\omega t)\,,z_2]_{R_2}$$

$$J[r*\cos(\omega t)\,,r*\sin(\omega t)\,,z_2]_{R_2}$$

In local referential (O_3, X_3, Y_3, Z_3):

$$G[-r*\cos(3\omega t)\,,-r*\sin(3\omega t)\,,z_2]_{R_2}$$

$$H[r*\cos(3\omega t)\,,r*\sin(3\omega t)\,,z_3]_{R_3}$$

There are relationships between parameters r, z_1, z_2, z and ψ. They are:

$$\psi = 30°$$

$$z = z_0 - z_1$$

$$z_{0x} = r_x \cdot \tan(\omega t) = \frac{r_x}{\sqrt{3}} = \frac{0.55605}{\sqrt{3}} = 0.321035617$$

$$z_2 = z_1$$

The local referential have the following origin and rotation matrix parameters:

$$O_1[0,0,z_0] \quad M_1\begin{pmatrix}\cos(\pi) & 0 & \sin(\pi)\\ 0 & 1 & 0\\ -\sin(\pi) & 0 & \cos(\pi)\end{pmatrix} = \begin{pmatrix}-1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & -1\end{pmatrix}$$

$$O_2\left[\frac{-\sqrt{3}}{2}z_0, 0, \frac{-1}{2}z_0\right] \quad M_2\begin{pmatrix}\cos(2\psi) & 0 & \sin(2\psi)\\ 0 & 1 & 0\\ -\sin(2\psi) & 0 & \cos(2\psi)\end{pmatrix} = \begin{pmatrix}\frac{1}{2} & 0 & \frac{\sqrt{3}}{2}\\ 0 & 1 & 0\\ \frac{-\sqrt{3}}{2} & 0 & \frac{1}{2}\end{pmatrix}$$

$$O_3\left[\frac{\sqrt{3}}{2}z_0, 0, \frac{-1}{2}z_0\right] \quad M_3\begin{pmatrix}\cos(-2\psi) & 0 & \sin(-2\psi)\\ 0 & 1 & 0\\ -\sin(-2\psi) & 0 & \cos(-2\psi)\end{pmatrix} = \begin{pmatrix}\frac{1}{2} & 0 & \frac{-\sqrt{3}}{2}\\ 0 & 1 & 0\\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2}\end{pmatrix}$$

Determine coordinates of electrinettes F and I:

In local referential R_1: F_{R1}[r*cos(ωt), r*sin(ωt), z_1], A_{R1}[-r*cos(ωt), -r*sin(ωt), z_1]

In absolute referential R:

$$F\begin{pmatrix}x_f\\ y_f\\ z_f\\ 1\end{pmatrix} = \begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & -1 & z_0\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}r\cdot\cos(\omega t)\\ r\cdot\sin(\omega t)\\ z_1\\ 1\end{pmatrix} = F\begin{pmatrix}-r\cdot\cos(\omega t)\\ r\cdot\sin(\omega t)\\ z_0 - z_1\\ 1\end{pmatrix}$$

$$F\begin{pmatrix}x_f\\ y_f\\ z_f\\ 1\end{pmatrix} = F\begin{pmatrix}-r\cdot\cos(\omega t)\\ r\cdot\sin(\omega t)\\ z\\ 1\end{pmatrix}$$

$$A\begin{pmatrix}x_a\\ y_a\\ z_a\\ 1\end{pmatrix} = \begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & -1 & z_0\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}-r\cdot\cos(\omega t)\\ -r\cdot\sin(\omega t)\\ z_1\\ 1\end{pmatrix} = A\begin{pmatrix}r\cdot\cos(\omega t)\\ -r\cdot\sin(\omega t)\\ z_0 - z_1\\ 1\end{pmatrix}$$

$$A\begin{pmatrix}x_a\\y_a\\z_a\\1\end{pmatrix}=A\begin{pmatrix}r\cdot\cos(\omega t)\\-r\cdot\sin(\omega t)\\z\\1\end{pmatrix}$$

In local referential R_2: I_{R2}[-r*cos(ωt), -r*sin(ωt), z_2], J_{R2}[r*cos(ωt), r*sin(ωt), z_2]

In referential R:

$$I\begin{pmatrix}x_i\\y_i\\z_i\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2}&0&\frac{\sqrt{3}}{2}&\frac{-z_0\sqrt{3}}{2}\\0&1&0&0\\\frac{-\sqrt{3}}{2}&0&\frac{1}{2}&-\frac{z_0}{2}\\0&0&0&1\end{pmatrix}\begin{pmatrix}-r\cdot\cos(\omega t)\\-r\cdot\sin(\omega t)\\z_2\\1\end{pmatrix}=I\begin{pmatrix}-\frac{r}{2}\cdot\cos(\omega t)+\frac{z_2\sqrt{3}}{2}-\frac{z_0\sqrt{3}}{2}\\-r\cdot\sin(\omega t)\\\frac{r\sqrt{3}}{2}\cos(\omega t)+\frac{z_2}{2}-\frac{z_0}{2}\\1\end{pmatrix}$$

$$I\begin{pmatrix}x_i\\y_i\\z_i\\1\end{pmatrix}=I\begin{pmatrix}-\frac{r}{2}\cdot\cos(\omega t)-\frac{z\sqrt{3}}{2}\\-r\cdot\sin(\omega t)\\\frac{r\sqrt{3}}{2}\cos(\omega t)-\frac{z}{2}\\1\end{pmatrix}$$

$$J\begin{pmatrix}x_j\\y_j\\z_j\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2}&0&\frac{\sqrt{3}}{2}&\frac{-z_0\sqrt{3}}{2}\\0&1&0&0\\\frac{-\sqrt{3}}{2}&0&\frac{1}{2}&-\frac{z_0}{2}\\0&0&0&1\end{pmatrix}\begin{pmatrix}r\cdot\cos(\omega t)\\r\cdot\sin(\omega t)\\z_2\\1\end{pmatrix}=J\begin{pmatrix}\frac{r}{2}\cdot\cos(\omega t)+\frac{z_2\sqrt{3}}{2}-\frac{z_0\sqrt{3}}{2}\\r\cdot\sin(\omega t)\\\frac{-r\sqrt{3}}{2}\cos(\omega t)+\frac{z_2}{2}-\frac{z_0}{2}\\1\end{pmatrix}$$

$$J\begin{pmatrix}x_j\\y_j\\z_j\\1\end{pmatrix}=J\begin{pmatrix}\frac{r}{2}\cdot\cos(\omega t)-\frac{z\sqrt{3}}{2}\\r\cdot\sin(\omega t)\\\frac{-r\sqrt{3}}{2}\cos(\omega t)-\frac{z}{2}\\1\end{pmatrix}$$

In local referential R_3: G_{R3}[-r*cos(3ωt), -r*sin(3ωt), z_3], H_{R3}[r*cos(3ωt), r*sin(3ωt), z_3]

In referential R:

$$G\begin{pmatrix}x_g\\y_g\\z_g\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2}&0&\frac{-\sqrt{3}}{2}&\frac{z_0\sqrt{3}}{2}\\0&1&0&0\\\frac{\sqrt{3}}{2}&0&\frac{1}{2}&-\frac{z_0}{2}\\0&0&0&1\end{pmatrix}\begin{pmatrix}-r\cdot\cos(3\omega t)\\-r\cdot\sin(3\omega t)\\z_3\\1\end{pmatrix}=G\begin{pmatrix}-\frac{r}{2}\cdot\cos(3\omega t)+\frac{z_0\sqrt{3}}{2}-\frac{z_3\sqrt{3}}{2}\\-r\cdot\sin(3\omega t)\\\frac{-r\sqrt{3}}{2}\cos(3\omega t)-\frac{z_0}{2}+\frac{z_3}{2}\\1\end{pmatrix}$$

$$H\begin{pmatrix} x_h \\ y_h \\ z_h \\ 1 \end{pmatrix} = \begin{pmatrix} \frac{1}{2} & 0 & \frac{-\sqrt{3}}{2} & \frac{z_0\sqrt{3}}{2} \\ 0 & 1 & 0 & 0 \\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} & -\frac{z_0}{2} \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} r\cdot\cos(3\omega t) \\ r\cdot\sin(3\omega t) \\ z_3 \\ 1 \end{pmatrix} = H\begin{pmatrix} \frac{r}{2}\cdot\cos(3\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2} \\ r\cdot\sin(3\omega t) \\ \frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} \\ 1 \end{pmatrix}$$

Let us determine the vector $\overrightarrow{D_{FI}}$ between 2 electrinettes F and I:

$$D_{FI}\begin{pmatrix} x_{fi} \\ y_{fi} \\ z_{fi} \end{pmatrix} = \begin{pmatrix} \frac{r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2} \\ -2r\cdot\sin(\omega t) \\ \frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2} \end{pmatrix}$$

$$D_{FI}^2 = \left[\frac{r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2}\right]^2 + [2r\cdot\sin(\omega t)]^2 + \left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2}\right]^2$$

Determine the vector $\overrightarrow{D_{FJ}}$ between 2 electrinettes F and J:

$$D_{FJ}\begin{pmatrix} x_{fj} \\ y_{fj} \\ z_{fj} \end{pmatrix} = \begin{pmatrix} \frac{3r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2} \\ 0 \\ \frac{-r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2} \end{pmatrix}$$

$$D_{FJ}^2 = \left[\frac{3r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2}\right]^2 + \left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{3z}{2}\right]^2$$

Determine the vector $\overrightarrow{D_{FG}}$ between 2 electrinettes F and G:

$$D_{FG}\begin{pmatrix} x_{fg} \\ y_{fg} \\ z_{fg} \end{pmatrix} = \begin{pmatrix} \frac{-r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2} \\ -r\cdot\sin(3\omega t) - r\cdot\sin(\omega t) \\ \frac{-r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z \end{pmatrix}$$

$$D_{FG}^2 = \left[\frac{-r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2}\right]^2 + [r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{-r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]^2$$

Determine the vector $\overrightarrow{D_{FH}}$ between 2 electrinettes F and H:

$$D_{FH}\begin{pmatrix} x_{fh} \\ y_{fh} \\ z_{fh} \end{pmatrix} = \begin{pmatrix} \frac{r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2} \\ r\cdot\sin(3\omega t) - r\cdot\sin(\omega t) \\ \frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z \end{pmatrix}$$

$$D_{FH}^2 = \left[\frac{r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2}\right]^2 + [r\cdot\sin(3\omega t) - r\cdot\sin(\omega t)]^2 + \left[\frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]^2$$

Determine the vector $\overrightarrow{D_{AI}}$ between 2 electrinettes A and I:

$$D_{AI}\begin{pmatrix} x_{ai} \\ y_{ai} \\ z_{ai} \end{pmatrix} = \begin{pmatrix} \frac{-3r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2} \\ 0 \\ \frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2} \end{pmatrix}$$

$$D_{AI}^2 = \left[\frac{-3r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2}\right]^2 + \left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2}\right]^2$$

Determine the vector $\overrightarrow{D_{AJ}}$ between 2 electrinettes A and J:

$$D_{AJ}\begin{pmatrix} x_{aj} \\ y_{aj} \\ z_{aj} \end{pmatrix} = \begin{pmatrix} \frac{-r}{2}\cos(\omega t) - \frac{z\sqrt{3}}{2} \\ 2r\cdot\sin(\omega t) \\ \frac{-r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2} \end{pmatrix}$$

$$D_{AJ}^2 = \left[\frac{r}{2}\cos(\omega t) + \frac{z\sqrt{3}}{2}\right]^2 + [2r\cdot\sin(\omega t)]^2 + \left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{3z}{2}\right]^2$$

Determine the vector $\overrightarrow{D_{AG}}$ between 2 electrinettes A and G:

$$D_{AG}\begin{pmatrix} x_{ag} \\ y_{ag} \\ z_{ag} \end{pmatrix} = \begin{pmatrix} \frac{-r}{2}\cos(3\omega t) - r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2} \\ -r\cdot\sin(3\omega t) + r\cdot\sin(\omega t) \\ \frac{-r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z \end{pmatrix}$$

$$D_{AG}^2 = \left[\frac{-r}{2}\cos(3\omega t) - r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2}\right]^2 + [-r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{-r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]^2$$

Determine the vector D_{AH} between 2 electrinettes A and H:

$$D_{AH}\begin{pmatrix} x_{ah} \\ y_{ah} \\ z_{ah} \end{pmatrix} = \begin{pmatrix} \frac{r}{2}\cos(3\omega t) - r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2} \\ r\cdot\sin(3\omega t) + r\cdot\sin(\omega t) \\ \frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z \end{pmatrix}$$

$$D_{AH}^2 = \left[\frac{r}{2}\cos(3\omega t) - r\cdot\cos(\omega t) + \frac{z_0\sqrt{3}}{2} - \frac{z_3\sqrt{3}}{2}\right]^2 + [r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]^2$$

Determine the vector D_{HA} between 2 electrinettes H and A:

$$D_{HA}\begin{pmatrix} x_{ha} \\ y_{ha} \\ z_{ha} \end{pmatrix} = \begin{pmatrix} \frac{-r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2} + \frac{z_3\sqrt{3}}{2} \\ -r\cdot\sin(3\omega t) - r\cdot\sin(\omega t) \\ \frac{-r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z \end{pmatrix}$$

$$D_{HA}^2 = \left[\frac{-r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2} + \frac{z_3\sqrt{3}}{2}\right]^2 + [r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{-r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z\right]^2$$

Determine the vector D_{HF} between 2 electrinettes H and F:

$$D_{HF}\begin{pmatrix} x_{hf} \\ y_{hf} \\ z_{hf} \end{pmatrix} = \begin{pmatrix} \frac{-r}{2}\cos(3\omega t) - r\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2} + \frac{z_3\sqrt{3}}{2} \\ -r\cdot\sin(3\omega t) + r\cdot\sin(\omega t) \\ \frac{-r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z \end{pmatrix}$$

$$D_{HF}^2 = \left[\frac{-r}{2}\cos(3\omega t) - r\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2} + \frac{z_3\sqrt{3}}{2}\right]^2 + [-r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{-r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z\right]^2$$

Determine the vector D_{HI} between 2 electrinettes H and I:

$$D_{HI}\begin{pmatrix} x_{hi} \\ y_{hi} \\ z_{hi} \end{pmatrix} = \begin{pmatrix} \frac{-r}{2}\cos(3\omega t) - \frac{r}{2}\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2} + \frac{z_3\sqrt{3}}{2} - \frac{z\sqrt{3}}{2} \\ -r\cdot\sin(3\omega t) - r\cdot\sin(\omega t) \\ \frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} - \frac{z}{2} \end{pmatrix}$$

$$D_{HI}^2 = \left[\frac{-r}{2}\cos(3\omega t) - \frac{r}{2}\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2} + \frac{z_3\sqrt{3}}{2} - \frac{z\sqrt{3}}{2}\right]^2 + [r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} - \frac{z}{2}\right]^2$$

Determine the vector D_{HJ} between 2 electrinettes H and J:

$$D_{HJ}\begin{pmatrix}x_{hj}\\y_{hj}\\z_{hj}\end{pmatrix}=\begin{pmatrix}\frac{-r}{2}\cos(3\omega t)+\frac{r}{2}\cdot\cos(\omega t)-\frac{z_0\sqrt{3}}{2}+\frac{z_3\sqrt{3}}{2}-\frac{z\sqrt{3}}{2}\\-r\cdot\sin(3\omega t)+r\cdot\sin(\omega t)\\\frac{-r\sqrt{3}}{2}\cos(\omega t)-\frac{r\sqrt{3}}{2}\cos(3\omega t)+\frac{z_0}{2}-\frac{z_3}{2}-\frac{z}{2}\end{pmatrix}$$

$$D_{HJ}^2=\left[\frac{-r}{2}\cos(3\omega t)+\frac{r}{2}\cdot\cos(\omega t)-\frac{z_0\sqrt{3}}{2}+\frac{z_3\sqrt{3}}{2}-\frac{z\sqrt{3}}{2}\right]^2+[r\cdot\sin(3\omega t)-r\cdot\sin(\omega t)]^2+\left[\frac{-r\sqrt{3}}{2}\cos(\omega t)-\frac{r\sqrt{3}}{2}\cos(3\omega t)+\frac{z_0}{2}-\frac{z_3}{2}-\frac{z}{2}\right]^2$$

4.8.3.2 Determine the mass of each electrinette

The electrinettes will be numbered as follows:

1. Electrinette F : speed v_1, the mass 中 $_{F\#}$ global.
2. Electrinette A : speed v_1, the mass 中 $_{F\#}$ global.
3. Electrinette J : speed v_1, the mass 中 $_{F\#}$ global.
4. Electrinette I : speed v_1, the mass 中 $_{F\#}$ global.
5. Electrinette G : speed v_3, the mass 中 $_{H\#}$ global.
6. Electrinette H : speed v_3, the mass 中 $_{H\#}$ global.

The overall mass of electrinette F is expressed by the following formula:

$$中_{F\#}=中_{F}+\frac{1}{2c^2}\cdot(E_{eFI}+E_{eFG})$$

Where:

- 中 $_{F\#}$: represents the overall inert mass of the electrinette F.
- 中 $_{F}$: is the neutral charge of the electrinette F
- E_{eFp} : is the electric potential energy between the electrinette F and the electrinette p having a sign opposite to that of the electrinette F. In addition, the distance between the electrinettes F and p varies between 0 and d > 0. With p = I or G.

To calculate the potential energy E_{eFp}, we need to know the average of the distance between them. Neglecting the displacements of the charginettes relative to the equilateral triangle, the distances are written as:

$$D_{FI}^2=\left[\frac{r}{2}\cos(\omega t)-\frac{z_0\sqrt{3}}{2}\right]^2+[2r\cdot\sin(\omega t)]^2+\left[\frac{r\sqrt{3}}{2}\cos(\omega t)-\frac{3z_0}{2}\right]^2$$

$$D_{FJ}^2=\left[\frac{3r}{2}\cos(\omega t)-\frac{z_0\sqrt{3}}{2}\right]^2+\left[\frac{r\sqrt{3}}{2}\cos(\omega t)+\frac{3z_0}{2}\right]^2$$

$$D_{FG}^2=\left[\frac{-r}{2}\cos(3\omega t)+r\cdot\cos(\omega t)+\frac{z_0\sqrt{3}}{2}\right]^2+[r\cdot\sin(3\omega t)+r\cdot\sin(\omega t)]^2+\left[\frac{-r\sqrt{3}}{2}\cos(3\omega t)-\frac{3z_0}{2}\right]^2$$

Taking into account the value of z_0:

$$D_{FI} = r \cdot \sqrt{[\cos(\omega t) - 1]^2 + 4[\sin(\omega t)]^2}$$

$$D_{FG} = \frac{r}{2}\sqrt{[1 - \cos(3\omega t) + 2\cos(\omega t)]^2 + 4[\sin(3\omega t) + \sin(\omega t)]^2 + 3[\cos(3\omega t) + 1]^2}$$

By plotting the curves over a full period of 2π using Simulink (file: average_distance_of_FI.slx):

$$f_{FI} = \sqrt{[\cos(\omega t) - 1]^2 + 4[\sin(\omega t)]^2}$$

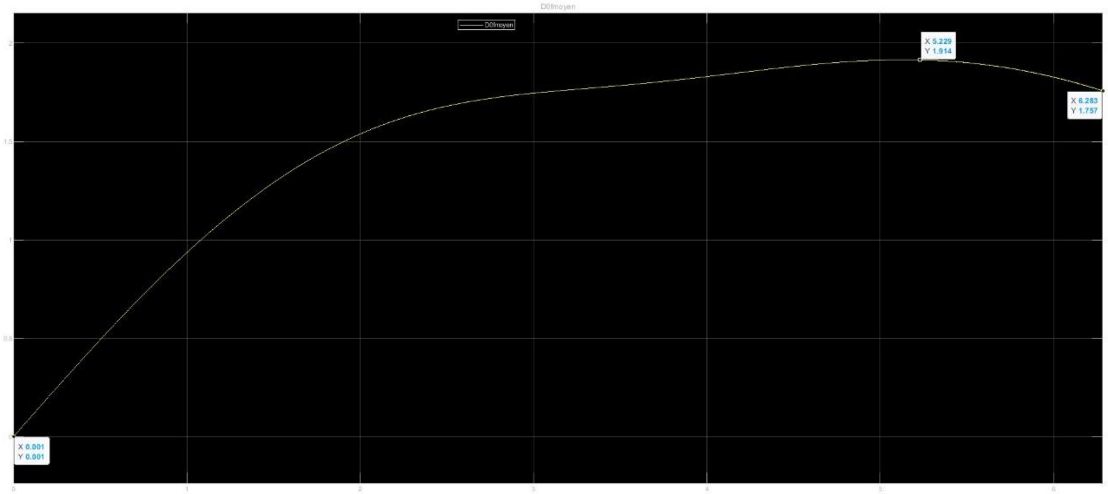


Figure 20 - Average value of FI distance

$D_{FI} = r*f_{FI} = 0.55605*10^{-15}*1.757 = 0.97698*10^{-15}$

$$f_{FG} = \frac{1}{2}\sqrt{[1 - \cos(3\omega t) + 2\cos(\omega t)]^2 + 4[\sin(3\omega t) + \sin(\omega t)]^2 + 3[\cos(3\omega t) + 1]^2}$$

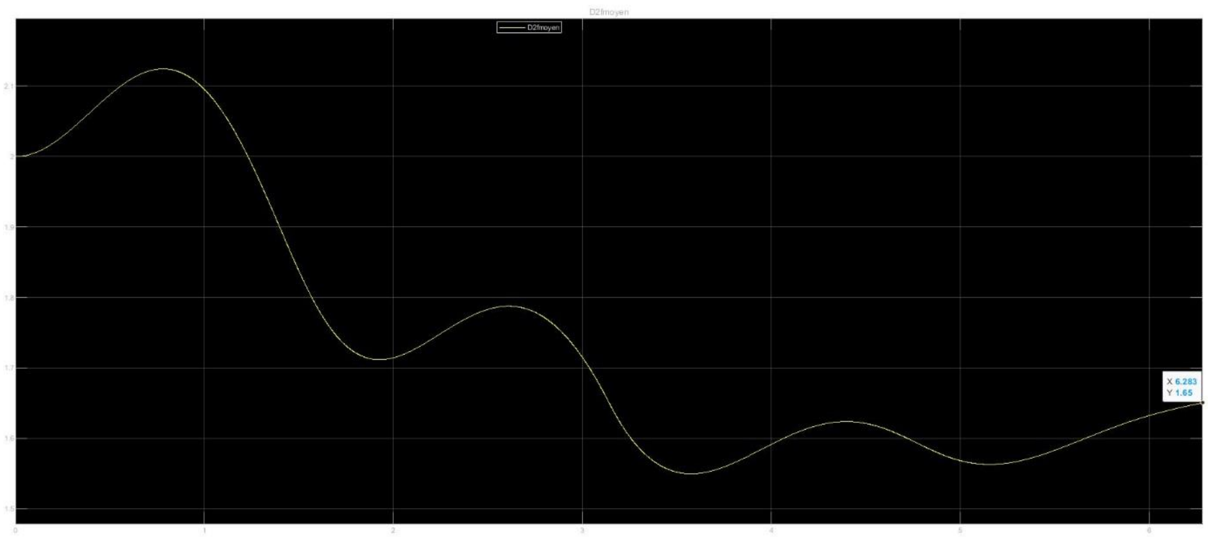


Figure 21 - Average value of FG distance

$D_{FG} = r*f_{FG} = 0.55605*10^{-15}*1.65 = 0.9174825*10^{-15}$

(File: average_distance_of_FG.slx)

The overall mass of the electrinette F becomes:

$$中_{F\#} = 中_{F} + \frac{k_e e^2}{2c^2 中_{ref}^2}\left[\frac{中_{F0}中_{I0}}{D_{FI}} + \frac{中_{F0}中_{G0}}{D_{FG}}\right]$$

With the orbital speed of the charginettes much lower than c, 中 $_F$ =中 $_{F0}$. So we have:

$$中_{F\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^2}\left[\frac{中_{F0}}{D_{FI}} + \frac{中_{H0}}{D_{FG}}\right]$$

$$中_{F\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^2 r}\left[\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}}\right]$$

$$中_{F\#x} = 0.72 + \frac{8.98755 * 1.602176^2 * 0.72 * 10}{2 * 2.997524^2 * 9.109382_0^2 * 0.55605}\left[\frac{0.72}{1.757} + \frac{6.478}{1.65}\right]$$

$$中_{F\#x} = 0.72 + \ 0.200330582[0.409789 + 3.926061]$$

$$中_{F\#x} = 1.588603$$

By symmetry, 中 $_{A\#}$ =中 $_{I\#}$ =中 $_{J\#}$ =中 $_{F\#}$.

The overall mass of the H-electrinette is expressed by the following formula:

$$中_{H\#} = 中_{H} + \frac{1}{2c^2}\cdot(E_{eHA} + E_{eHI})$$

Where:

- 中 $_{H\#}$: represents the overall inert mass of the electrinette H.
- 中 $_{H}$: is the neutral charge of the electrinette H
- E_{eHp} : is the electric potential energy between the H-electrinette and the p-electrinette. With p = A or I.

To calculate the potential energy E_{eHp}, we need to know the average of the distance between them. Neglecting the displacements of the charginettes relative to the equilateral triangle, the distances are written as:

$$D_{HA}^2 = \left[\frac{-r}{2}\cos(3\omega t) + r\cdot\cos(\omega t) - \frac{z_0\sqrt{3}}{2}\right]^2 + [r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{-r\sqrt{3}}{2}\cos(3\omega t) + \frac{3z_0}{2}\right]^2$$

$$D_{HI}^2 = \left[\frac{-r}{2}\cos(3\omega t) - \frac{r}{2}\cdot\cos(\omega t) - z_0\sqrt{3}\right]^2 + [r\cdot\sin(3\omega t) + r\cdot\sin(\omega t)]^2 + \left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{r\sqrt{3}}{2}\cos(3\omega t)\right]^2$$

Taking into account the value of z_0:

$$D_{HA} = \frac{r}{2}\sqrt{[\cos(3\omega t) - 2\cos(\omega t) + 1]^2 + 4[\sin(3\omega t) + \sin(\omega t)]^2 + 3[1 - \cos(3\omega t)]^2}$$

$$D_{HI} = \frac{r}{2} \cdot \sqrt{[\cos(3\omega t) + \cos(\omega t) + 2]^2 + 4[\sin(3\omega t) + \sin(\omega t)]^2 + 3[\cos(\omega t) - \cos(3\omega t)]^2}$$

By plotting the curves over a full period of 2π using Simulink (file: average_distance_of_HA.slx):

$$f_{HA} = \frac{1}{2}\sqrt{[\cos(3\omega t) - 2\cos(\omega t) + 1]^2 + 4[\sin(3\omega t) + \sin(\omega t)]^2 + 3[1 - \cos(3\omega t)]^2}$$

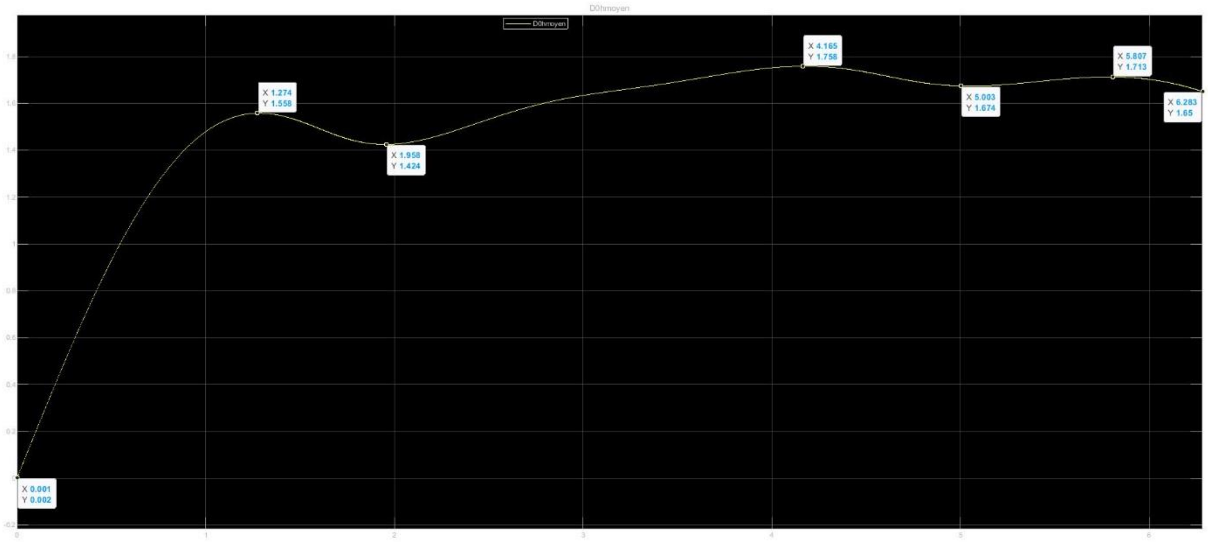


Figure 22 - Average of HA distance

$D_{HA} = r*f_{HA} = 0.55605*10^{-15}*1.65 = 0.9174825*10^{-15}$

$$f_{HI} = \frac{1}{2} \cdot \sqrt{[\cos(3\omega t) + \cos(\omega t) + 2]^2 + 4[\sin(3\omega t) + \sin(\omega t)]^2 + 3[\cos(\omega t) - \cos(3\omega t)]^2}$$

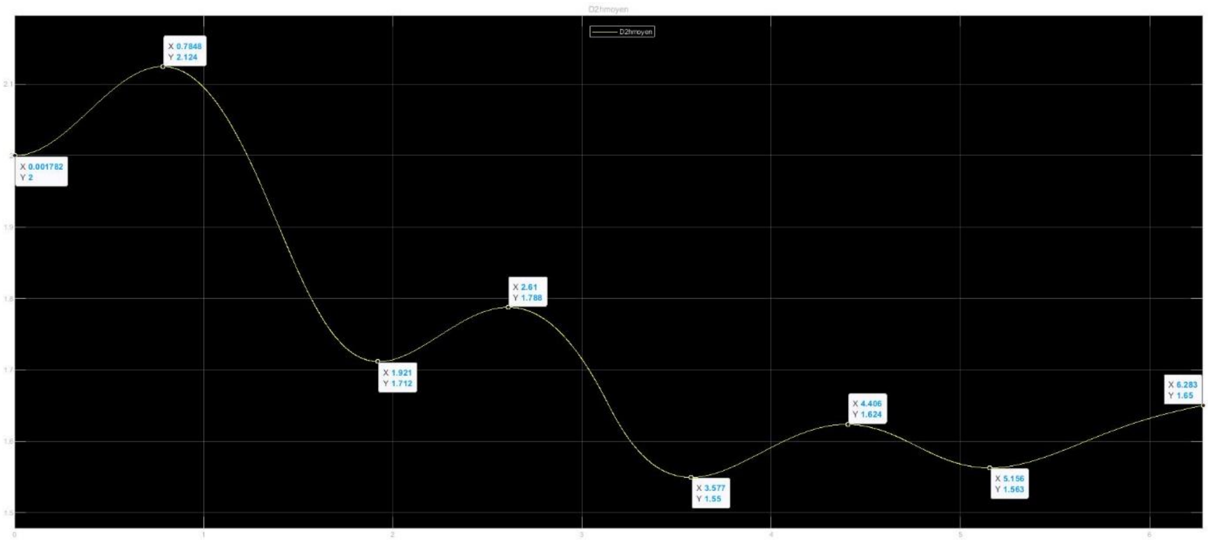


Figure 23 - Average of HI distance

$D_{HI} = r*f_{HI} = 0.55605*10^{-15}*1.65 = 0.9174825*10^{-15}$
(file: average_distance_of_HI.slx)

The overall mass of the H-electrinette becomes:

$$中_{H\#} = 中_{H} + \frac{k_e e^2}{2c^2 中_{ref}^{2}}\left[\frac{中_{H0}中_{A0}}{D_{HA}} + \frac{中_{H0}中_{I0}}{D_{HI}}\right]$$

With the orbital speed of the charginettes much lower than c, $中_{H}$ = $中_{H0}$. So we have:

$$中_{H\#} = 中_{H0} + \frac{k_e e^2 中_{H0}}{2c^2 中_{ref}^{2} r}\left[\frac{中_{A0}}{f_{HA}} + \frac{中_{I0}}{f_{HI}}\right]$$

$$中_{H\#x} = 6.478 + \frac{8.98755 * 1.602176^2 * 6.478 * 10}{2 * 2.997524^2 * 9.109382_0^2 * 0.55605}\left[\frac{0.72}{1.65} + \frac{0.72}{1.65}\right]$$

$$中_{H\#x} = 6.478 + \ 3.6048375[0.872727273]$$

$$中_{H\#x} = 9.62404$$

By symmetry, $中_{G\#}$ = $中_{H\#}$.

($中_{H0x}$, v_{3x}, r_x) = (6.478, 9.0, 0.55605).

($中_{F0x}$, v_{1x}, r_x) = (0.72, 3.0, 0.55605).

The chrominette's electrinettes are:

- 4 * $中_{F\#x}$ = 4 * 1.588603 = 6.354413
- 2 * $中_{H\#x}$ = 2 * 9.6404 = 19.24808

Which gives the mass of the chrominette:

> $中_{chromx}$ = 6.354412 + 19.24808 = 25.6025
>
> $中_{chrom}$ = 25.6025 * 10^{-31}kg.
>
> $中_{chrom}$ = 25.6025 * 10^{-31}kg * c^2 / 1.602 176 634 × 10^{-19} J.
>
> $中_{chrom}$ = 143.581077215 * 10^4 eV = 1.435811 MeV.
>
> $中_{quark}$ = 1.435811 MeV + 511 keV = 1.946811 MeV.

The influence of an electrinette within the chrominette:

> In the case of a quark, there is an electrinette placed in the middle of the chrominette. Since the electric force is greatly diminished by the neutralization of the charginettes, the coupling between this electrinette and the chrominette by the electric force is relatively weak. Which explains the instability of quarks.

4.8.3.3 Determine the electrical interactions between the electrinettes

To model the interactions between the chrominette electrinettes, the following properties will be used:

- The charginettes behave like solid disks with two electrinettes rotating on the periphery.
- The electric fields generated by the electrinettes are attenuated as described in the charginette paragraph.
- The interactions between the electrinettes are doubly attenuated, since on each side, their electric fields are. The attenuation coefficient between two electrinettes 1 and 2 inter charginettes is therefore written as follows:

$$k_{n12} = \frac{10^3}{f_1} \cdot \frac{10^3}{f_2} = \frac{10^6}{f_1 \cdot f_2}$$

  Where:

  f_i represents the rotation frequency of the charginette i.

- There is a particularity when two electrinettes come very close together. In fact, the neutralization depends on the interaction distance. We propose to use the following formula:

$$k_{n12} = 10^{-\frac{D}{r} \cdot 100} + \frac{10^6}{f_1 \cdot f_2}$$

  Where:

  1. k_{n12} : is the attenuation coefficient of the electrical interaction between an electrinette A of charginette 1 of frequency f_1 and an electrinette B of charginette 2 of frequency f_2.
  2. D : is the distance between electrinette A and electrinette B.
  3. r : is the radius of the charginettes 1 and 2 which have the same radius.

Numerical application:

- $r = 0.55605 * 10^{-15}$ m
- $v_1 = 3*10^2$ m/s
- $v_3 = 9*10^2$ m/s
- $f_1 = v_1/r = 5.395198*10^{17}$. For attenuation, the value retained will be 10^{11}.
- $f_3 = v_3/r = 1.618559*10^{18}$. For attenuation, the value retained will be 10^{11}.
- $k_{n13} = 10^{-\frac{D}{r} \cdot 100} + 10^{-22}$

4.8.3.4 Establish the dynamic equations governing each electrinette

Within the chrominette, it is assumed that each charginette moves along its axis of symmetry. This is the O_1Z_1 axis for the AF charginette, the O_2Z_2 axis for the IJ charginette, the O_3Z_3 axis for the GH charginette. By symmetry, the electrinettes A, F, I and J obey one equation. The electrinettes G and H obey another equation.

Project the dynamic equation of the electrinettes F and A onto the O_1Z_1 axis:

$$m_{FA} \cdot \ddot{z}_1 = 力_{ez_1}$$

Equation 23 - Chrominette differential equation 1

Where:

- m_{FA} : is the overall mass of the electrinette F + the overall mass of the electrinette A. For a linear speed much lower than c, $m_F = 中_{F\#}$ and $m_A = 中_{A\#}$.

- 力 $_{ez1}$: is the electric force experienced by the electrinette F + the electric force experienced by the electrinette A on the O_1Z_1 axis.

The force $\overrightarrow{力_F}$ experienced by the electrinette F is as follows:

$$\overrightarrow{力_F} = \frac{k_{nFI}k_e q_F q_I \overrightarrow{D_{FI}}}{D_{FI}^3 + \beta^3} - \frac{k_{nFJ}k_e q_F q_J \overrightarrow{D_{FJ}}}{D_{FJ}^3 + \beta^3} + \frac{k_{nFG}k_e q_F q_G \overrightarrow{D_{FG}}}{D_{FG}^3 + \beta^3} - \frac{k_{nFH}k_e q_F q_H \overrightarrow{D_{FH}}}{D_{FH}^3 + \beta^3}$$

The force $\overrightarrow{力_A}$ experienced by the A electrinette is as follows:

$$\overrightarrow{力_A} = -\frac{k_{nAI}k_e q_A q_I \overrightarrow{D_{AI}}}{D_{AI}^3 + \beta^3} + \frac{k_{nAJ}k_e q_A q_J \overrightarrow{D_{AJ}}}{D_{AJ}^3 + \beta^3} - \frac{k_{nAG}k_e q_A q_G \overrightarrow{D_{AG}}}{D_{AG}^3 + \beta^3} + \frac{k_{nAH}k_e q_A q_H \overrightarrow{D_{AH}}}{D_{AH}^3 + \beta^3}$$

The force $\overrightarrow{力_{FA}}$ experienced by the FA charginette is as follows:

$$\overrightarrow{力_{FA}} = \overrightarrow{力_F} + \overrightarrow{力_A}$$

By projecting onto the O_1Z_1 axis which has the vector:

$$\frac{\overrightarrow{O_1O}}{\left\|\overrightarrow{O_1O}\right\|} = \begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix}$$

Knowing that the OZ axis is collinear with the O_1Z_1 axis, we project onto the OZ axis:

$$\begin{aligned}
力_{Fz} = {} & \frac{k_{nFI}k_e q_F q_I \left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2}\right]}{D_{FI}^3 + \beta^3} + \frac{k_{nFJ}k_e q_F q_J \left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{3z}{2}\right]}{D_{FJ}^3 + \beta^3} \\
& - \frac{k_{nFG}k_e q_F q_G \left[\frac{r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z\right]}{D_{FG}^3 + \beta^3} \\
& - \frac{k_{nFH}k_e q_F q_H \left[\frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]}{D_{FH}^3 + \beta^3} - \frac{k_{nAI}k_e q_A q_I \left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2}\right]}{D_{AI}^3 + \beta^3} \\
& - \frac{k_{nAJ}k_e q_A q_J \left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{3z}{2}\right]}{D_{AJ}^3 + \beta^3} + \frac{k_{nAG}k_e q_A q_G \left[\frac{r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z\right]}{D_{AG}^3 + \beta^3} \\
& + \frac{k_{nAH}k_e q_A q_H \left[\frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]}{D_{AH}^3 + \beta^3}
\end{aligned}$$

By making a change of scale, the equation becomes:

$$中_{FA\#x} \cdot \ddot{z_x} = \frac{k_{nFIx}k_{ex}q_{Fx}q_{Ix}\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) - \frac{3z_x}{2}\right]}{D_{FIx}^3 + {\beta_x}^3} + \frac{k_{nFJx}k_{ex}q_{Fx}q_{Jx}\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{3z_x}{2}\right]}{D_{FJx}^3 + {\beta_x}^3}$$
$$- \frac{k_{nFGx}k_{ex}q_{Fx}q_{Gx}\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) + \frac{z_{0x}}{2} - \frac{z_{3x}}{2} + z_x\right]}{D_{FGx}^3 + {\beta_x}^3}$$
$$- \frac{k_{nFHx}k_{ex}q_{Fx}q_{Hx}\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) - \frac{z_{0x}}{2} + \frac{z_{3x}}{2} - z_x\right]}{D_{FHx}^3 + {\beta_x}^3}$$
$$- \frac{k_{nAIx}k_{ex}q_{Ax}q_{Ix}\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) - \frac{3z_x}{2}\right]}{D_{AIx}^3 + {\beta_x}^3}$$
$$- \frac{k_{nAJx}k_{ex}q_{Ax}q_{Jx}\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{3z_x}{2}\right]}{D_{AJx}^3 + {\beta_x}^3}$$
$$+ \frac{k_{nAGx}k_{ex}q_{Ax}q_{Gx}\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) + \frac{z_{0x}}{2} - \frac{z_{3x}}{2} + z_x\right]}{D_{AGx}^3 + {\beta_x}^3}$$
$$+ \frac{k_{nAHx}k_{ex}q_{Ax}q_{Hx}\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) - \frac{z_{0x}}{2} + \frac{z_{3x}}{2} - z_x\right]}{D_{AHx}^3 + {\beta_x}^3}$$

$z'' = z_x'' * 10^{31}$ m s^{-2}.

$中_{F\#} = 中_{F\#x} * 10^{-31}$ kg = 1.588603 * 10^{-31} kg

$中_{FA\#} = 中_{F\#} + 中_{A\#} = 2\ 中_{F\#} = 中_{FA\#x} * 10^{-31}$ kg = 3.177207 * 10^{-31} kg

$r = r_x * 10^{-15}$ m = 0.55605 * 10^{-15} m

$\beta = \beta_x * 10^{-15}$ m = $10^{-3} * 10^{-15}$ m

$z = z_x * 10^{-15}$ m

e = 1.602 176 565 * 10^{-19} C = $e_x * 10^{-19}$ C

k_e = 8.987 551 787 368 176 * 10^9 kg^{-1} m^{-1} A^{-2} = $k_{ex} * 10^9$ kg^{-1} m^{-1} A^{-2}

$v = v_x * 10^8$ m/s = $(3*10^{-6}) * 10^8$ m/s

$\omega = v / r = \omega_x * 10^{23}$ radian s^{-1}. = $(5.395198274*10^{-6})*10^{23}$ radian s^{-1}. = 2πf = 2π/T

T = 2π/ ω = 2π r / v = $t_x * 10^{-23}$ s = $(1.164588397*10^6) * 10^{-23}$ s

$$q_{?x} = \frac{中_{?0x}}{中_{refx}} \cdot e_x$$

With here: ? = F, I, J, G, H. Knowing that $中_{F0} = 中_{I0} = 中_{J0}$ and $中_{G0} = 中_{H0}$:

- $k_{ex}q_{Fx}q_{Ix} = k_{ex}q_{Fx}q_{Jx} = k_{ex}\frac{中_{F0x}}{中_{refx}} \cdot \frac{中_{F0x}}{中_{refx}} \cdot e_x^2 = k_{ex} \cdot \frac{中_{F0x}^2}{中_{refx}^2} \cdot e_x^2 = k_{11x} \cdot e_x^2$
- $k_{11} = 8.987551787 \cdot 10^9 \frac{0.72^2}{9.109382^2} = 0.05614726 \cdot 10^9 = k_{11x} \cdot 10^9$
- $k_{ex}q_{Fx}q_{Gx} = k_{ex}q_{Fx}q_{Hx} = k_{ex}\frac{中_{F0x}}{中_{refx}} \cdot \frac{中_{H0x}}{中_{refx}} \cdot e_x^2 = k_{16x} \cdot e_x^2$
- $k_{16} = 8.987551787 \cdot 10^9 \frac{0.72 \cdot 6.478}{9.109382^2} = 0.505169378 \cdot 10^9 = k_{16x} \cdot 10^9$

$$k_{nF?} = 10^{-\frac{D_{F?}}{r} \cdot 100} + k_{n0F?x} \cdot 10^{+1} = 10^{-\frac{D_{F?}}{r} \cdot 100} + \frac{10^3}{f_F} \cdot \frac{10^3}{f_?} \cdot 10^{+1}$$

Since the frequency values are greater than the saturation value, we have:

$$k_{nF?} = 10^{-\frac{D_{F?}}{r} \cdot 100} + 10^{-11} \cdot 10^{-11} \cdot 10^1$$

So:

$$k_{nF?} = 10^{-\frac{D_{F?}}{r} \cdot 100} + 10^{-21}$$

Project the dynamic equation of the H-electrinette onto the O_3Z_3 axis:

$$m_h \cdot \ddot{z}_3 = 力_{ez_3}$$

Equation 24 - Chrominette differential equation 2

Where:

- m_h : is the overall mass of the electrinette H. For a linear speed much lower than c, m_h = $中_{H\#}$
- $力_{ez3}$: is the electric force experienced by the electrinette H on the axis O_3Z_3.

The force $\overrightarrow{力_h}$ experienced by the H electrinette is as follows:

$$\overrightarrow{力_h} = \frac{k_{nHA}k_eq_Hq_A\overrightarrow{D_{HA}}}{D_{HA}^3 + \beta^3} - \frac{k_{nHF}k_eq_Hq_F\overrightarrow{D_{HF}}}{D_{HF}^3 + \beta^3} + \frac{k_{nHI}k_eq_Hq_I\overrightarrow{D_{HI}}}{D_{HI}^3 + \beta^3} - \frac{k_{nHJ}k_eq_Hq_J\overrightarrow{D_{HJ}}}{D_{HJ}^3 + \beta^3}$$

By projecting onto the O_3Z_3 axis which has the vector:

$$\frac{\overrightarrow{O_3O}}{\|\overrightarrow{O_3O}\|} = \begin{pmatrix} \frac{-\sqrt{3}}{2} \\ 0 \\ \frac{1}{2} \end{pmatrix}$$

$$力_{hz3} = \frac{k_{nHA}k_e q_H q_A\left[z_0 - z_3 - \frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2}\right]}{D_{HA}^3 + \beta^3} - \frac{k_{nHF}k_e q_H q_F\left[z_0 - z_3 + \frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2}\right]}{D_{HF}^3 + \beta^3} + \frac{k_{nHI}k_e q_H q_I\left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2} + z_0 - z_3\right]}{D_{HI}^3 + \beta^3} - \frac{k_{nHJ}k_e q_H q_J\left[-\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2} + z_0 - z_3\right]}{D_{HJ}^3 + \beta^3}$$

By making a change of scale, the equation becomes:

$$中_{H\#} \cdot \ddot{z_{3x}} = \frac{k_{nHAx}k_{ex} q_{Hx} q_{Ax}\left[-\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + z_{0x} - z_{3x} + \frac{z_x}{2}\right]}{D_{HAx}^3 + {\beta_x}^3} - \frac{k_{nHFx}k_{ex} q_{Hx} q_{Fx}\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + z_{0x} - z_{3x} + \frac{z_x}{2}\right]}{D_{HFx}^3 + {\beta_x}^3} + \frac{k_{nHIx}k_{ex} q_{Hx} q_{Ix}\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{z_x}{2} + z_{0x} - z_{3x}\right]}{D_{HIx}^3 + {\beta_x}^3} - \frac{k_{nHJx}k_{ex} q_{Hx} q_{Jx}\left[-\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{z_x}{2} + z_{0x} - z_{3x}\right]}{D_{HJx}^3 + {\beta_x}^3}$$

With:

$$q_{?x} = \frac{中_{?0x}}{中_{refx}} \cdot e_x$$

With here: ? = F, A, I, J, H. Knowing that 中 $_{F0}$ =中 $_{A0}$ =中 $_{I0}$ =中 $_{J0}$ and 中 $_{G0}$ =中 $_{H0}$:

- $k_{ex}q_{Hx}q_{Ax} = k_{ex}q_{Hx}q_{Fx} = k_{ex}q_{Hx}q_{Ix} = k_{ex}q_{Hx}q_{Jx} = k_{ex}\frac{中_{H0x}}{中_{refx}} \cdot \frac{中_{F0x}}{中_{refx}} = k_{16x}$

$$k_{nH?} = 10^{-\frac{D_{H?}}{r}\cdot 100} + 10^{-21}$$

4.8.3.5 Solving Differential Equations Using Matlab-Simulink Software Package Tool

By solving the equations with Simulink, we obtain the curves z (blue) and z_3 (yellow):

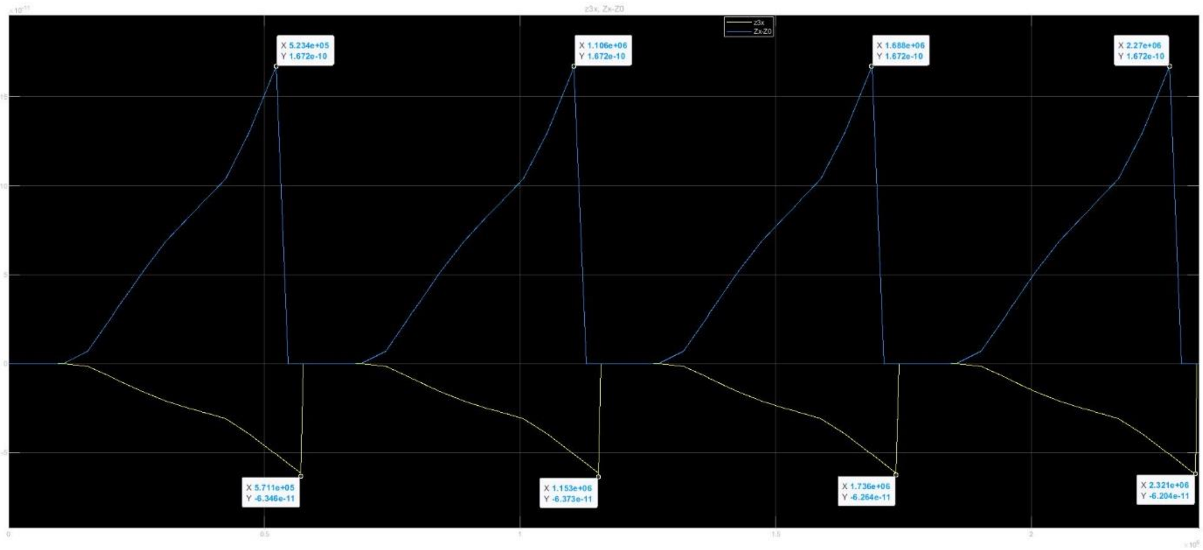


Figure 24 - Chrominette charginette Oscillation

We see that the oscillation amplitude of z_x is $1.972*10^{-10}$. The ratio with the radius r_x is $3.00*10^{-10}$.

The oscillation amplitude of z_{3x} is $6.373*10^{-11}$. The ratio with the radius r_x is $1.15*10^{-10}$.

Further details are given in: Appendix A.2.

4.8.4 Stability of nucleonette 晶 ^{d}

The charge radius for the proton R_p is measured in the laboratory. It is located in the following range:

- $0.82 * 10^{-15}$ m < R_p < $0.88 * 10^{-15}$ m

The preferred value is: $0.84 * 10^{-15}$ m. Now the structure of the proton can be schematized by the following figure:

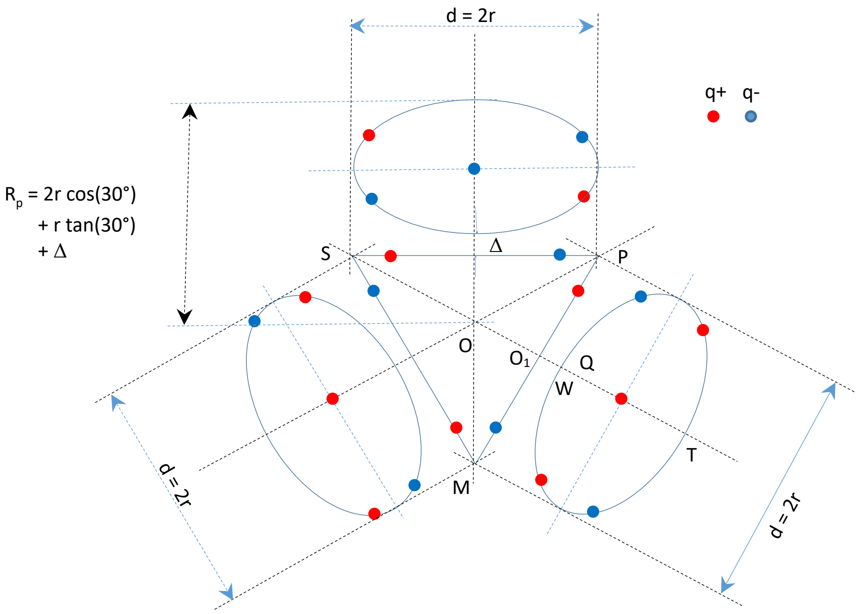


Figure 25 - Proton radius

Assuming that the charge radius corresponds to the maximum radius of a proton, we have:

- $R_p = 2\ r\cos(30°) + r\tan(30°) + \Delta$

We deduce that the radius r of the circles containing the Charginettes composing the proton:

$$r = \frac{R_p - \Delta}{2 \cdot \cos(30^{\circ}) + \tan(30^{\circ})} = \frac{R_p - \Delta}{\sqrt{3} + \frac{1}{\sqrt{3}}}$$

The value of Δ is negligible compared to r. Hence: $r = 0.36373067 * 10^{-15}$ m rounded to $0.36373 * 10^{-15}$ m.

This value of the radius of the charginettes will also be used for the charginettes making up the nucleonette.

To establish the dynamic behavior of the 9 charginettes within the nucleonette, we will proceed in the following 5 steps:

1. Determine the coordinates of the electrinettes and the distances between them
2. Determine the mass of each electrinette
3. Determine the electrical interactions between the electrinettes
4. Establish the dynamic equations governing each electrinette
5. Solving Differential Equations Using Matlab-Simulink Software Package Tool

4.8.4.1 Positioning between the 3 chrominettes

By examining the curves of the amplitudes z and z3, the question of consistency arises. Indeed, the position furthest from z relative to the position of minimal z is at the angle α close to π. But the ideal position is for α = π/2. The problem is that at this position, the speed of the AF charginette is not zero. It is therefore necessary to consider stopping the AF charginette at the position α = π/2. This is a constraint. Indeed, if the position were different, the structure of the nucleonette would no longer hold. This constraint is valid for the 3 middle charginettes.

4.8.4.2 Determine the coordinates of the electrinettes and the distances between them

Let us establish the relationships between the global and local coordinates of the electrinettes.

A global referential and a local referential per external chrominette are illustrated by the following diagram:

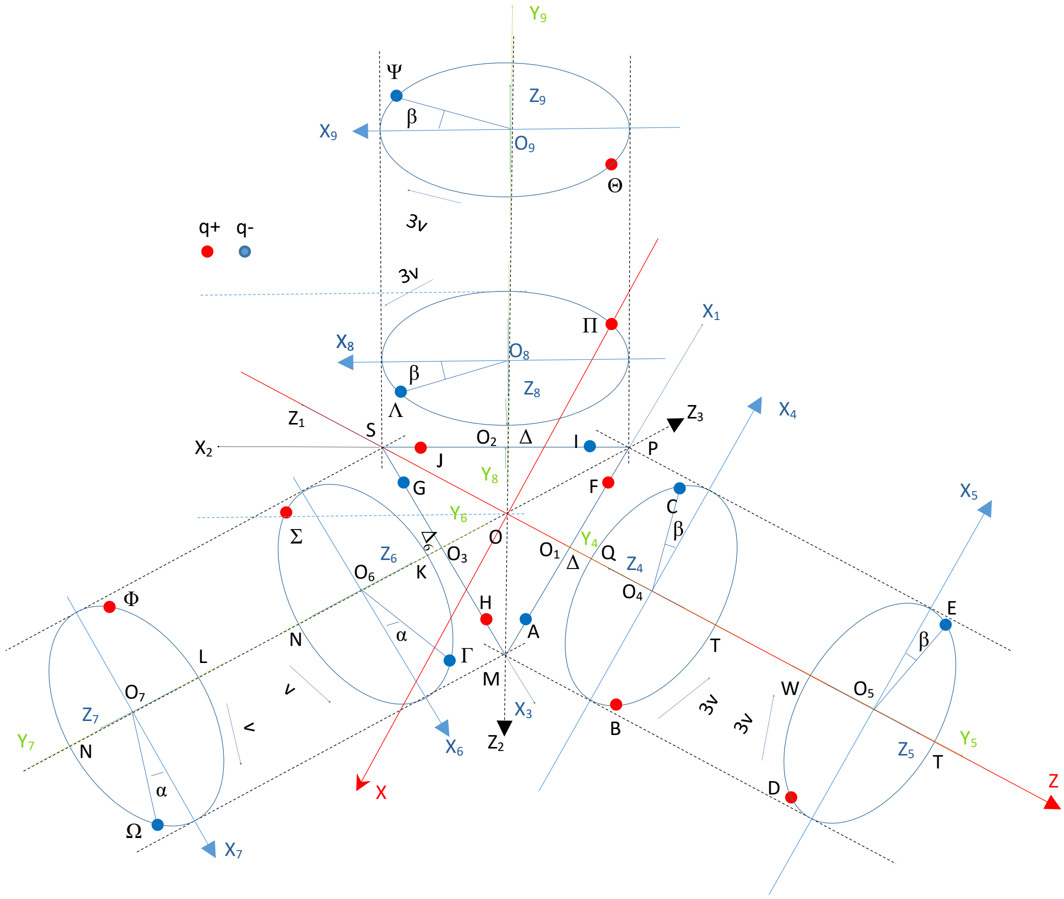


Figure 26 - Nucleonette structure

The referential R, R_1, R_2 and R_3 of paragraph stability of the chrominette are used again here. We add the referential $R_4(O_4, X_4, Y_4, Z_4)$, $R_5(O_5, X_5, Y_5, Z_5)$, $R_6(O_6, X_6, Y_6, Z_6)$ and $R_7(O_7, X_7, Y_7, Z_7)$.

Δ represents the distance on the OZ axis the amplitude of the AF charginette. Δ_6 represents the distance on the O_3Z_3 axis the amplitude of the GH charginette.

Let us determine the coordinates of the origins of these 4 new referential. For the coordinates of O_4 and O_5, we use the following diagram:

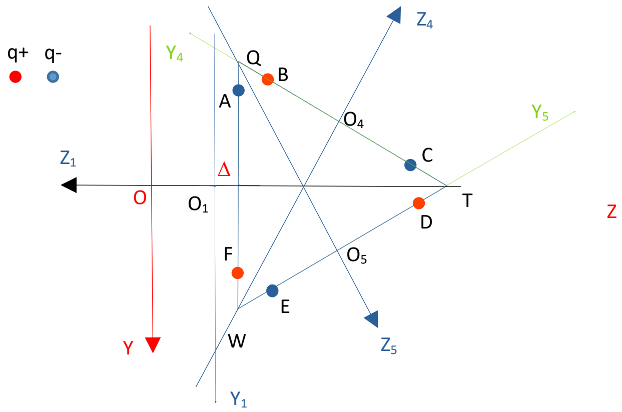


Figure 27 - Chrominette ABCDEF axial view

In the R_1 referential, the coordinates of O_4 and O_5 are:

$$O_4\begin{pmatrix}0\\ -r\cdot\sin(30^{\circ})\\ -\Delta-r\cdot\cos(30^{0})\end{pmatrix}=O_4\begin{pmatrix}0\\ -\frac{r}{2}\\ -\Delta-r\cdot\frac{\sqrt{3}}{2}\end{pmatrix}$$

$$O_5\begin{pmatrix}0\\ r\cdot\sin(30^{\circ})\\ -\Delta-r\cdot\cos(30^{0})\end{pmatrix}=O_5\begin{pmatrix}0\\ \frac{r}{2}\\ -\Delta-r\cdot\frac{\sqrt{3}}{2}\end{pmatrix}$$

After the coordinates of the origins of the local referential, it remains to determine their matrices.

Starting from the R_1 referential, the referential $R_4(O_4, X_4, Y_4, Z_4)$ is obtained by a rotation of 2π/3 around the O_1X_1 axis, then a displacement towards O_4. It is necessary to first add the rotation of R_1 in the R referential.

$$M_{4R1}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & \cos\left(\frac{2\pi}{3}\right) & -\sin\left(\frac{2\pi}{3}\right) & -\frac{r}{2}\\ 0 & \sin\left(\frac{2\pi}{3}\right) & \cos\left(\frac{2\pi}{3}\right) & -\Delta-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}=\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & -\frac{\sqrt{3}}{2} & -\frac{r}{2}\\ 0 & \frac{\sqrt{3}}{2} & -\frac{1}{2} & -\Delta-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$M_1\begin{pmatrix}\cos(\pi) & 0 & \sin(\pi) & 0\\ 0 & 1 & 0 & 0\\ -\sin(\pi) & 0 & \cos(\pi) & z_0\\ 0 & 0 & 0 & 1\end{pmatrix}=\begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & -1 & z_0\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$M_4=M_1\otimes M_{4R1}=\begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & -1 & z_0\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2}\\ 0 & \frac{\sqrt{3}}{2} & -\frac{1}{2} & -\Delta-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$=\begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2}\\ 0 & -\frac{\sqrt{3}}{2} & \frac{1}{2} & \Delta+\frac{\sqrt{3}}{2}r+z_0\\ 0 & 0 & 0 & 1\end{pmatrix}$$

With:

$$z_0=\frac{r}{\sqrt{3}}=\frac{0.36373}{\sqrt{3}}=0.21$$

Starting from the R_1 referential, the referential $R_5(O_5, X_5, Y_5, Z_5)$ is obtained by a rotation of -2π/3 around the O_1X_1 axis, then a displacement towards O_5. It is necessary to first add the rotation of R_1 in the R referential.

$$M_{5R1}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & \cos\left(-\frac{2\pi}{3}\right) & -\sin\left(-\frac{2\pi}{3}\right) & \frac{r}{2}\\ 0 & \sin\left(-\frac{2\pi}{3}\right) & \cos\left(-\frac{2\pi}{3}\right) & -\Delta - r\cdot\frac{\sqrt{3}}{2}\\ 0 & 0 & 0 & 1\end{pmatrix}=\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2}\\ 0 & -\frac{\sqrt{3}}{2} & -\frac{1}{2} & -\Delta-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$M_5 = M_1 \otimes M_{5R1} = \begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 0 & -1 & z_0\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2}\\ 0 & -\frac{\sqrt{3}}{2} & -\frac{1}{2} & -\Delta-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$=\begin{pmatrix}-1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2}\\ 0 & \frac{\sqrt{3}}{2} & \frac{1}{2} & \Delta+\frac{\sqrt{3}}{2}r+z_0\\ 0 & 0 & 0 & 1\end{pmatrix}$$

For the coordinates of O_6 and O_7, we use the following diagram:

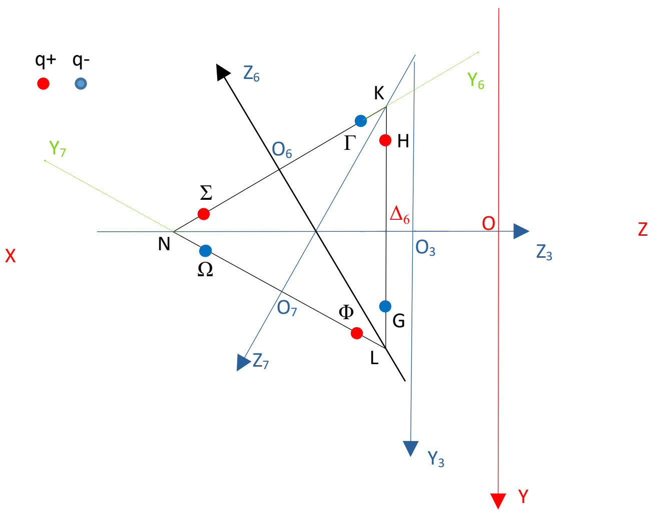


Figure 28 - Chrominette GHΓΣΩΦ axial view

In the R_3 referential, the coordinates of O_6 and O_7 are:

$$O_6\begin{pmatrix}0\\ -r\cdot\sin(30^{\circ})\\ -\Delta_6 - r\cdot\cos(30^{0})\end{pmatrix} = O_6\begin{pmatrix}0\\ -\frac{r}{2}\\ -\Delta_6 - r\cdot\frac{\sqrt{3}}{2}\end{pmatrix}$$

$$O_7\begin{pmatrix}0\\ r\cdot\sin(30^{\circ})\\ -\Delta_6 - r\cdot\cos(30^{0})\end{pmatrix} = O_7\begin{pmatrix}0\\ \frac{r}{2}\\ -\Delta_6 - r\cdot\frac{\sqrt{3}}{2}\end{pmatrix}$$

Starting from the R_3 referential, the referential $R_6(O_6, X_6, Y_6, Z_6)$ is obtained by a rotation of 2π/3 around the O_3X_3 axis, then a displacement towards O_6. It is necessary to first add the rotation of R_3 in the R referential.

$$M_{6R3}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & \cos\left(\frac{2\pi}{3}\right) & -\sin\left(\frac{2\pi}{3}\right) & -\frac{r}{2}\\ 0 & \sin\left(\frac{2\pi}{3}\right) & \cos\left(\frac{2\pi}{3}\right) & -\Delta_6-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}=\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2}\\ 0 & \frac{\sqrt{3}}{2} & -\frac{1}{2} & -\Delta_6-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$M_3\begin{pmatrix}\cos\left(\frac{-\pi}{3}\right) & 0 & \sin\left(\frac{-\pi}{3}\right) & \frac{\sqrt{3}}{2}z_0\\ 0 & 1 & 0 & 0\\ -\sin\left(\frac{-\pi}{3}\right) & 0 & \cos\left(\frac{-\pi}{3}\right) & -\frac{1}{2}z_0\\ 0 & 0 & 0 & 1\end{pmatrix}=\begin{pmatrix}\frac{1}{2} & 0 & \frac{-\sqrt{3}}{2} & \frac{\sqrt{3}}{2}z_0\\ 0 & 1 & 0 & 0\\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} & -\frac{1}{2}z_0\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$M_6=M_3\otimes M_{6R3}=\begin{pmatrix}\frac{1}{2} & 0 & \frac{-\sqrt{3}}{2} & \frac{\sqrt{3}}{2}z_0\\ 0 & 1 & 0 & 0\\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} & -\frac{1}{2}z_0\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2}\\ 0 & \frac{\sqrt{3}}{2} & -\frac{1}{2} & -\Delta_6-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$=\begin{pmatrix}\frac{1}{2} & \frac{-3}{4} & \frac{\sqrt{3}}{4} & \frac{\sqrt{3}}{2}\Delta_6+\frac{3}{4}r+\frac{\sqrt{3}}{2}z_0\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2}\\ \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{4} & -\frac{1}{4} & -\frac{1}{2}\Delta_6-\frac{\sqrt{3}}{4}r-\frac{1}{2}z_0\\ 0 & 0 & 0 & 1\end{pmatrix}$$

Starting from the R_3 referential, the referential $R_7(O_7, X_7, Y_7, Z_7)$ is obtained by a rotation of -2π/3 around the O_3X_3 axis, then a displacement towards O_7. It is necessary to first add the rotation of R_3 in the R referential.

$$M_{7R3}\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & \cos\left(\frac{-2\pi}{3}\right) & -\sin\left(\frac{-2\pi}{3}\right) & \frac{r}{2}\\ 0 & \sin\left(\frac{-2\pi}{3}\right) & \cos\left(\frac{-2\pi}{3}\right) & -\Delta_6-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}=\begin{pmatrix}1 & 0 & 0 & 0\\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2}\\ 0 & \frac{-\sqrt{3}}{2} & -\frac{1}{2} & -\Delta_6-\frac{\sqrt{3}}{2}r\\ 0 & 0 & 0 & 1\end{pmatrix}$$

$$M_7 = M_3 \otimes M_{7R3} = \begin{pmatrix} \frac{1}{2} & 0 & \frac{-\sqrt{3}}{2} & \frac{\sqrt{3}}{2} z_0 \\ 0 & 1 & 0 & 0 \\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} & -\frac{1}{2} z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2} \\ 0 & \frac{-\sqrt{3}}{2} & -\frac{1}{2} & -\Delta_6 - \frac{\sqrt{3}}{2} r \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{1}{2} & \frac{3}{4} & \frac{\sqrt{3}}{4} & \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4} r + \frac{\sqrt{3}}{2} z_0 \\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2} \\ \frac{\sqrt{3}}{2} & \frac{-\sqrt{3}}{4} & -\frac{1}{4} & -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4} r - \frac{1}{2} z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Determine the coordinates of the electrinettes B and C in the local referential R_4:

$$B_{R4} \begin{pmatrix} -r \cdot \cos(3\omega t) \\ -r \cdot \sin(3\omega t) \\ z_4 \end{pmatrix}$$

$$C_{R4} \begin{pmatrix} r \cdot \cos(3\omega t) \\ r \cdot \sin(3\omega t) \\ z_4 \end{pmatrix}$$

Determine the coordinates of the electrinettes B and C in the global referential R:

$$B \begin{pmatrix} x_b \\ y_b \\ z_b \\ 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & -\frac{\sqrt{3}}{2} & \frac{-r}{2} \\ 0 & -\frac{\sqrt{3}}{2} & \frac{1}{2} & \Delta + r\frac{\sqrt{3}}{2} + z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} -r \cdot \cos(3\omega t) \\ -r \cdot \sin(3\omega t) \\ z_4 \\ 1 \end{pmatrix}$$

$$B \begin{pmatrix} x_b \\ y_b \\ z_b \\ 1 \end{pmatrix} = B \begin{pmatrix} r \cdot \cos(3\omega t) \\ \frac{r}{2}\sin(3\omega t) - z_4\frac{\sqrt{3}}{2} - \frac{r}{2} \\ r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 \\ 1 \end{pmatrix}$$

$$C \begin{pmatrix} x_c \\ y_c \\ z_c \\ 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & -\frac{\sqrt{3}}{2} & \frac{-r}{2} \\ 0 & -\frac{\sqrt{3}}{2} & \frac{1}{2} & \Delta + r\frac{\sqrt{3}}{2} + z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} r \cdot \cos(3\omega t) \\ r \cdot \sin(3\omega t) \\ z_4 \\ 1 \end{pmatrix}$$

$$C \begin{pmatrix} x_c \\ y_c \\ z_c \\ 1 \end{pmatrix} = C \begin{pmatrix} -r \cdot \cos(3\omega t) \\ -\frac{r}{2}\sin(3\omega t) - z_4\frac{\sqrt{3}}{2} - \frac{r}{2} \\ -r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 \\ 1 \end{pmatrix}$$

Determine the coordinates of the electrinettes D and E in the local referential R_5:

$$D_{R5}\begin{pmatrix} -r\cdot\cos(3\omega t) \\ -r\cdot\sin(3\omega t) \\ z_4 \end{pmatrix}$$

$$E_{R5}\begin{pmatrix} r\cdot\cos(3\omega t) \\ r\cdot\sin(3\omega t) \\ z_4 \end{pmatrix}$$

Determine the coordinates of the electrinettes D and E in the global referential R:

$$D\begin{pmatrix} x_d \\ y_d \\ z_d \\ 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2} \\ 0 & \frac{\sqrt{3}}{2} & \frac{1}{2} & \Delta + r\frac{\sqrt{3}}{2} + z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\begin{pmatrix} -r\cdot\cos(3\omega t) \\ -r\cdot\sin(3\omega t) \\ z_4 \\ 1 \end{pmatrix}$$

$$D\begin{pmatrix} x_d \\ y_d \\ z_d \\ 1 \end{pmatrix} = D\begin{pmatrix} r\cdot\cos(3\omega t) \\ \frac{r}{2}\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2} \\ -r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 \\ 1 \end{pmatrix}$$

$$E\begin{pmatrix} x_e \\ y_e \\ z_e \\ 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2} \\ 0 & \frac{\sqrt{3}}{2} & \frac{1}{2} & \Delta + r\frac{\sqrt{3}}{2} + z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix}\begin{pmatrix} r\cdot\cos(3\omega t) \\ r\cdot\sin(3\omega t) \\ z_4 \\ 1 \end{pmatrix}$$

$$E\begin{pmatrix} x_e \\ y_e \\ z_e \\ 1 \end{pmatrix} = E\begin{pmatrix} -r\cdot\cos(3\omega t) \\ -\frac{r}{2}\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2} \\ r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 \\ 1 \end{pmatrix}$$

Determine the coordinates of the electrinettes Γ and Σ in the local referential R_6:

$$\Gamma_{R6}\begin{pmatrix} r\cdot\cos(\omega t) \\ r\cdot\sin(\omega t) \\ z_6 \end{pmatrix}$$

$$\Sigma_{R6}\begin{pmatrix} -r\cdot\cos(\omega t) \\ -r\cdot\sin(\omega t) \\ z_6 \end{pmatrix}$$

Determine the coordinates of the electrinettes Γ and Σ in the global referential R:

$$\Gamma\begin{pmatrix}x_\gamma\\y_\gamma\\z_\gamma\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2} & \frac{-3}{4} & \frac{\sqrt{3}}{4} & \Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & \frac{-r}{2}\\ \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{4} & -\frac{1}{4} & -\frac{\Delta_6}{2}-r\frac{\sqrt{3}}{4}-\frac{z_0}{2}\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}r\cdot\cos(\omega t)\\ r\cdot\sin(\omega t)\\ z_6\\ 1\end{pmatrix}$$

$$\Gamma\begin{pmatrix}x_\gamma\\y_\gamma\\z_\gamma\\1\end{pmatrix}=\Gamma\begin{pmatrix}\frac{r}{2}\cdot\cos(\omega t)-\frac{3}{4}r\cdot\sin(\omega t)+z_6\frac{\sqrt{3}}{4}+\Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\ -\frac{r}{2}\cdot\sin(\omega t)-z_6\frac{\sqrt{3}}{2}-\frac{r}{2}\\ r\frac{\sqrt{3}}{2}\cdot\cos(\omega t)+r\frac{\sqrt{3}}{4}\cdot\sin(\omega t)-\frac{z_6}{4}-\frac{r\sqrt{3}}{4}-\frac{\Delta_6}{2}-\frac{z_0}{2}\\ 1\end{pmatrix}$$

$$\Sigma\begin{pmatrix}x_\sigma\\y_\sigma\\z_\sigma\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2} & \frac{-3}{4} & \frac{\sqrt{3}}{4} & \Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & \frac{-r}{2}\\ \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{4} & -\frac{1}{4} & -\frac{\Delta_6}{2}-r\frac{\sqrt{3}}{4}-\frac{z_0}{2}\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}-r\cdot\cos(\omega t)\\ -r\cdot\sin(\omega t)\\ z_6\\ 1\end{pmatrix}$$

$$\Sigma\begin{pmatrix}x_\sigma\\y_\sigma\\z_\sigma\\1\end{pmatrix}=\Sigma\begin{pmatrix}\frac{-r}{2}\cdot\cos(\omega t)+\frac{3}{4}r\cdot\sin(\omega t)+z_6\frac{\sqrt{3}}{4}+\Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\ \frac{r}{2}\cdot\sin(\omega t)-z_6\frac{\sqrt{3}}{2}-\frac{r}{2}\\ -r\frac{\sqrt{3}}{2}\cdot\cos(\omega t)-r\frac{\sqrt{3}}{4}\cdot\sin(\omega t)-\frac{z_6}{4}-\frac{r\sqrt{3}}{4}-\frac{\Delta_6}{2}-\frac{z_0}{2}\\ 1\end{pmatrix}$$

Determine the coordinates of the electrinettes Ω and Φ in the local referential R_7:

$$\Omega_{R7}\begin{pmatrix}r\cdot\cos(\omega t)\\ r\cdot\sin(\omega t)\\ z_6\end{pmatrix}$$

$$\Phi_{R7}\begin{pmatrix}-r\cdot\cos(\omega t)\\ -r\cdot\sin(\omega t)\\ z_6\end{pmatrix}$$

Determine the coordinates of the electrinettes Ω and Φ in the global referential R:

$$\Omega\begin{pmatrix}x_\omega\\y_\omega\\z_\omega\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2} & \frac{3}{4} & \frac{\sqrt{3}}{4} & \Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\ 0 & -\frac{1}{2} & \frac{\sqrt{3}}{2} & \frac{r}{2}\\ \frac{\sqrt{3}}{2} & \frac{-\sqrt{3}}{4} & -\frac{1}{4} & -\frac{\Delta_6}{2}-r\frac{\sqrt{3}}{4}-\frac{z_0}{2}\\ 0 & 0 & 0 & 1\end{pmatrix}\begin{pmatrix}r\cdot\cos(\omega t)\\ r\cdot\sin(\omega t)\\ z_6\\ 1\end{pmatrix}$$

$$\Omega\begin{pmatrix}x_\omega\\y_\omega\\z_\omega\\1\end{pmatrix}=\Omega\begin{pmatrix}\frac{r}{2}\cdot\cos(\omega t)+\frac{3}{4}r\cdot\sin(\omega t)+z_6\frac{\sqrt{3}}{4}+\Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\-\frac{r}{2}\cdot\sin(\omega t)+z_6\frac{\sqrt{3}}{2}+\frac{r}{2}\\r\frac{\sqrt{3}}{2}\cdot\cos(\omega t)-r\frac{\sqrt{3}}{4}\cdot\sin(\omega t)-\frac{z_6}{4}-\frac{r\sqrt{3}}{4}-\frac{\Delta_6}{2}-\frac{z_0}{2}\\1\end{pmatrix}$$

$$\Phi\begin{pmatrix}x_\varphi\\y_\varphi\\z_\varphi\\1\end{pmatrix}=\begin{pmatrix}\frac{1}{2}&\frac{3}{4}&\frac{\sqrt{3}}{4}&\Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\0&-\frac{1}{2}&\frac{\sqrt{3}}{2}&\frac{r}{2}\\\frac{\sqrt{3}}{2}&\frac{-\sqrt{3}}{4}&-\frac{1}{4}&-\frac{\Delta_6}{2}-r\frac{\sqrt{3}}{4}-\frac{z_0}{2}\\0&0&0&1\end{pmatrix}\begin{pmatrix}-r\cdot\cos(\omega t)\\-r\cdot\sin(\omega t)\\z_6\\1\end{pmatrix}$$

$$\Phi\begin{pmatrix}x_\omega\\y_\omega\\z_\omega\\1\end{pmatrix}=\Phi\begin{pmatrix}\frac{-r}{2}\cdot\cos(\omega t)-\frac{3}{4}r\cdot\sin(\omega t)+z_6\frac{\sqrt{3}}{4}+\Delta_6\frac{\sqrt{3}}{2}+\frac{3r}{4}+z_0\frac{\sqrt{3}}{2}\\\frac{r}{2}\cdot\sin(\omega t)+z_6\frac{\sqrt{3}}{2}+\frac{r}{2}\\-r\frac{\sqrt{3}}{2}\cdot\cos(\omega t)+r\frac{\sqrt{3}}{4}\cdot\sin(\omega t)-\frac{z_6}{4}-\frac{r\sqrt{3}}{4}-\frac{\Delta_6}{2}-\frac{z_0}{2}\\1\end{pmatrix}$$

Determine the vectors and distances between the electrinettes F, B, C, D and E:

$$\overrightarrow{FB}=\begin{pmatrix}r\cdot\cos(3\omega t)+r\cdot\cos(\omega t)\\\frac{r}{2}\cdot\sin(3\omega t)-z_4\frac{\sqrt{3}}{2}-\frac{r}{2}-r\cdot\sin(\omega t)\\r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+\frac{z_4}{2}+r\frac{\sqrt{3}}{2}+\Delta+z_0-z\end{pmatrix}$$

$$D_{FB}^2=[r\cdot\cos(3\omega t)+r\cdot\cos(\omega t)]^2+\left[\frac{r}{2}\cdot\sin(3\omega t)-z_4\frac{\sqrt{3}}{2}-\frac{r}{2}-r\cdot\sin(\omega t)\right]^2+\left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+\frac{z_4}{2}+r\frac{\sqrt{3}}{2}+\Delta+z_0-z\right]^2$$

$$\overrightarrow{FC}=\begin{pmatrix}-r\cdot\cos(3\omega t)+r\cdot\cos(\omega t)\\-\frac{r}{2}\cdot\sin(3\omega t)-z_4\frac{\sqrt{3}}{2}-\frac{r}{2}-r\cdot\sin(\omega t)\\-r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+\frac{z_4}{2}+r\frac{\sqrt{3}}{2}+\Delta+z_0-z\end{pmatrix}$$

$$D_{FC}^2=[-r\cdot\cos(3\omega t)+r\cdot\cos(\omega t)]^2+\left[\frac{r}{2}\cdot\sin(3\omega t)+z_4\frac{\sqrt{3}}{2}+\frac{r}{2}+r\cdot\sin(\omega t)\right]^2+\left[-r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+\frac{z_4}{2}+r\frac{\sqrt{3}}{2}+\Delta+z_0-z\right]^2$$

$$\overrightarrow{FD} = \begin{pmatrix} r \cdot \cos(3\omega t) + r \cdot \cos(\omega t) \\ \frac{r}{2} \cdot \sin(3\omega t) + z_4 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(\omega t) \\ -r\frac{\sqrt{3}}{2} \cdot \sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z \end{pmatrix}$$

$$D_{FD}^2 = [r \cdot \cos(3\omega t) + r \cdot \cos(\omega t)]^2 + \left[\frac{r}{2} \cdot \sin(3\omega t) + z_4 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(\omega t)\right]^2 + \left[-r\frac{\sqrt{3}}{2} \cdot \sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

$$\overrightarrow{FE} = \begin{pmatrix} -r \cdot \cos(3\omega t) + r \cdot \cos(\omega t) \\ -\frac{r}{2} \cdot \sin(3\omega t) + z_4 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(\omega t) \\ r\frac{\sqrt{3}}{2} \cdot \sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z \end{pmatrix}$$

$$D_{FE}^2 = [-r \cdot \cos(3\omega t) + r \cdot \cos(\omega t)]^2 + \left[-\frac{r}{2} \cdot \sin(3\omega t) + z_4 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2} \cdot \sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

Determine the vectors and distances between the electrinettes Η, Γ, Σ, Ω and Φ:

$$\overrightarrow{H\Gamma} = \begin{pmatrix} \frac{r}{2} \cdot \cos(\omega t) - \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2} \\ -\frac{r}{2} \cdot \sin(\omega t) - z_6 \frac{\sqrt{3}}{2} - \frac{r}{2} - r \cdot \sin(3\omega t) \\ r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) + r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) - \frac{z_6}{4} - r\frac{\sqrt{3}}{4} - \frac{\Delta_6}{2} - r\frac{\sqrt{3}}{2}\cos(3\omega t) - \frac{z_3}{2} \end{pmatrix}$$

$$D_{H\Gamma}^2 = \left[\frac{r}{2} \cdot \cos(\omega t) - \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2}\right]^2 + \left[-\frac{r}{2} \cdot \sin(\omega t) - z_6 \frac{\sqrt{3}}{2} - \frac{r}{2} - r \cdot \sin(3\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) + r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) - \frac{z_6}{4} - r\frac{\sqrt{3}}{4} - \frac{\Delta_6}{2} - r\frac{\sqrt{3}}{2}\cos(3\omega t) - \frac{z_3}{2}\right]^2$$

$$\overrightarrow{H\Sigma} = \begin{pmatrix} \frac{-r}{2} \cdot \cos(\omega t) + \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2} \\ \frac{r}{2} \cdot \sin(\omega t) - z_6 \frac{\sqrt{3}}{2} - \frac{r}{2} - r \cdot \sin(3\omega t) \\ -r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) - r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) - \frac{z_6}{4} - r\frac{\sqrt{3}}{4} - \frac{\Delta_6}{2} - r\frac{\sqrt{3}}{2}\cos(3\omega t) - \frac{z_3}{2} \end{pmatrix}$$

$$D_{H\Sigma}^2 = \left[\frac{-r}{2} \cdot \cos(\omega t) + \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2}\right]^2 + \left[\frac{r}{2} \cdot \sin(\omega t) - z_6 \frac{\sqrt{3}}{2} - \frac{r}{2} - r \cdot \sin(3\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) + r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) + \frac{z_6}{4} + r\frac{\sqrt{3}}{4} + \frac{\Delta_6}{2} + r\frac{\sqrt{3}}{2}\cos(3\omega t) + \frac{z_3}{2}\right]^2$$

$$\overrightarrow{H\Omega} = \begin{pmatrix} \frac{r}{2} \cdot \cos(\omega t) + \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2} \\ -\frac{r}{2} \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(3\omega t) \\ r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) - r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) - \frac{z_6}{4} - r\frac{\sqrt{3}}{4} - \frac{\Delta_6}{2} - r\frac{\sqrt{3}}{2}\cos(3\omega t) - \frac{z_3}{2} \end{pmatrix}$$

$$D_{H\Omega}^2 = \left[\frac{r}{2} \cdot \cos(\omega t) + \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2}\right]^2 + \left[-\frac{r}{2} \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(3\omega t)\right]^2 + \left[-r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) + r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) + \frac{z_6}{4} + r\frac{\sqrt{3}}{4} + \frac{\Delta_6}{2} + r\frac{\sqrt{3}}{2}\cos(3\omega t) + \frac{z_3}{2}\right]^2$$

$$\overrightarrow{H\Phi} = \begin{pmatrix} \frac{-r}{2} \cdot \cos(\omega t) - \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2} \\ \frac{r}{2} \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(3\omega t) \\ -r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) + r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) - \frac{z_6}{4} - r\frac{\sqrt{3}}{4} - \frac{\Delta_6}{2} - r\frac{\sqrt{3}}{2}\cos(3\omega t) - \frac{z_3}{2} \end{pmatrix}$$

$$D_{H\Phi}^2 = \left[\frac{-r}{2} \cdot \cos(\omega t) - \frac{3}{4} r \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{4} + \Delta_6 \frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2} \cdot \cos(3\omega t) + z_3 \frac{\sqrt{3}}{2}\right]^2 + \left[\frac{r}{2} \cdot \sin(\omega t) + z_6 \frac{\sqrt{3}}{2} + \frac{r}{2} - r \cdot \sin(3\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) - r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) + \frac{z_6}{4} + r\frac{\sqrt{3}}{4} + \frac{\Delta_6}{2} + r\frac{\sqrt{3}}{2}\cos(3\omega t) + \frac{z_3}{2}\right]^2$$

Determine the vectors and distances between the electrinettes C, D, E and A:

$$\overrightarrow{AC} = \begin{pmatrix} -r \cdot \cos(3\omega t) - r \cdot \cos(\omega t) \\ -\frac{r}{2}\sin(3\omega t) - z_4 \frac{\sqrt{3}}{2} - \frac{r}{2} + r \cdot \sin(\omega t) \\ -r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z \end{pmatrix}$$

$$D_{AC}^2 = [r\cdot\cos(3\omega t) + r\cdot\cos(\omega t)]^2 + \left[r\cdot\sin(\omega t) - \frac{r}{2}\cdot\sin(3\omega t) - z_4\frac{\sqrt{3}}{2} - \frac{r}{2}\right]^2 + \left[-r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

$$\overrightarrow{AD} = \begin{pmatrix} r\cdot\cos(3\omega t) - r\cdot\cos(\omega t) \\ \frac{r}{2}\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2} + r\cdot\sin(\omega t) \\ -r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z \end{pmatrix}$$

$$D_{AD}^2 = [r\cdot\cos(3\omega t) - r\cdot\cos(\omega t)]^2 + \left[r\cdot\sin(\omega t) + \frac{r}{2}\cdot\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2}\right]^2 + \left[-r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

$$\overrightarrow{AE} = \begin{pmatrix} -r\cdot\cos(3\omega t) - r\cdot\cos(\omega t) \\ -\frac{r}{2}\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2} + r\cdot\sin(\omega t) \\ r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z \end{pmatrix}$$

$$D_{AE}^2 = [r\cdot\cos(3\omega t) + r\cdot\cos(\omega t)]^2 + \left[r\cdot\sin(\omega t) - \frac{r}{2}\cdot\sin(3\omega t) + \frac{\sqrt{3}}{2}z_4 + \frac{r}{2}\right]^2 + \left[r\frac{\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

Determine the vectors and distances between the electrinettes B, A, D and E:

$$\overrightarrow{BA} = \begin{pmatrix} r\cdot\cos(\omega t) - r\cdot\cos(3\omega t) \\ -r\cdot\sin(\omega t) - \frac{r}{2}\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2} \\ z - r\frac{\sqrt{3}}{2}\sin(3\omega t) - \frac{z_4}{2} - r\frac{\sqrt{3}}{2} - \Delta - z_0 \end{pmatrix}$$

$$\overrightarrow{BE} = \begin{pmatrix} -2r\cdot\cos(3\omega t) \\ -r\cdot\sin(3\omega t) + z_4\sqrt{3} + r \\ 0 \end{pmatrix}$$

$$D_{BE}^2 = [2r\cdot\cos(3\omega t)]^2 + \left[-r\cdot\sin(3\omega t) + z_4\sqrt{3} + r\right]^2$$

$$\overrightarrow{BD} = \begin{pmatrix} 0 \\ z_4\sqrt{3} + r \\ r\sqrt{3}\sin(3\omega t) \end{pmatrix}$$

$$D_{BD}^2 = \left[r + z_4\sqrt{3}\right]^2 + 3[r \cdot \sin(3\omega t)]^2$$

Determine the vectors and distances between electrinettes D, E and C:

$$\overrightarrow{CD} = \begin{pmatrix} 2r \cdot \cos(3\omega t) \\ r \cdot \sin(3\omega t) + z_4\sqrt{3} + r \\ 0 \end{pmatrix}$$

$$D_{CD}^2 = 4[r \cdot \cos(3\omega t)]^2 + \left[r \cdot \sin(3\omega t) + z_4\sqrt{3} + r\right]^2$$

$$\overrightarrow{CE} = \begin{pmatrix} 0 \\ z_4\sqrt{3} + r \\ r\sqrt{3}\sin(3\omega t) \end{pmatrix}$$

$$D_{CE}^2 = \left[r + z_4\sqrt{3}\right]^2 + 3[r \cdot \sin(3\omega t)]^2$$

Determine the vectors and distances between the electrinettes Σ, Φ, G and Ω:

$$\overrightarrow{\Sigma\Omega} = \begin{pmatrix} r \cdot \cos(\omega t) \\ -r \cdot \sin(\omega t) + z_6\sqrt{3} + r \\ r\sqrt{3} \cdot \cos(\omega t) \end{pmatrix}$$

$$D_{\Sigma\Omega}^2 = [r \cdot \cos(\omega t)]^2 + \left[-r \cdot \sin(\omega t) + z_6\sqrt{3} + r\right]^2 + \left[r\sqrt{3} \cdot \cos(\omega t)\right]^2$$

$$\overrightarrow{\Sigma\Phi} = \begin{pmatrix} -\frac{3}{2} r \cdot \sin(\omega t) \\ z_6\sqrt{3} + r \\ \frac{\sqrt{3}}{2} r \cdot \sin(\omega t) \end{pmatrix}$$

$$D_{\Sigma\Phi}^2 = \left[-\frac{3}{2} r \cdot \sin(\omega t)\right]^2 + \left[z_6\sqrt{3} + r\right]^2 + \left[\frac{\sqrt{3}}{2} r \cdot \sin(\omega t)\right]^2$$

$$\overrightarrow{\Sigma G} = \begin{pmatrix} -\frac{r}{2} \cdot \cos(3\omega t) - \frac{z_3\sqrt{3}}{2} + \frac{r}{2} \cdot \cos(\omega t) - \frac{3}{4} r \sin(\omega t) - \frac{\sqrt{3}}{4} z_6 - \frac{\sqrt{3}}{2}\Delta_6 - \frac{3r}{4} \\ -r \cdot \sin(3\omega t) - \frac{r}{2} \cdot \sin(\omega t) + \frac{\sqrt{3}}{2} z_6 + \frac{r}{2} \\ -\frac{\sqrt{3}}{2} r \cdot \cos(3\omega t) + \frac{z_3}{2} + \frac{\sqrt{3}}{2} r \cdot \cos(\omega t) + \frac{\sqrt{3}}{4} r \cdot \sin(\omega t) + \frac{z_6}{4} + \frac{\sqrt{3}}{4} r + \frac{\Delta_6}{2} \end{pmatrix}$$

$$\overrightarrow{\Gamma H} = \begin{pmatrix} \frac{r}{2} \cdot \cos(3\omega t) - z_3\frac{\sqrt{3}}{2} - \frac{r}{2} \cdot \cos(\omega t) + \frac{3}{4} r \cdot \sin(\omega t) - z_6\frac{\sqrt{3}}{4} - \Delta_6\frac{\sqrt{3}}{2} - \frac{3r}{4} \\ r \cdot \sin(3\omega t) + \frac{r}{2} \cdot \sin(\omega t) + z_6\frac{\sqrt{3}}{2} + \frac{r}{2} \\ r\frac{\sqrt{3}}{2}\cos(3\omega t) + \frac{z_3}{2} - r\frac{\sqrt{3}}{2} \cdot \cos(\omega t) - r\frac{\sqrt{3}}{4} \cdot \sin(\omega t) + \frac{z_6}{4} + r\frac{\sqrt{3}}{4} + \frac{\Delta_6}{2} \end{pmatrix}$$

Determine the vectors and distances between the electrinettes Γ, Φ, G and Ω:

$$\overrightarrow{\Gamma\Omega} = \begin{pmatrix} \frac{3}{2}r \cdot \sin(\omega t) \\ z_6\sqrt{3} + r \\ -\frac{\sqrt{3}}{2}r \cdot \sin(\omega t) \end{pmatrix}$$

$$D_{\Gamma\Omega}^2 = \left[\frac{3}{2}r \cdot \sin(\omega t)\right]^2 + \left[z_6\sqrt{3} + r\right]^2 + \left[\frac{\sqrt{3}}{2}r \cdot \sin(\omega t)\right]^2$$

$$\overrightarrow{\Gamma\Phi} = \begin{pmatrix} -r \cdot \cos(\omega t) \\ r \cdot \sin(\omega t) + z_6\sqrt{3} + r \\ -\sqrt{3}\, r \cdot \cos(\omega t) \end{pmatrix}$$

$$D_{\Gamma\Phi}^2 = [-r \cdot \cos(\omega t)]^2 + \left[r + r \cdot \sin(\omega t) + z_6\sqrt{3}\right]^2 + \left[-\sqrt{3}\, r \cdot \cos(\omega t)\right]^2$$

$$\overrightarrow{\Gamma G} = \begin{pmatrix} -\frac{r}{2} \cdot \cos(3\omega t) - \frac{z_3\sqrt{3}}{2} - \frac{r}{2} \cdot \cos(\omega t) + \frac{3}{4}r\sin(\omega t) - \frac{\sqrt{3}}{4}z_6 - \frac{\sqrt{3}}{2}\Delta_6 - \frac{3r}{4} \\ -r \cdot \sin(3\omega t) + \frac{r}{2} \cdot \sin(\omega t) + \frac{\sqrt{3}}{2}z_6 + \frac{r}{2} \\ -\frac{\sqrt{3}}{2}r \cdot \cos(3\omega t) + \frac{z_3}{2} - \frac{\sqrt{3}}{2}r \cdot \cos(\omega t) - \frac{\sqrt{3}}{4}r \cdot \sin(\omega t) + \frac{z_6}{4} + \frac{\sqrt{3}}{4}r + \frac{\Delta_6}{2} \end{pmatrix}$$

4.8.4.3 Determine the mass of each electrinette

The electrinettes will be numbered as follows:

1. Electrinette F : speed v_1, la masse 中 $_{F\#}$ global.
2. Electrinette A : speed v_1, la masse 中 $_{F\#}$ global.
3. Electrinette J : speed v_1, la mass 中 $_{F\#}$ global.
4. Electrinette I : speed v_1, la mass 中 $_{F\#}$ global.
5. Electrinette G : speed v_3, la mass 中 $_{H\#}$ global.
6. Electrinette H : speed v_3, la mass 中 $_{H\#}$ global.
7. Electrinette B : speed v_3, la mass 中 $_{B\#}$ global.
8. Electrinette C : speed v_3, la mass 中 $_{B\#}$ global.
9. Electrinette D : speed v_3, la mass 中 $_{B\#}$ global.
10. Electrinette E : speed v_3, la mass 中 $_{B\#}$ global.
11. Electrinette Θ : speed v_3, la mass 中 $_{B\#}$ global.
12. Electrinette Ψ : speed v_3, la mass 中 $_{B\#}$ global.
13. Electrinette Π : speed v_3, la mass 中 $_{B\#}$ global.
14. Electrinette Λ : speed v_3, la mass 中 $_{B\#}$ global.

15. Electrinette Γ : speed v_1, la mass 中 $_{Γ\#}$ global.
16. Electrinette Σ : speed v_1, la mass 中 $_{Γ\#}$ global.
17. Electrinette Ω : speed v_1, la mass 中 $_{Γ\#}$ global.
18. Electrinette Φ : speed v_1, la mass 中 $_{Γ\#}$ global.

The overall mass of the electrinette F is expressed by the following formula:

$$中_{F\#} = 中_F + \frac{1}{2c^2} \cdot (E_{eFI} + E_{eFG} + E_{eFC} + E_{eFE})$$

Where:

- 中 $_{F\#}$: represents the overall inert mass of the electrinette F.
- 中 $_F$: is the neutral charge of the electrinette F
- E_{eFp} : is the electric potential energy between the electrinette F and the electrinette p having a sign opposite to that of the electrinette F. In addition, the distance between the electrinettes F and p varies between 0 and d > 0. With p = I, G, C or E.

To calculate the potential energy E_{eFp}, we need to know the average of the distance between them. Neglecting the displacements of the charginettes relative to the equilateral triangle, the distances are written as:

$D_{FI} = r*f_{FI} = 0.36373 *10^{-15}*1.757 = 0.63907361*10^{-15}$ m

$D_{FG} = r*f_{FG} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

$$D_{FC}^2 = [-r \cdot \cos(3\omega t) + r \cdot \cos(\omega t)]^2 + \left[\frac{r}{2} \cdot \sin(3\omega t) + z_4 \frac{\sqrt{3}}{2} + \frac{r}{2} + r \cdot \sin(\omega t)\right]^2 + \left[-r\frac{\sqrt{3}}{2} \cdot \sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

Calculation conditions:

$\Delta = \Delta_6 = z_4 = z_6 = 0$

$z = z_0 = r/\sqrt{3}$

$$D_{FC} = \frac{r}{2}\sqrt{4[-\cos(3\omega t) + \cos(\omega t)]^2 + [\sin(3\omega t) + 1 + 2 \cdot \sin(\omega t)]^2 + 3[1 - \sin(3\omega t)]^2}$$

Plot the curve using Simulink (file: average_distance_of_FC.slx)

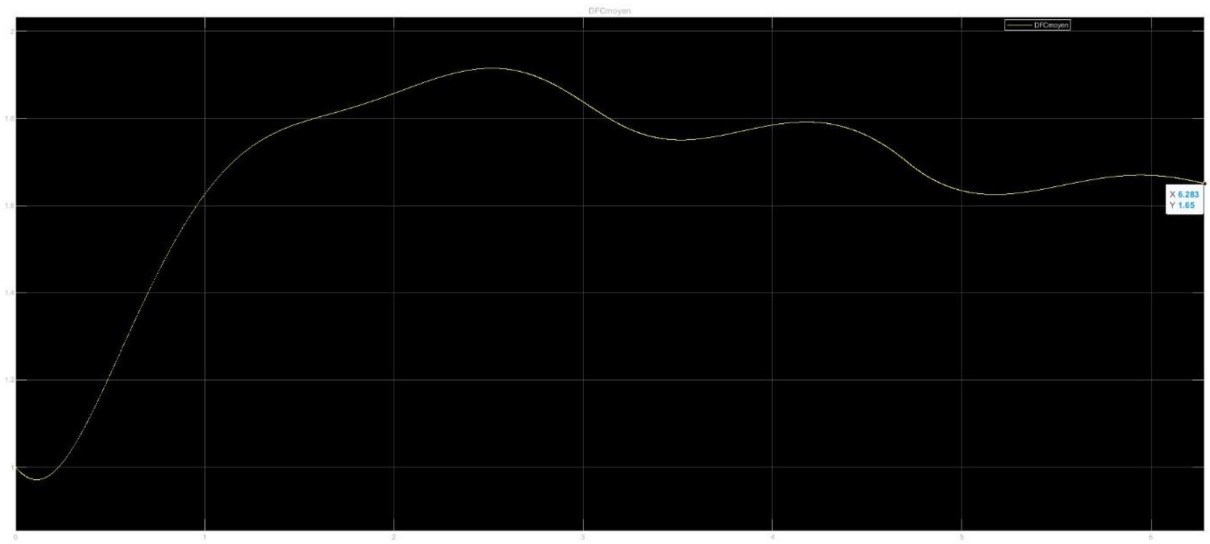


Figure 29 - Average of FC distance

$D_{FC} = r*f_{FC} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

$$D_{FE}^2 = [-r\cdot\cos(3\omega t) + r\cdot\cos(\omega t)]^2 + \left[-\frac{r}{2}\cdot\sin(3\omega t) + z_4\frac{\sqrt{3}}{2} + \frac{r}{2} - r\cdot\sin(\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t) + \frac{z_4}{2} + r\frac{\sqrt{3}}{2} + \Delta + z_0 - z\right]^2$$

$$D_{FE} = \frac{r}{2}\sqrt{4[-\cos(3\omega t) + \cos(\omega t)]^2 + [-\sin(3\omega t) + 1 - 2\cdot\sin(\omega t)]^2 + 3[1 + \sin(3\omega t)]^2}$$

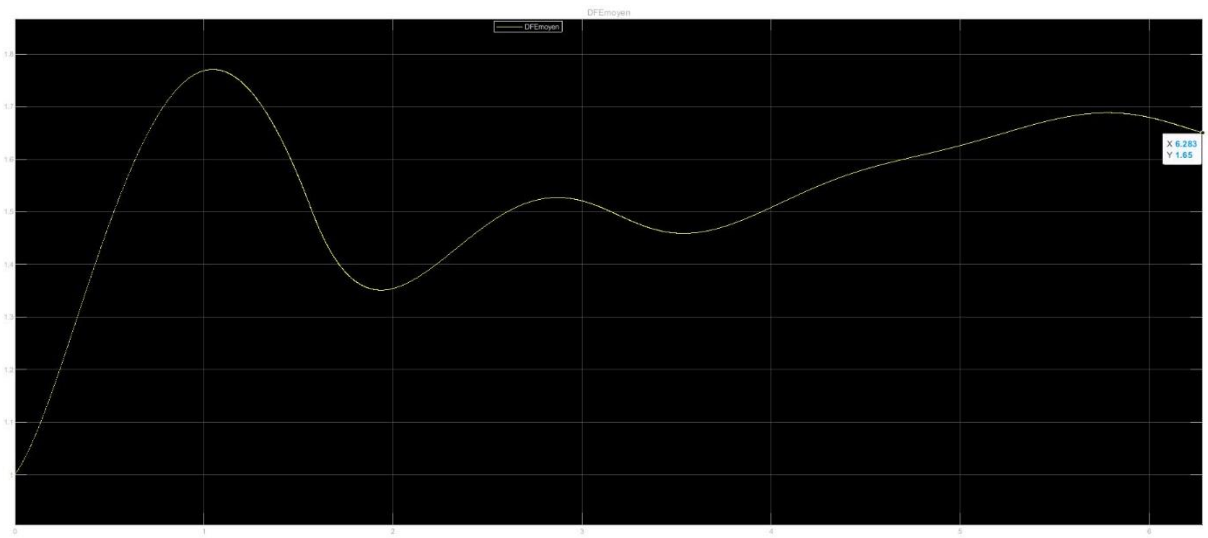


Figure 30 - Average of FE distance

$D_{FE} = r*f_{FE} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
(File: average_distance_of_FE.slx)

$D_{HA} = r*f_{HA} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

$D_{HI} = r*f_{HI} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

$$D_{H\Gamma}^2 = \left[\frac{r}{2}\cdot\cos(\omega t) - \frac{3}{4}r\cdot\sin(\omega t) + z_6\frac{\sqrt{3}}{4} + \Delta_6\frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2}\cdot\cos(3\omega t) + z_3\frac{\sqrt{3}}{2}\right]^2 + \left[-\frac{r}{2}\cdot\sin(\omega t) - z_6\frac{\sqrt{3}}{2} - \frac{r}{2} - r\cdot\sin(3\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2}\cdot\cos(\omega t) + r\frac{\sqrt{3}}{4}\cdot\sin(\omega t) - \frac{z_6}{4} - r\frac{\sqrt{3}}{4} - \frac{\Delta_6}{2} - r\frac{\sqrt{3}}{2}\cos(3\omega t) - \frac{z_3}{2}\right]^2$$

$$\frac{D_{H\Gamma}^2}{r^2} = \left[\frac{1}{2}\cdot\cos(\omega t) - \frac{3}{4}\cdot\sin(\omega t) + \frac{3}{4} - \frac{1}{2}\cdot\cos(3\omega t)\right]^2 + \left[\frac{1}{2}\cdot\sin(\omega t) + \frac{1}{2} + \sin(3\omega t)\right]^2 + \left[\frac{\sqrt{3}}{2}\cdot\cos(\omega t) + \frac{\sqrt{3}}{4}\cdot\sin(\omega t) - \frac{\sqrt{3}}{4} - \frac{\sqrt{3}}{2}\cos(3\omega t)\right]^2$$

$$\frac{4\cdot D_{H\Gamma}^2}{r^2} = \left[\frac{3}{2} + \cos(\omega t) - \frac{3}{2}\cdot\sin(\omega t) - \cos(3\omega t)\right]^2 + [\sin(\omega t) + 1 + 2\cdot\sin(3\omega t)]^2 + 3\left[\cos(\omega t) + \frac{1}{2}\cdot\sin(\omega t) - \frac{1}{2} - \cos(3\omega t)\right]^2$$

$$\frac{4^2 D_{H\Gamma}^2}{r^2} = [3 + 2\cos(\omega t) - 3\sin(\omega t) - 2\cos(3\omega t)]^2 + [2\sin(\omega t) + 2 + 4\sin(3\omega t)]^2 + 3[2\cdot\cos(\omega t) + \sin(\omega t) - 1 - 2\cdot\cos(3\omega t)]^2$$

Plot the curve using Simulink (file: average_distance_of_Hgamma.slx)

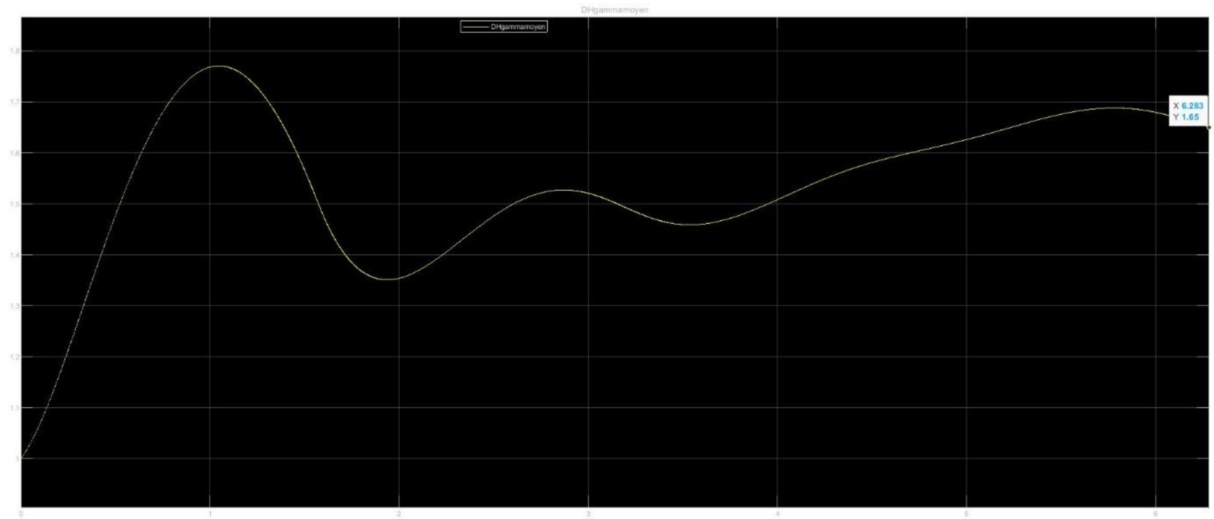


Figure 31 - Average of HΓ distance

$D_{H\Gamma} = r*f_{H\Gamma} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

$$D_{H\Omega}^2 = \left[\frac{r}{2}\cos(\omega t) + \frac{3}{4} r\sin(\omega t) + z_6\frac{\sqrt{3}}{4} + \Delta_6\frac{\sqrt{3}}{2} + \frac{3r}{4} - \frac{r}{2}\cos(3\omega t) + z_3\frac{\sqrt{3}}{2}\right]^2 + \left[-\frac{r}{2}\cdot\sin(\omega t) + z_6\frac{\sqrt{3}}{2} + \frac{r}{2} - r\cdot\sin(3\omega t)\right]^2 + \left[-r\frac{\sqrt{3}}{2}\cos(\omega t) + r\frac{\sqrt{3}}{4}\cdot\sin(\omega t) + \frac{z_6}{4} + r\frac{\sqrt{3}}{4} + \frac{\Delta_6}{2} + r\frac{\sqrt{3}}{2}\cos(3\omega t) + \frac{z_3}{2}\right]^2$$

$$D_{H\Omega}^2 = \left[\frac{r}{2}\cdot\cos(\omega t) + \frac{3}{4}r\cdot\sin(\omega t) + \frac{3r}{4} - \frac{r}{2}\cdot\cos(3\omega t)\right]^2 + \left[-\frac{r}{2}\cdot\sin(\omega t) + \frac{r}{2} - r\cdot\sin(3\omega t)\right]^2 + \left[-r\frac{\sqrt{3}}{2}\cdot\cos(\omega t) + r\frac{\sqrt{3}}{4}\cdot\sin(\omega t) + r\frac{\sqrt{3}}{4} + r\frac{\sqrt{3}}{2}\cos(3\omega t)\right]^2$$

$$\frac{4}{r^2}D_{H\Omega}^2 = \left[\cos(\omega t) + \frac{3}{2}\cdot\sin(\omega t) + \frac{3}{2} - \cos(3\omega t)\right]^2 + [-\sin(\omega t) + 1 - 2\cdot\sin(3\omega t)]^2 + 3\left[-\cos(\omega t) + \frac{1}{2}\cdot\sin(\omega t) + \frac{1}{2} + \cos(3\omega t)\right]^2$$

$$\frac{4^2}{r^2}D_{H\Omega}^2 = [3 + 2\cdot\cos(\omega t) + 3\cdot\sin(\omega t) - 2\cdot\cos(3\omega t)]^2 + [2 - 2\cdot\sin(\omega t) - 4\cdot\sin(3\omega t)]^2 + 3[\sin(\omega t) - 2\cdot\cos(\omega t) + 1 + 2\cdot\cos(3\omega t)]^2$$

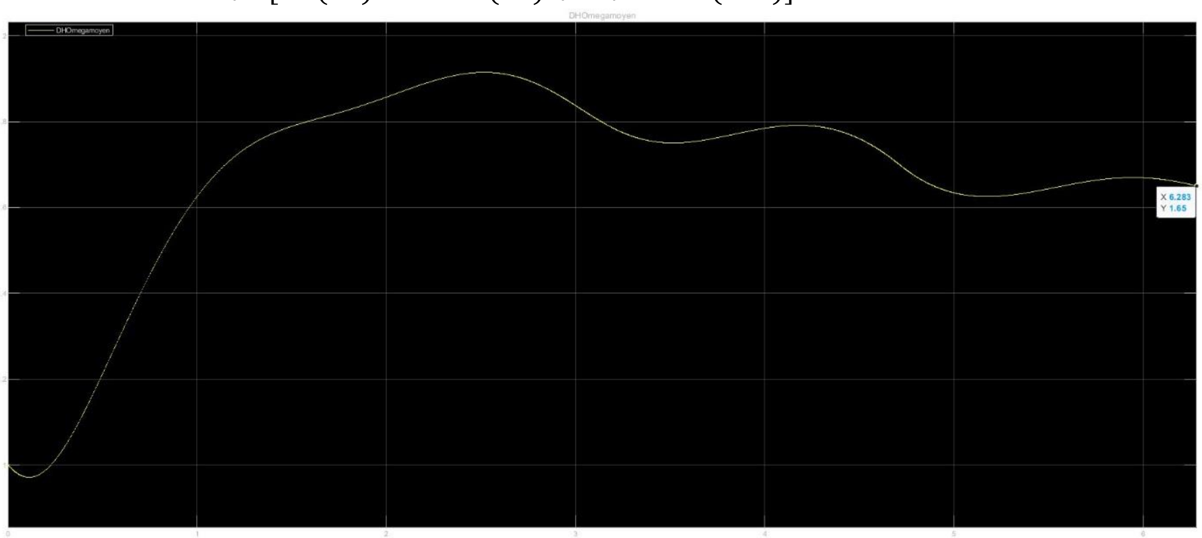


Figure 32 - Average of HΩ distance

$D_{H\Omega} = r*f_{H\Omega} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
(File: average_distance_of_HOmega.slx)

$$D_{BE}^2 = [2r\cdot\cos(3\omega t)]^2 + \left[-r\cdot\sin(3\omega t) + z_4\sqrt{3} + r\right]^2$$

$Z_4 = 0$

$$D_{BE} = r\cdot\sqrt{[2\cdot\cos(3\omega t)]^2 + [1 - \sin(3\omega t)]^2}$$

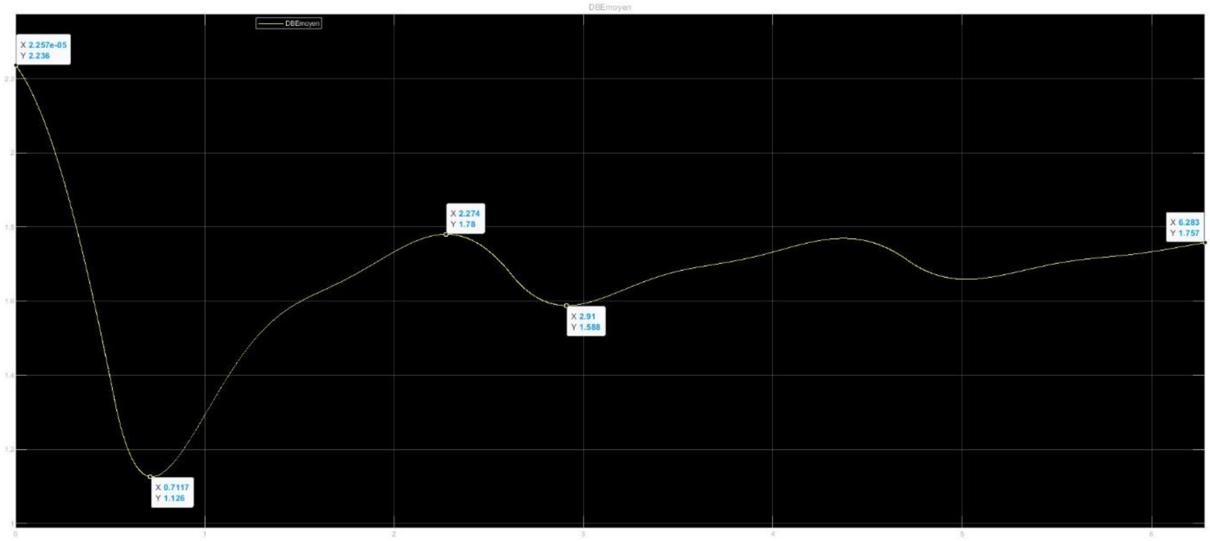


Figure 33 - Average of BE distance

$D_{BE} = r*f_{BE} = 0.36373*10^{-15}*1.757 = 0.63907361*10^{-15}$ m
(File: average_distance_of_BE.slx)

$$D_{BA}^2 = [r \cdot \cos(\omega t) - r \cdot \cos(3\omega t)]^2 + \left[\frac{r}{2} - r\sin(\omega t) - \frac{r}{2} \cdot \sin(3\omega t)\right]^2 + \left[r\frac{\sqrt{3}}{2} + r\frac{\sqrt{3}}{2} \cdot \sin(3\omega t)\right]^2$$

$$D_{BA}^2 \frac{4}{r^2} = 4[\cos(\omega t) - \cos(3\omega t)]^2 + [1 - 2\sin(\omega t) - \sin(3\omega t)]^2 + 3[1 + \sin(3\omega t)]^2$$

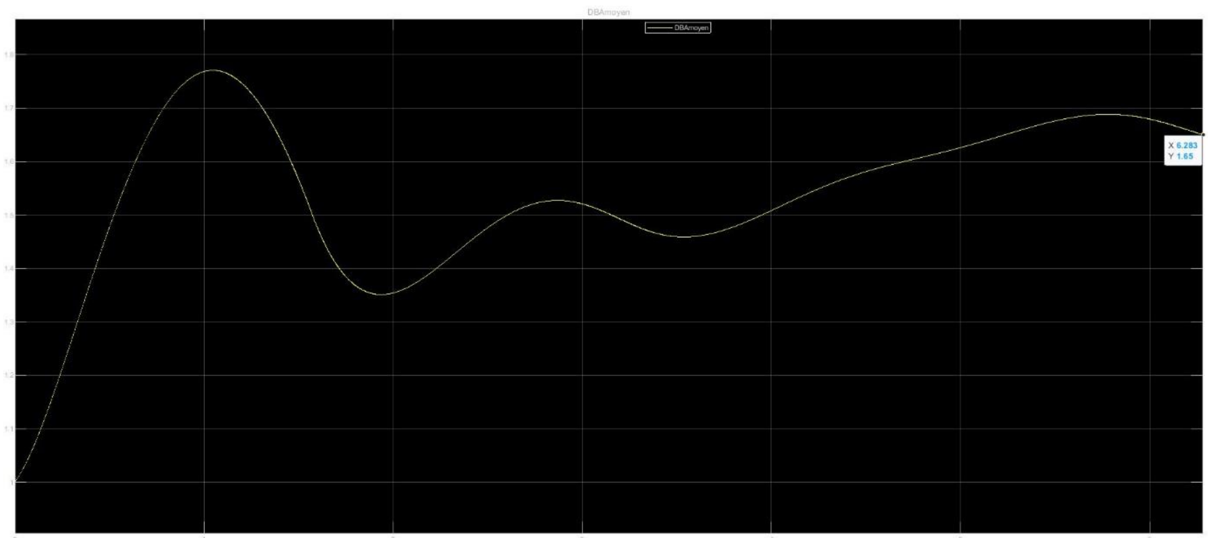


Figure 34 - Average of BA distance

$D_{BA} = r*f_{BA} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
(File: average_distance_of_BA.slx)

$$D_{\Sigma\Omega}^2 = [r \cdot \cos(\omega t)]^2 + \left[-r \cdot \sin(\omega t) + z_6\sqrt{3} + r\right]^2 + \left[r\sqrt{3} \cdot \cos(\omega t)\right]^2$$

$Z_6 = 0$

$$D_{\Sigma\Omega} = r \cdot \sqrt{[\cos(\omega t)]^2 + [1 - \sin(\omega t)]^2 + 3[\cos(\omega t)]^2}$$

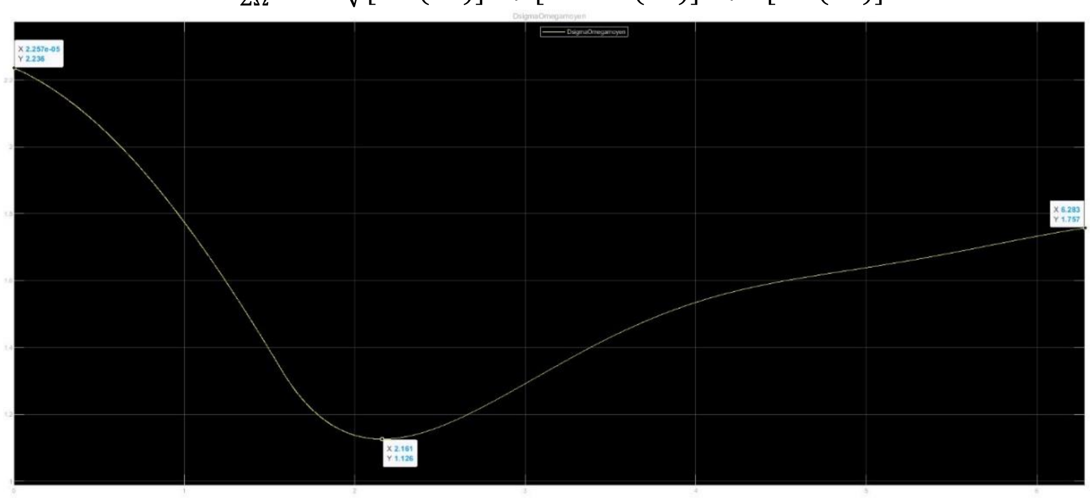


Figure 35 - Average of ΣΩ distance

$D_{\Sigma\Omega} = r*f_{\Sigma\Omega} = 0.36373*10^{-15}*1.757 = 0.63907361*10^{-15}$ m

(File: average_distance_of_SigmaOmega.slx)

$$D_{\Sigma G}^2 \frac{1}{r^2} = \left[\frac{1}{2} \cdot \cos(\omega t) - \frac{1}{2} \cdot \cos(3\omega t) - \frac{3}{4} \cdot \sin(\omega t) - \frac{3}{4}\right]^2 + \left[\frac{1}{2} - \frac{1}{2} \cdot \sin(\omega t) - \sin(3\omega t)\right]^2 + \left[\frac{\sqrt{3}}{4} + \frac{\sqrt{3}}{2} \cdot \cos(\omega t) + \frac{\sqrt{3}}{4} \cdot \sin(\omega t) - \frac{\sqrt{3}}{2} \cdot \cos(3\omega t)\right]^2$$

$Z_6 = Z_3 = \Delta_6 = 0$

$$D_{\Sigma G}^2 \frac{4^2}{r^2} = [2 \cdot \cos(\omega t) - 2 \cdot \cos(3\omega t) - 3 \cdot \sin(\omega t) - 3]^2 + [2 - 2 \cdot \sin(\omega t) - 4 \cdot \sin(3\omega t)]^2 + 3[1 + 2 \cdot \cos(\omega t) + \sin(\omega t) - 2 \cdot \cos(3\omega t)]^2$$

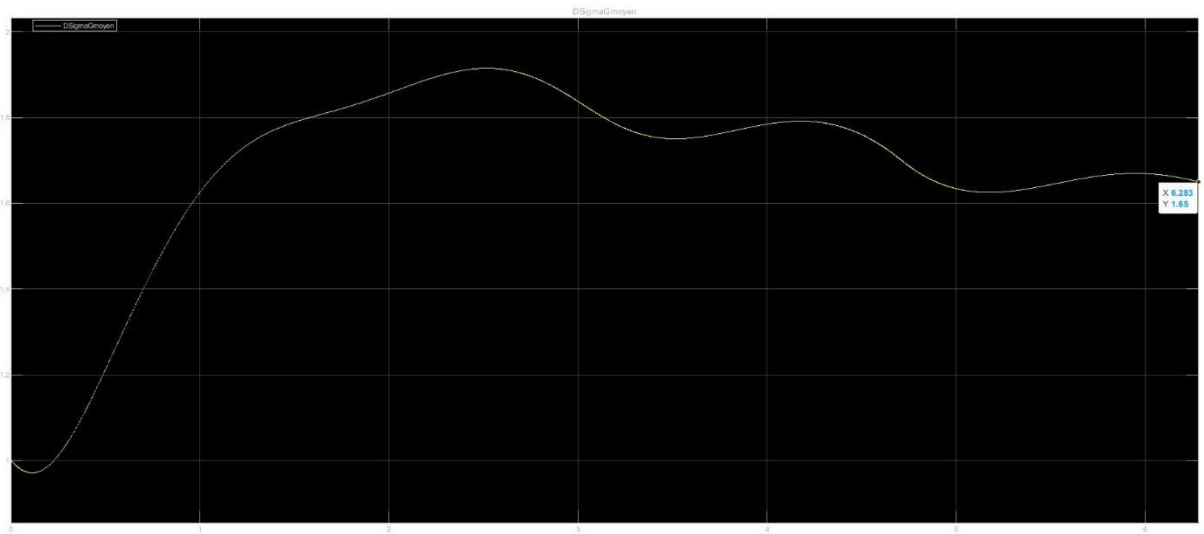


Figure 36 - Average of ΣG distance

$D_{\Sigma G} = r*f_{\Sigma G} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

(File: average_distance_of_SigmaG.slx)

The overall mass of the electrinette F becomes:

$$中_{F\#} = 中_{F} + \frac{k_e e^2}{2c^2 中_{ref}^{2}} \cdot \left(\frac{中_{F0}中_{I0}}{D_{FI}} + \frac{中_{F0}中_{G0}}{D_{FG}} + \frac{中_{F0}中_{C0}}{D_{FC}} + \frac{中_{F0}中_{E0}}{D_{FE}}\right)$$

With the orbital speed of the charginettes much lower than c, $中_{F}$ =$中_{F0}$. So we have:

$$中_{F\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^{2}} \cdot \left(\frac{中_{F0}}{D_{FI}} + \frac{中_{H0}}{D_{FG}} + \frac{中_{H0}}{D_{FC}} + \frac{中_{H0}}{D_{FE}}\right)$$

$$中_{F\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^{2} \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}}\right)$$

By symmetry, $中_{A\#}$ =$中_{I\#}$ =$中_{J\#}$ =$中_{F\#}$.

The overall mass of the H-electrinette is expressed by the following formula:

$$中_{H\#} = 中_{H} + \frac{1}{2c^2} \cdot (E_{eHA} + E_{eHI} + E_{eH\Gamma} + E_{eH\Omega})$$

Where:

- $中_{H\#}$: represents the overall inert mass of the electrinette H.
- $中_{H}$: is the neutral charge of the electrinette H
- E_{eHp} : is the electric potential energy between the H-electrinette and the p-electrinette. With p = A, I, Γ or Ω.

$$中_{H\#} = 中_{H} + \frac{k_e e^2}{2c^2 中_{ref}^{2}} \cdot \left(\frac{中_{H0}中_{A0}}{D_{HA}} + \frac{中_{H0}中_{I0}}{D_{HI}} + \frac{中_{H0}中_{\Gamma}}{D_{H\Gamma}} + \frac{中_{H0}中_{\Omega}}{D_{H\Omega}}\right)$$

$$中_{H\#} = 中_{H0} + \frac{k_e e^2 中_{H0}}{2c^2 中_{ref}^{2} \cdot r} \cdot \left(\frac{中_{F0}}{f_{HA}} + \frac{中_{F0}}{f_{HI}} + \frac{中_{F0}}{f_{H\Gamma}} + \frac{中_{F0}}{f_{H\Omega}}\right)$$

$$中_{H\#} = 中_{H0} + \frac{k_e e^2 中_{H0} \cdot 中_{F0}}{2c^2 中_{ref}^{2} \cdot r} \cdot \left(\frac{1}{f_{HA}} + \frac{1}{f_{HI}} + \frac{1}{f_{H\Gamma}} + \frac{1}{f_{H\Omega}}\right)$$

By symmetry, $中_{G\#}$ =$中_{H\#}$.

The overall mass of the electrinette B is expressed by the following formula:

$$中_{B\#} = 中_{B} + \frac{1}{2c^2} \cdot (E_{eBA} + E_{eBE})$$

Where:

- $中_{B\#}$: represents the overall inert mass of the electrinette B.
- $中_{B}$: is the neutral charge of the electrinette B

- E_{eBp} : is the electric potential energy between electrinette B and electrinette p having a sign opposite to that of electrinette B. In addition, the distance between electrinettes B and p varies between 0 and d > 0. With p = A or E.

$$中_{B\#} = 中_{B} + \frac{k_e e^2}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{B0}中_{F0}}{D_{BA}} + \frac{中_{B0}中_{E0}}{D_{BE}} \right)$$

$$中_{B\#} = 中_{H0} + \frac{k_e e^2 中_{H0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{BA}} + \frac{中_{H0}}{f_{BE}} \right)$$

By symmetry, $中_{C\#} = 中_{D\#} = 中_{E\#} = 中_{\Theta\#} = 中_{\Psi\#} = 中_{\Pi\#} = 中_{\Lambda\#} = 中_{B\#}$.

The overall mass of the electrinette Σ is expressed by the following formula:

$$中_{\Sigma\#} = 中_{\Sigma} + \frac{1}{2c^2} \cdot (E_{e\Sigma G} + E_{e\Sigma\Omega})$$

Where:

- $中_{\Sigma\#}$: represents the overall inert mass of the electrinette Σ.
- $中_{\Sigma}$: is the neutral charge of the electrinette Σ
- $E_{e\Sigma p}$: is the electric potential energy between the Σ electrinette and the p electrinette having a sign opposite to that of the Σ electrinette. In addition, the distance between the Σ and p electrinettes varies between 0 and d > 0. With p = G or Ω.

$$中_{\Sigma\#} = 中_{\Sigma} + \frac{k_e e^2}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{\Sigma 0}中_{G0}}{D_{\Sigma G}} + \frac{中_{\Sigma 0}中_{\Omega 0}}{D_{\Sigma\Omega}} \right)$$

$$中_{\Sigma\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}} \right)$$

By symmetry, $中_{\Gamma\#} = 中_{\Omega\#} = 中_{\Phi\#} = 中_{\Sigma\#}$.

The overall mass of the nucleonette is:

$$中_{nucl} = \sum_{p=1}^{18} 中_{p\#}$$

$$中_{nucl} = 4 \cdot 中_{F\#} + 2 \cdot 中_{H\#} + 8 \cdot 中_{B\#} + 4 \cdot 中_{\Sigma\#}$$

$$中_{nucl} = 4 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}}\right) + 2 \cdot 中_{H0} + \frac{k_e e^2 中_{H0} \cdot 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{1}{f_{HA}} + \frac{1}{f_{HI}} + \frac{1}{f_{H\Gamma}} + \frac{1}{f_{H\Omega}}\right) + 8 \cdot 中_{H0} + \frac{4k_e e^2 中_{H0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{BA}} + \frac{中_{H0}}{f_{BE}}\right) + 4 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right)$$

$$中_{nucl} = 8 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}} + \frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right) + 10 \cdot 中_{H0} + \frac{k_e e^2 中_{H0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{HA}} + \frac{中_{F0}}{f_{HI}} + \frac{中_{F0}}{f_{H\Gamma}} + \frac{中_{F0}}{f_{H\Omega}} + \frac{4\ 中_{F0}}{f_{BA}} + \frac{4\ 中_{H0}}{f_{BE}}\right)$$

The mass of the nucleonette is equal to the mass of the neutron – the mass of 2 positrons and 2 electrons:

$$中_{nucl} = 中_{n0} - 4\ 中_{e+} = 939.5654\ MeV - 4 \cdot 511\ KeV = 937.5214\ MeV$$

Because of:

$$r = \frac{k_e 中_{F0} e^2}{4 中_{ref}^2} \cdot \left(\frac{k_n}{v_1^2}\right)$$

$$r = \frac{k_e 中_{H0} e^2}{4 中_{ref}^2} \cdot \left[\frac{k_n}{(3v_1)^2}\right] = \frac{k_e 中_{H0} e^2}{4 中_{ref}^2 \cdot 9} \cdot \left[\frac{k_n}{(v_1)^2}\right]$$

By combining the two:

$$\frac{r}{中_{F0}} = \frac{9r}{中_{H0}}$$

$$中_{H0} = 9 \cdot 中_{F0}$$

The previous equality becomes:

$$中_{nucl} = 8 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{9中_{F0}}{f_{FG}} + \frac{9中_{F0}}{f_{FC}} + \frac{9中_{F0}}{f_{FE}} + \frac{9中_{F0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right) + 10 \cdot 9中_{F0} + \frac{9k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{HA}} + \frac{中_{F0}}{f_{HI}} + \frac{中_{F0}}{f_{H\Gamma}} + \frac{中_{F0}}{f_{H\Omega}} + \frac{4\ 中_{F0}}{f_{BA}} + \frac{4 \cdot 9\ 中_{F0}}{f_{BE}}\right)$$

$$中_{nucl} = 98中_{F0} + \frac{k_e e^2 中_{F0}^2}{c^2 中_{ref}^2 \cdot r} \cdot \left[\left(\frac{2}{f_{FI}} + \frac{18}{f_{FG}} + \frac{18}{f_{FC}} + \frac{18}{f_{FE}} + \frac{18}{f_{\Sigma G}} + \frac{2}{f_{\Sigma\Omega}}\right) + \left(\frac{9}{f_{HA}} + \frac{9}{f_{HI}} + \frac{9}{f_{H\Gamma}} + \frac{9}{f_{H\Omega}} + \frac{36}{f_{BA}} + \frac{324}{f_{BE}}\right)\right]$$

We have a second degree equation with respect to 中 F0.

$$a = \frac{k_e e^2}{c^2 中_{ref}^2 \cdot r}\left[\frac{2}{f_{FI}} + \frac{18}{f_{FG}} + \frac{18}{f_{FC}} + \frac{18}{f_{FE}} + \frac{18}{f_{\Sigma G}} + \frac{2}{f_{\Sigma\Omega}} + \frac{9}{f_{HA}} + \frac{9}{f_{HI}} + \frac{9}{f_{H\Gamma}} + \frac{9}{f_{H\Omega}} + \frac{36}{f_{BA}} + \frac{324}{f_{BE}}\right]$$

$$b = 98$$

$$c_s = -中_{nucl} = -中_{nucl} \cdot \frac{e}{c^2} = -\frac{937.521 \cdot 1.602177 \cdot 10^6 \cdot 10^{-19}}{2.997525^2 \cdot 10^{16}} = -1{,}67172969 \cdot 10^{-27} \cdot kg$$

$$[\Sigma_f] = \frac{2}{1.757} + \frac{18}{1.65} + \frac{18}{1.65} + \frac{18}{1.65} + \frac{18}{1.65} + \frac{2}{1.757} + \frac{9}{1.65} + \frac{9}{1.65} + \frac{9}{1.65} + \frac{9}{1.65} + \frac{36}{1.65} + \frac{324}{1.757}$$

$$[\Sigma_f] = \frac{2+2+324}{1.757} + \frac{18 \cdot 4 + 9 \cdot 4 + 36}{1.65}$$

$$[\Sigma_f] = \frac{328}{1.757} + \frac{144}{1.65}$$

$$[\Sigma_f] = 273.954571325$$

$$\frac{a_n}{a_d} = \frac{8.987552 \cdot 1.602177^2 \cdot 10^9 \cdot 10^{-38}}{2.997525^2 \cdot 9.109382^2 \cdot 0.36373 \cdot 10^{16} \cdot 10^{-62} \cdot 10^{-15}} = 8.5070664 \cdot 10^{30}$$

$$a = \frac{a_n}{a_d}[\Sigma_f] = 8{,}5070664 \cdot 10^{30} \cdot 273{,}954571325 = 2.330\,549\,728\,846 \cdot 10^{33}$$

$$中_{F0} = \frac{-b \pm \sqrt{b^2 - 4ac_s}}{2 \cdot a}$$

$$中_{F0} = \frac{-98 \pm \sqrt{98^2 + 4 \cdot 2.330549729 \cdot 10^{33} \cdot 1{,}671729687 \cdot 10^{-27}}}{2 \cdot 2.330549729 \cdot 10^{33}}$$

$$中_{F0} = \frac{-98 \pm 3948.898667}{4.6610994577 \cdot 10^{33}} = 8{,}2617818 \cdot 10^{-31} kg$$

$$中_{H0} = 9 \cdot 中_{F0} = 7{,}4356036198 \cdot 10^{-30} kg$$

$$v_1^2 = \frac{k_e 中_{F0} e^2}{4 中_{ref}^2} \cdot \left(\frac{k_n}{r}\right)$$

$$v_1^2 = \frac{k_e 中_{F0} e^2}{4 中_{ref}^2} \cdot \left(\frac{k_n}{r}\right) = \frac{8.987552 \cdot 8{,}2617818 \cdot 1.602177^2 \cdot 10^9 10^{-31} 10^{-38}}{4 \cdot 9.109382^2 \cdot 10^{-62}} \cdot \frac{10^{-11+15}}{0.36373}$$

$$v_1^2 = 1{,}578771143 \cdot 10^6$$

$$v_1 = 1{,}256491601 \cdot 10^3 m/s$$

$$v_3 = 3{,}769474803 \cdot 10^3 m/s$$

Determine the angular velocity:

$$\omega_1 = \frac{v_1}{r} = \frac{1{,}256491601 \cdot 10^3}{0.36373 \cdot 10^{-15}} = 3.454462379 \cdot 10^{-5} \cdot 10^{23}\, radian/s$$

$$\omega_{1x} = 3.454462379 \cdot 10^{-5}$$

$$T_1 = \frac{2\pi r}{v_1} = 1.81886054 \cdot 10^5 \cdot 10^{-23}\, s$$

$$中_{F\#} = 中_{F0} + \frac{a_n}{a_d} \cdot \frac{中_{F0}}{2} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}}\right)$$

$$中_{F\#} \cdot 10^{31} = 8{,}2617818 + 0,850707 \cdot \frac{8{,}2617818}{2} \cdot \left(\frac{8{,}2617818}{1.757} + \frac{74{,}356036198}{1.65} + \frac{74{,}356036198}{1.65} + \frac{74{,}356036198}{1.65}\right)$$

$$中_{F\#} \cdot 10^{31} = 499{,}877694321$$

$$中_{F\#} = 499{,}877694321 \cdot 10^{-31} kg$$

$$2\ 中_{F\#} = 999{,}755388642 \cdot 10^{-31} kg$$

$$中_{H\#} = 中_{H0} + \frac{a_n}{a_d} \cdot \frac{中_{H0} \cdot 中_{F0}}{2} \cdot \left(\frac{1}{f_{HA}} + \frac{1}{f_{HI}} + \frac{1}{f_{H\Gamma}} + \frac{1}{f_{H\Omega}}\right)$$

$$中_{H\#} \cdot 10^{31} = 74{,}356036198 + 0,850707 \cdot \frac{74{,}356036198 \cdot 8{,}2617818}{2} \cdot \left(\frac{1}{1.65} + \frac{1}{1.65} + \frac{1}{1.65} + \frac{1}{1.65}\right)$$

$$中_{H\#} = 707{,}811386658 \cdot 10^{-31} kg$$

$$中_{B\#} = 中_{H0} + \frac{a_n}{a_d} \cdot \frac{中_{H0}}{2} \cdot \left(\frac{中_{F0}}{f_{BA}} + \frac{中_{H0}}{f_{BE}}\right)$$

$$中_{B\#} \cdot 10^{31} = 74{,}356036198 + 0,850707 \cdot \frac{74{,}356036198}{2} \cdot \left(\frac{8{,}2617818}{1.65} + \frac{74{,}356036198}{1.757}\right)$$

$$中_{B\#} = 1571{,}169247473 \cdot 10^{-31} kg$$

$$2中_{B\#} = 3142{,}392494946 \cdot 10^{-31} kg$$

$$中_{\Sigma\#} = 中_{F0} + \frac{a_n}{a_d} \cdot \frac{中_{F0}}{2} \cdot \left(\frac{中_{H0}}{f_{\Sigma \mathrm{G}}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right)$$

$$中_{\Sigma\#} \cdot 10^{31} = 8{,}2617818 + 0,850707 \cdot \frac{8{,}2617818}{2} \cdot \left(\frac{74{,}356036198}{1.65} + \frac{8{,}2617818}{1.757}\right)$$

$$中_{\Sigma\#} = 183{,}150019091 \cdot 10^{-31} kg$$

$$2\ 中_{\Sigma\#} = 366.300038182 \cdot 10^{-31} kg$$

Verification:

$$中_{nucl} = 4中_{F\#} + 2中_{H\#} + 8中_{B\#} + 4中_{\Sigma\#}$$

$$中_{nucl} = 4 \cdot 499{,}878 + 2 \cdot 707{,}811 + 8 \cdot 1571{,}196 + 4 \cdot 183{,}150 = 16717.304 \cdot 10^{-31}\ kg$$

This value corresponds well to the mass of the proton – the mass of 3 electrinettes

= $1.675*10^{-27} - 4*9.110*10^{-31} = 16713.56*10^{-31}$ kg.

4.8.4.4 Determine the electrical interactions between the electrinettes

The electrical forces experienced by the first-rank F-electrinette are as follows:

- $\overrightarrow{力_{FI}} = \frac{k_{nFI} \cdot k_{eFI} \cdot e^2 \cdot \overrightarrow{D_{FI}}}{D_{FI}^3}$
- $\overrightarrow{力_{FJ}} = \frac{k_{nFJ} \cdot k_{eFJ} \cdot e^2 \cdot \overrightarrow{D_{FJ}}}{D_{FJ}^3}$
- $\overrightarrow{力_{FG}} = \frac{k_{nFG} \cdot k_{eFG} \cdot e^2 \cdot \overrightarrow{D_{FG}}}{D_{FG}^3}$
- $\overrightarrow{力_{FH}} = \frac{k_{nFH} \cdot k_{eFH} \cdot e^2 \cdot \overrightarrow{D_{FH}}}{D_{FH}^3}$
- $\overrightarrow{力_{FB}} = \frac{k_{nFB} \cdot k_{eFB} \cdot e^2 \cdot \overrightarrow{D_{FB}}}{D_{FB}^3}$
- $\overrightarrow{力_{FC}} = \frac{k_{nFC} \cdot k_{eFC} \cdot e^2 \cdot \overrightarrow{D_{FC}}}{D_{FC}^3}$
- $\overrightarrow{力_{FD}} = \frac{k_{nFD} \cdot k_{eFD} \cdot e^2 \cdot \overrightarrow{D_{FD}}}{D_{FD}^3}$
- $\overrightarrow{力_{FE}} = \frac{k_{nFE} \cdot k_{eFE} \cdot e^2 \cdot \overrightarrow{D_{FE}}}{D_{FE}^3}$

The electrical forces experienced by the second-rank F-electrinette are as follows:

- $\overrightarrow{力_{F\Sigma}} = \frac{k_{nF\Sigma} \cdot k_{eF\Sigma} \cdot e^2 \cdot \overrightarrow{D_{F\Sigma}}}{D_{F\Sigma}^3}$
- $\overrightarrow{力_{F\Gamma}} = \frac{k_{nF\Gamma} \cdot k_{eF\Gamma} \cdot e^2 \cdot \overrightarrow{D_{F\Gamma}}}{D_{F\Gamma}^3}$
- $\overrightarrow{力_{F\Phi}} = \frac{k_{nF\Phi} \cdot k_{eF\Phi} \cdot e^2 \cdot \overrightarrow{D_{F\Phi}}}{D_{F\Phi}^3}$
- $\overrightarrow{力_{F\Omega}} = \frac{k_{nF\Omega} \cdot k_{eF\Omega} \cdot e^2 \cdot \overrightarrow{D_{F\Omega}}}{D_{F\Omega}^3}$
- $\overrightarrow{力_{F\Theta}} = \frac{k_{nF\Theta} \cdot k_{eF\Theta} \cdot e^2 \cdot \overrightarrow{D_{F\Theta}}}{D_{F\Theta}^3}$
- $\overrightarrow{力_{F\Psi}} = \frac{k_{nF\Psi} \cdot k_{eF\Psi} \cdot e^2 \cdot \overrightarrow{D_{F\Psi}}}{D_{F\Psi}^3}$
- $\overrightarrow{力_{F\Pi}} = \frac{k_{nF\Pi} \cdot k_{eF\Pi} \cdot e^2 \cdot \overrightarrow{D_{F\Pi}}}{D_{F\Pi}^3}$
- $\overrightarrow{力_{F\Lambda}} = \frac{k_{nF\Lambda} \cdot k_{eF\Lambda} \cdot e^2 \cdot \overrightarrow{D_{F\Lambda}}}{D_{F\Lambda}^3}$

The second-rank forces are negligible because the electrinettes concerned are behind a charginette which acts as an electric screen.

Determine the coefficients:

$$k_{eF?} = k_e \frac{中_F}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{nF?} = 10^{-\frac{D_{F?}}{r} \cdot 100} + 10^{-21}$$

With: ? = I, J, G, H, B, C, D, E.

Knowing that:

$$中_{I} = 中_{J} = 中_{A} = 中_{F}$$

$$中_{G} = 中_{B} = 中_{C} = 中_{D} = 中_{E} = 中_{H}$$

So:????

$$k_{eFI} = k_{eFJ} = k_{eFF} = k_e \frac{中_{F}^{2}}{中_{ref}^{2}} = 8.987552 \cdot 10^9 \cdot \frac{8{,}2617818^2}{9.109382^2} = 7.39283526 \cdot 10^9$$

$$k_{eFG} = k_{eFH} = k_{eFB} = k_{eFC} = k_{eFD} = k_{eFE}$$

$$k_{eFH} = k_e \frac{中_{F}中_{H}}{中_{ref}^{2}} = 9 \cdot k_{eFF} = 66.535517341 \cdot 10^9$$

The electrical forces experienced by the first-rank A-electrinette are as follows:

- $\overrightarrow{力_{AI}} = \frac{k_{nAI} \cdot k_{eAI} \cdot e^2 \cdot \overrightarrow{D_{AI}}}{D_{AI}^3}$
- $\overrightarrow{力_{AJ}} = \frac{k_{nAJ} \cdot k_{eAJ} \cdot e^2 \cdot \overrightarrow{D_{AJ}}}{D_{AJ}^3}$
- $\overrightarrow{力_{AG}} = \frac{k_{nAG} \cdot k_{eAG} \cdot e^2 \cdot \overrightarrow{D_{AG}}}{D_{AG}^3}$
- $\overrightarrow{力_{AH}} = \frac{k_{nAH} \cdot k_{eAH} \cdot e^2 \cdot \overrightarrow{D_{AH}}}{D_{AH}^3}$
- $\overrightarrow{力_{AB}} = \frac{k_{nAB} \cdot k_{eAB} \cdot e^2 \cdot \overrightarrow{D_{AB}}}{D_{AB}^3}$
- $\overrightarrow{力_{AC}} = \frac{k_{nAC} \cdot k_{eAC} \cdot e^2 \cdot \overrightarrow{D_{AC}}}{D_{AC}^3}$
- $\overrightarrow{力_{AD}} = \frac{k_{nAD} \cdot k_{eAD} \cdot e^2 \cdot \overrightarrow{D_{AD}}}{D_{AD}^3}$
- $\overrightarrow{力_{AE}} = \frac{k_{nAE} \cdot k_{eAE} \cdot e^2 \cdot \overrightarrow{D_{AE}}}{D_{AE}^3}$

The electrical forces experienced by the second-rank A-electrinette are as follows:

- $\overrightarrow{力_{A\Sigma}} = \frac{k_{nA\Sigma} \cdot k_{eA\Sigma} \cdot e^2 \cdot \overrightarrow{D_{A\Sigma}}}{D_{A\Sigma}^3}$
- $\overrightarrow{力_{A\Gamma}} = \frac{k_{nA\Gamma} \cdot k_{eA\Gamma} \cdot e^2 \cdot \overrightarrow{D_{A\Gamma}}}{D_{A\Gamma}^3}$
- $\overrightarrow{力_{A\Phi}} = \frac{k_{nA\Phi} \cdot k_{eA\Phi} \cdot e^2 \cdot \overrightarrow{D_{A\Phi}}}{D_{A\Phi}^3}$
- $\overrightarrow{力_{A\Omega}} = \frac{k_{nA\Omega} \cdot k_{eA\Omega} \cdot e^2 \cdot \overrightarrow{D_{A\Omega}}}{D_{A\Omega}^3}$
- $\overrightarrow{力_{A\Theta}} = \frac{k_{nA\Theta} \cdot k_{eA\Theta} \cdot e^2 \cdot \overrightarrow{D_{A\Theta}}}{D_{A\Theta}^3}$
- $\overrightarrow{力_{A\Psi}} = \frac{k_{nA\Psi} \cdot k_{eA\Psi} \cdot e^2 \cdot \overrightarrow{D_{A\Psi}}}{D_{A\Psi}^3}$

- $\overrightarrow{力}_{A\Pi} = \frac{k_{nA\Pi} \cdot k_{eA\Pi} \cdot e^2 \cdot \overrightarrow{D_{A\Pi}}}{D_{A\Pi}^3}$
- $\overrightarrow{力}_{A\Lambda} = \frac{k_{nA\Lambda} \cdot k_{eA\Lambda} \cdot e^2 \cdot \overrightarrow{D_{A\Lambda}}}{D_{A\Lambda}^3}$

Second-rank forces are negligible for the same reasons as before.

Determine the coefficients:

$$k_{eA?} = k_e \frac{中_A}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{nA?} = 10^{-\frac{D_{A?}}{r} \cdot 100} + 10^{-21}$$

With: ? = I, J, G, H, B, C, D, E.

Knowing that:

$$中_I = 中_J = 中_A = 中_F$$

$$中_G = 中_B = 中_C = 中_D = 中_E = 中_H$$

So:

$$k_{eAI} = k_{eAJ} = k_{eFF} = k_e \frac{中_F^2}{中_{ref}^2} = 7.386512554 \cdot 10^9$$

$$k_{eAG} = k_{eAH} = k_{eAB} = k_{eAC} = k_{eAD} = k_{eAE} = k_{eFH} = 66.535517341 \cdot 10^9$$

The electrical forces experienced by the first-rank H-electrinette are as follows:

- $\overrightarrow{力}_{HI} = \frac{k_{nHI} \cdot k_{eHI} \cdot e^2 \cdot \overrightarrow{D_{HI}}}{D_{HI}^3}$
- $\overrightarrow{力}_{HJ} = \frac{k_{nHJ} \cdot k_{eHJ} \cdot e^2 \cdot \overrightarrow{D_{HJ}}}{D_{HJ}^3}$
- $\overrightarrow{力}_{HA} = \frac{k_{nHA} \cdot k_{eHA} \cdot e^2 \cdot \overrightarrow{D_{HA}}}{D_{HA}^3}$
- $\overrightarrow{力}_{HF} = \frac{k_{nHF} \cdot k_{eHF} \cdot e^2 \cdot \overrightarrow{D_{HF}}}{D_{HF}^3}$
- $\overrightarrow{力}_{H\Gamma} = \frac{k_{nH\Gamma} \cdot k_{eH\Gamma} \cdot e^2 \cdot \overrightarrow{D_{H\Gamma}}}{D_{H\Gamma}^3}$
- $\overrightarrow{力}_{H\Sigma} = \frac{k_{nH\Sigma} \cdot k_{eH\Sigma} \cdot e^2 \cdot \overrightarrow{D_{H\Sigma}}}{D_{H\Sigma}^3}$
- $\overrightarrow{力}_{H\Omega} = \frac{k_{nH\Omega} \cdot k_{eH\Omega} \cdot e^2 \cdot \overrightarrow{D_{H\Omega}}}{D_{H\Omega}^3}$
- $\overrightarrow{力}_{H\Phi} = \frac{k_{nH\Phi} \cdot k_{eH\Phi} \cdot e^2 \cdot \overrightarrow{D_{H\Phi}}}{D_{H\Phi}^3}$

The electrical forces experienced by the second-rank H-electrinette are as follows:

- $\overrightarrow{力}_{HB} = \frac{k_{nHB} \cdot k_{eHB} \cdot e^2 \cdot \overrightarrow{D_{HB}}}{D_{HB}^3}$

- $\overrightarrow{力}_{HC} = \frac{k_{nHC} \cdot k_{eHC} \cdot e^2 \cdot \overrightarrow{D_{HC}}}{D_{HC}^3}$
- $\overrightarrow{力}_{HD} = \frac{k_{nHD} \cdot k_{eHD} \cdot e^2 \cdot \overrightarrow{D_{HD}}}{D_{HD}^3}$
- $\overrightarrow{力}_{HE} = \frac{k_{nHE} \cdot k_{eHE} \cdot e^2 \cdot \overrightarrow{D_{HE}}}{D_{HE}^3}$
- $\overrightarrow{力}_{H\Lambda} = \frac{k_{nH\Lambda} \cdot k_{eH\Lambda} \cdot e^2 \cdot \overrightarrow{D_{H\Lambda}}}{D_{H\Lambda}^3}$
- $\overrightarrow{力}_{H\Pi} = \frac{k_{nH\Pi} \cdot k_{eH\Pi} \cdot e^2 \cdot \overrightarrow{D_{H\Pi}}}{D_{H\Pi}^3}$
- $\overrightarrow{力}_{H\Psi} = \frac{k_{nH\Psi} \cdot k_{eH\Psi} \cdot e^2 \cdot \overrightarrow{D_{H\Psi}}}{D_{H\Psi}^3}$
- $\overrightarrow{力}_{H\Theta} = \frac{k_{nH\Theta} \cdot k_{eH\Theta} \cdot e^2 \cdot \overrightarrow{D_{H\Theta}}}{D_{H\Theta}^3}$

Second-rank forces are negligible for the same reasons as before.

Determine the coefficients:

$$k_{eH?} = k_e \frac{中_H}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{nH?} = 10^{-\frac{D_{H?}}{r} \cdot 100} + 10^{-21}$$

With: ? = I, J, A, F, Γ, Σ, Ω, Φ.

Knowing that:

$$中_I = 中_J = 中_A = 中_\Gamma = 中_\Sigma = 中_\Omega = 中_\Phi = 中_F$$

So:

$$k_{eHI} = k_{eHJ} = k_{eHA} = k_{eH\Gamma} = k_{eH\Sigma} = k_{eH\Omega} = k_{eH\Phi} = k_{eHF} = k_{eFH}$$

The electrical forces experienced by the first-rank B-electrinette are as follows:

- $\overrightarrow{力}_{BF} = \frac{k_{nBF} \cdot k_{eBF} \cdot e^2 \cdot \overrightarrow{D_{BF}}}{D_{BF}^3}$
- $\overrightarrow{力}_{BA} = \frac{k_{nBA} \cdot k_{eBA} \cdot e^2 \cdot \overrightarrow{D_{BA}}}{D_{BA}^3}$
- $\overrightarrow{力}_{BD} = \frac{k_{nBD} \cdot k_{eBD} \cdot e^2 \cdot \overrightarrow{D_{BD}}}{D_{BD}^3}$
- $\overrightarrow{力}_{BE} = \frac{k_{nBE} \cdot k_{eBE} \cdot e^2 \cdot \overrightarrow{D_{BE}}}{D_{BE}^3}$

The electrical forces experienced by the second-rank B-electrinette are as follows:

- $\overrightarrow{力}_{BI} = \frac{k_{nBI} \cdot k_{eBI} \cdot e^2 \cdot \overrightarrow{D_{BI}}}{D_{BI}^3}$
- $\overrightarrow{力}_{BJ} = \frac{k_{nBJ} \cdot k_{eBJ} \cdot e^2 \cdot \overrightarrow{D_{BJ}}}{D_{BJ}^3}$
- $\overrightarrow{力}_{BG} = \frac{k_{nBG} \cdot k_{eBG} \cdot e^2 \cdot \overrightarrow{D_{BG}}}{D_{BG}^3}$

- $\overrightarrow{力}_{BH} = \frac{k_{nBH} \cdot k_{eBH} \cdot e^2 \cdot \overrightarrow{D_{BH}}}{D_{BH}^3}$

Second-rank forces as well as third-rank forces are negligible for the same reasons as before.

Determine the coefficients:

$$k_{eB?} = k_e \frac{中_B}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{nB?} = 10^{-\frac{D_{B?}}{r} \cdot 100} + 10^{-21}$$

With: ? = F, A, D, E.

Knowing that:

$$中_A = 中_F$$

$$中_B = 中_D = 中_E = 中_H$$

So:

$$k_{eBA} = k_{eBF} = k_{eFH}$$

$$k_{eBD} = k_{eBE} = k_{eHH} = k_e \frac{中_H^2}{中_{ref}^2} = 9 \cdot k_{eFH} = 598{,}819656066 \cdot 10^9$$

The electrical forces experienced by the first-rank C-electrinette are as follows:

- $\overrightarrow{力}_{CF} = \frac{k_{nCF} \cdot k_{eCF} \cdot e^2 \cdot \overrightarrow{D_{CF}}}{D_{CF}^3}$
- $\overrightarrow{力}_{CA} = \frac{k_{nCA} \cdot k_{eCA} \cdot e^2 \cdot \overrightarrow{D_{CA}}}{D_{CA}^3}$
- $\overrightarrow{力}_{CD} = \frac{k_{nCD} \cdot k_{eCD} \cdot e^2 \cdot \overrightarrow{D_{CD}}}{D_{CD}^3}$
- $\overrightarrow{力}_{CE} = \frac{k_{nCE} \cdot k_{eCE} \cdot e^2 \cdot \overrightarrow{D_{CE}}}{D_{CE}^3}$

The electrical forces experienced by the second-rank C-electrinette are as follows:

- $\overrightarrow{力}_{CI} = \frac{k_{nCI} \cdot k_{eCI} \cdot e^2 \cdot \overrightarrow{D_{CI}}}{D_{CI}^3}$
- $\overrightarrow{力}_{CJ} = \frac{k_{nCJ} \cdot k_{eCJ} \cdot e^2 \cdot \overrightarrow{D_{CJ}}}{D_{CJ}^3}$
- $\overrightarrow{力}_{CG} = \frac{k_{nCG} \cdot k_{eCG} \cdot e^2 \cdot \overrightarrow{D_{CG}}}{D_{CG}^3}$
- $\overrightarrow{力}_{CH} = \frac{k_{nCH} \cdot k_{eCH} \cdot e^2 \cdot \overrightarrow{D_{CH}}}{D_{CH}^3}$

Second-rank forces as well as third-rank forces are negligible for the same reasons as before.

Determine the coefficients:

$$k_{eC?} = k_e \frac{中_C}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{nC?} = 10^{-\frac{D_{C?}}{r} \cdot 100} + 10^{-21}$$

With: ? = F, A, D, E.

Knowing that:

$$中_A = 中_F$$

$$中_C = 中_D = 中_E = 中_H$$

So:

$$k_{eCA} = k_{eCF} = k_{eFH}$$

$$k_{eCD} = k_{eCE} = k_{eHH}$$

The electric forces experienced by the first-rank Σ-electrinette are as follows:

- $\overrightarrow{力_{\Sigma G}} = \frac{k_{n\Sigma G} \cdot k_{e\Sigma G} \cdot e^2 \cdot \overrightarrow{D_{\Sigma G}}}{D_{\Sigma G}^3}$
- $\overrightarrow{力_{\Sigma H}} = \frac{k_{n\Sigma H} \cdot k_{e\Sigma H} \cdot e^2 \cdot \overrightarrow{D_{\Sigma H}}}{D_{\Sigma H}^3}$
- $\overrightarrow{力_{\Sigma \Phi}} = \frac{k_{n\Sigma \Phi} \cdot k_{e\Sigma \Phi} \cdot e^2 \cdot \overrightarrow{D_{\Sigma \Phi}}}{D_{\Sigma \Phi}^3}$
- $\overrightarrow{力_{\Sigma \Omega}} = \frac{k_{n\Sigma \Omega} \cdot k_{e\Sigma \Omega} \cdot e^2 \cdot \overrightarrow{D_{\Sigma \Omega}}}{D_{\Sigma \Omega}^3}$

The electric forces experienced by the second-rank Σ-electrinette are as follows:

- $\overrightarrow{力_{\Sigma F}} = \frac{k_{n\Sigma F} \cdot k_{e\Sigma F} \cdot e^2 \cdot \overrightarrow{D_{\Sigma F}}}{D_{\Sigma F}^3}$
- $\overrightarrow{力_{\Sigma A}} = \frac{k_{n\Sigma A} \cdot k_{e\Sigma A} \cdot e^2 \cdot \overrightarrow{D_{\Sigma A}}}{D_{\Sigma A}^3}$
- $\overrightarrow{力_{\Sigma I}} = \frac{k_{n\Sigma I} \cdot k_{e\Sigma I} \cdot e^2 \cdot \overrightarrow{D_{\Sigma I}}}{D_{\Sigma I}^3}$
- $\overrightarrow{力_{\Sigma J}} = \frac{k_{n\Sigma J} \cdot k_{e\Sigma J} \cdot e^2 \cdot \overrightarrow{D_{\Sigma J}}}{D_{\Sigma J}^3}$

Second-rank forces as well as third-rank forces are negligible for the same reasons as before.

Determine the coefficients:

$$k_{e\Sigma?} = k_e \frac{中_\Sigma}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{n\Sigma?} = 10^{-\frac{D_{\Sigma?}}{r} \cdot 100} + 10^{-21}$$

With: ? = G, H, Φ, Ω.

Knowing that:

$$中_G = 中_H$$

$$中_\Phi = 中_\Omega = 中_\Sigma = 中_F$$

So:

$$k_{e\Sigma G} = k_{e\Sigma H} = k_{eFH}$$

$$k_{e\Sigma\Omega} = k_{e\Sigma\Phi} = k_{eFF}$$

The electric forces experienced by the first-rank Γ-electrinette are as follows:

- $\overrightarrow{力_{\Gamma G}} = \frac{k_{n\Gamma G} \cdot k_{e\Gamma G} \cdot e^2 \cdot \overrightarrow{D_{\Gamma G}}}{D_{\Gamma G}^3}$
- $\overrightarrow{力_{\Gamma H}} = \frac{k_{n\Gamma H} \cdot k_{e\Gamma H} \cdot e^2 \cdot \overrightarrow{D_{\Gamma H}}}{D_{\Gamma H}^3}$
- $\overrightarrow{力_{\Gamma\Phi}} = \frac{k_{n\Gamma\Phi} \cdot k_{e\Gamma\Phi} \cdot e^2 \cdot \overrightarrow{D_{\Gamma\Phi}}}{D_{\Gamma\Phi}^3}$
- $\overrightarrow{力_{\Gamma\Omega}} = \frac{k_{n\Gamma\Omega} \cdot k_{e\Gamma\Omega} \cdot e^2 \cdot \overrightarrow{D_{\Gamma\Omega}}}{D_{\Gamma\Omega}^3}$

The electrical forces experienced by the second-rank Γ-electrinette are as follows:

- $\overrightarrow{力_{\Gamma F}} = \frac{k_{n\Gamma F} \cdot k_{e\Gamma F} \cdot e^2 \cdot \overrightarrow{D_{\Gamma F}}}{D_{\Gamma F}^3}$
- $\overrightarrow{力_{\Gamma A}} = \frac{k_{n\Gamma A} \cdot k_{e\Gamma A} \cdot e^2 \cdot \overrightarrow{D_{\Gamma A}}}{D_{\Gamma A}^3}$
- $\overrightarrow{力_{\Gamma I}} = \frac{k_{n\Gamma I} \cdot k_{e\Gamma I} \cdot e^2 \cdot \overrightarrow{D_{\Gamma I}}}{D_{\Gamma I}^3}$
- $\overrightarrow{力_{\Gamma J}} = \frac{k_{n\Gamma J} \cdot k_{e\Gamma J} \cdot e^2 \cdot \overrightarrow{D_{\Gamma J}}}{D_{\Gamma J}^3}$

Second-rank forces as well as third-rank forces are negligible for the same reasons as before.

Determine the coefficients:

$$k_{e\Gamma ?} = k_e \frac{中_\Gamma}{中_{ref}} \cdot \frac{中_?}{中_{ref}}$$

$$k_{n\Gamma ?} = 10^{-\frac{D_{\Gamma ?}}{r} \cdot 100} + 10^{-21}$$

With: ? = G, H, Φ, Ω.

Knowing that:

$$中_G = 中_H$$

$$中_\Phi = 中_\Omega = 中_\Gamma = 中_F$$

So:

$$k_{e\Gamma G} = k_{e\Gamma H} = k_{eFH}$$

$$k_{e\Gamma\Omega} = k_{e\Gamma\Phi} = k_{eFF}$$

4.8.4.5 Establish the dynamic equations governing each electrinette

Within the nucleonette, each charginette is assumed to move along its axis of symmetry. These are the following axis:

1. Axis O_1Z_1 for charginette AF,
2. Axis O_2Z_2 for charginette IJ,
3. Axis O_3Z_3 for charginette GH.
4. Axis O_4Z_4 for charginette BC
5. Axis O_5Z_5 for charginette DE
6. Axis O_6Z_6 for charginette ΓΣ
7. Axis O_7Z_7 for charginette ΦΩ
8. Axis O_8Z_8 for charginette ΛΠ
9. Axis O_9Z_9 for charginette ΘΨ

By symmetry, the equations governing the electrinettes are grouped as follows:

1. Equation 1 : The electrinettes A, F, I and J obey the first equation with mass $中_{FA\#}$
2. Equation 2 : the electrinettes G and H obey the second equation with the mass $中_{H\#}$.
3. Equation 3 : the electrinettes B, C, D, E, Λ, Π, Θ and Ψ obey the third equation with mass $中_{B\#}$.
4. Equation 4 : the electrinettes Γ, Σ, Φ and Ω obey the fourth equation with the mass $中_{\Sigma\#}$.

Project the dynamic equation of the electrinettes F and A onto the O_1Z_1 axis:

$$m_{FA} \cdot \ddot{z}_1 = 力_{ez_1}$$

Equation 25 - Nucleonette differential equation 1

Where:

- m_{FA} : is the overall mass of the electrinette F + the overall mass of the electrinette A. For a linear speed much lower than c, $m_F = 中_{F\#}$ and $m_A = 中_{F\#}$.
- $力_{ez1}$: is the electric force experienced by the electrinette F + the electric force experienced by the electrinette A on the axis O_1Z_1.

The force $\overrightarrow{力_F}$ experienced by the F-electrinette is as follows:

$$\overrightarrow{力_F} = \frac{k_{nFI}k_{eFI}e^2\overrightarrow{D_{FI}}}{D_{FI}^3 + \beta^3} - \frac{k_{nFJ}k_{eFJ}e^2\overrightarrow{D_{FJ}}}{D_{FJ}^3 + \beta^3} + \frac{k_{nFG}k_{eFG}e^2\overrightarrow{D_{FG}}}{D_{FG}^3 + \beta^3} - \frac{k_{nFH}k_{eFH}e^2\overrightarrow{D_{FH}}}{D_{FH}^3 + \beta^3} - \frac{k_{nFB}k_{eFB}e^2\overrightarrow{D_{FB}}}{D_{FB}^3 + \beta^3} + \frac{k_{nFC}k_{eFC}e^2\overrightarrow{D_{FC}}}{D_{FC}^3 + \beta^3} - \frac{k_{nFD}k_{eFD}e^2\overrightarrow{D_{FD}}}{D_{FD}^3 + \beta^3} + \frac{k_{nFE}k_{eFE}e^2\overrightarrow{D_{FE}}}{D_{FE}^3 + \beta^3}$$

The force $\overrightarrow{力_A}$ experienced by the A-electrinette is as follows:

$$\overrightarrow{力_A} = -\frac{k_{nAI}k_{eAI}e^2\overrightarrow{D_{AI}}}{D_{AI}^3 + \beta^3} + \frac{k_{nAJ}k_{eAJ}e^2\overrightarrow{D_{AJ}}}{D_{AJ}^3 + \beta^3} - \frac{k_{nAG}k_{eAG}e^2\overrightarrow{D_{AG}}}{D_{AG}^3 + \beta^3} + \frac{k_{nAH}k_{eAH}e^2\overrightarrow{D_{AH}}}{D_{AH}^3 + \beta^3} + \frac{k_{nAB}k_{eAB}e^2\overrightarrow{D_{AB}}}{D_{AB}^3 + \beta^3} - \frac{k_{nAC}k_{eAC}e^2\overrightarrow{D_{AC}}}{D_{AC}^3 + \beta^3} + \frac{k_{nAD}k_{eAD}e^2\overrightarrow{D_{AD}}}{D_{AD}^3 + \beta^3} - \frac{k_{nAE}k_{eAE}e^2\overrightarrow{D_{AE}}}{D_{AE}^3 + \beta^3}$$

The force $\overrightarrow{力_{FA}}$ experienced by the charginette FA is as follows:

$$\overrightarrow{力_{FA}} = \overrightarrow{力_{F}} + \overrightarrow{力_{A}}$$

By projecting onto the O_1Z_1 axis which has the vector:

$$\frac{\overrightarrow{O_1O}}{\|\overrightarrow{O_1O}\|} = \begin{pmatrix} 0 \\ 0 \\ -1 \end{pmatrix}$$

Knowing that the OZ axis is collinear with the O_1Z_1 axis, we project onto the OZ axis:

$$\begin{aligned}
力_{FAz} = & \frac{k_{nFI}k_{eFI}e^2\left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2}\right]}{D_{FI}^3 + \beta^3} + \frac{k_{nFJ}k_{eFJ}\left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{3z}{2}\right]}{D_{FJ}^3 + \beta^3} \\
& - \frac{k_{nFG}k_{eFG}e^2\left[\frac{r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z\right]}{D_{FG}^3 + \beta^3} - \frac{k_{nFH}k_{eFH}e^2\left[\frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]}{D_{FH}^3 + \beta^3} \\
& - \frac{k_{nFB}k_{eFB}e^2\left[\frac{r\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + \frac{\sqrt{3}}{2}r + \Delta + z_0 - z\right]}{D_{FB}^3 + \beta^3} \\
& - \frac{k_{nFC}k_{eFC}e^2\left[z + \frac{r\sqrt{3}}{2}\sin(3\omega t) - \frac{z_4}{2} - \frac{\sqrt{3}}{2}r - \Delta - z_0\right]}{D_{FC}^3 + \beta^3} \\
& + \frac{k_{nFD}k_{eFD}e^2\left[z + \frac{r\sqrt{3}}{2}\sin(3\omega t) - \frac{z_4}{2} - \frac{\sqrt{3}}{2}r - \Delta - z_0\right]}{D_{FD}^3 + \beta^3} \\
& + \frac{k_{nFE}k_{eFE}e^2\left[\frac{r\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + \frac{\sqrt{3}}{2}r + \Delta + z_0 - z\right]}{D_{FE}^3 + \beta^3} - \frac{k_{nAI}k_{eAI}e^2\left[\frac{r\sqrt{3}}{2}\cos(\omega t) - \frac{3z}{2}\right]}{D_{AI}^3 + \beta^3} \\
& - \frac{k_{nAJ}k_{eAJ}e^2\left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{3z}{2}\right]}{D_{AJ}^3 + \beta^3} + \frac{k_{nAG}k_{eAG}e^2\left[\frac{r\sqrt{3}}{2}\cos(3\omega t) + \frac{z_0}{2} - \frac{z_3}{2} + z\right]}{D_{AG}^3 + \beta^3} \\
& + \frac{k_{nAH}k_{eAH}e^2\left[\frac{r\sqrt{3}}{2}\cos(3\omega t) - \frac{z_0}{2} + \frac{z_3}{2} - z\right]}{D_{AH}^3 + \beta^3} \\
& + \frac{k_{nAB}k_{eAB}e^2\left[\frac{r\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + \frac{\sqrt{3}}{2}r + \Delta + z_0 - z\right]}{D_{AB}^3 + \beta^3} \\
& - \frac{k_{nAC}k_{eAC}e^2\left[-\frac{r\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + \frac{\sqrt{3}}{2}r + \Delta + z_0 - z\right]}{D_{AC}^3 + \beta^3} \\
& + \frac{k_{nAD}k_{eAD}e^2\left[-\frac{r\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + \frac{\sqrt{3}}{2}r + \Delta + z_0 - z\right]}{D_{AD}^3 + \beta^3} \\
& - \frac{k_{nAE}k_{eAE}e^2\left[\frac{r\sqrt{3}}{2}\sin(3\omega t) + \frac{z_4}{2} + \frac{\sqrt{3}}{2}r + \Delta + z_0 - z\right]}{D_{AE}^3 + \beta^3}
\end{aligned}$$

By making a change of scale, the equation becomes:

$$
\begin{aligned}
中_{FA\#x} \cdot \ddot{z_x} = {} & \frac{k_{nFIx}k_{eFIx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) - \frac{3z_x}{2}\right]}{D_{FIx}^3 + \beta_x{}^3} + \frac{k_{nFJx}k_{eFJx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{3z_x}{2}\right]}{D_{FJx}^3 + \beta_x{}^3} \\
& - \frac{k_{nFGx}k_{eFGx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) + \frac{z_{0x}}{2} - \frac{z_{3x}}{2} + z_x\right]}{D_{FGx}^3 + \beta_x{}^3} \\
& - \frac{k_{nFHx}k_{eFHx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) - \frac{z_{0x}}{2} + \frac{z_{3x}}{2} - z_x\right]}{D_{FHx}^3 + \beta_x{}^3} \\
& - \frac{k_{nFBx}k_{eFBx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{FBx}^3 + \beta_x^3} \\
& + \frac{k_{nFCx}k_{eFCx}e_x^2\left[-\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{FCx}^3 + \beta_x^3} \\
& - \frac{k_{nFDx}k_{eFDx}e_x^2\left[-\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{FDx}^3 + \beta_x^3} \\
& + \frac{k_{nFEx}k_{eFEx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{FEx}^3 + \beta_x^3} \\
& - \frac{k_{nAIx}k_{eAIx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) - \frac{3z_x}{2}\right]}{D_{AIx}^3 + \beta_x^3} - \frac{k_{nAJx}k_{eAJx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{3z_x}{2}\right]}{D_{AJx}^3 + \beta_x^3} \\
& + \frac{k_{nAGx}k_{eAGx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) + \frac{z_{0x}}{2} - \frac{z_{3x}}{2} + z_x\right]}{D_{AGx}^3 + \beta_x^3} \\
& + \frac{k_{nAHx}k_{eAHx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(3\omega_x t_x) - \frac{z_{0x}}{2} + \frac{z_{3x}}{2} - z_x\right]}{D_{AHx}^3 + \beta_x^3} \\
& + \frac{k_{nABx}k_{eABx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{ABx}^3 + \beta_x^3} \\
& - \frac{k_{nACx}k_{eACx}e_x^2\left[-\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{ACx}^3 + \beta_x^3} \\
& + \frac{k_{nADx}k_{eADx}e_x^2\left[-\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{ADx}^3 + \beta_x^3} \\
& - \frac{k_{nAEx}k_{eAEx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\sin(3\omega_x t_x) + \frac{z_{4x}}{2} + \frac{\sqrt{3}}{2}r_x + \Delta_x + z_{0x} - z_x\right]}{D_{AEx}^3 + \beta_x^3}
\end{aligned}
$$

Project the dynamic equation of the H-electrinette onto the O_3Z_3 axis which has the vector:

$$\frac{\overrightarrow{O_3O}}{\|\overrightarrow{O_3O}\|} = \begin{pmatrix} \frac{-\sqrt{3}}{2} \\ 0 \\ \frac{1}{2} \end{pmatrix}$$

$$m_h \cdot \ddot{z_3} = 力_{ez_3}$$

Equation 26 - Nucleonette differential equation 2

Where:

- m_h : is the overall mass of the electrinette H. For a linear speed much lower than c, m_h = $中_{H\#}$
- $力_{ez3}$: is the electric force experienced by the electrinette H on the axis O_3Z_3.

The force $\overrightarrow{力_h}$ experienced by the H-electrinette is as follows:

$$\overrightarrow{力_h} = \frac{k_{nHA}k_{eHA}e^2\overrightarrow{D_{HA}}}{D_{HA}^3+\beta^3} - \frac{k_{nHF}k_{eHF}e^2\overrightarrow{D_{HF}}}{D_{HF}^3+\beta^3} + \frac{k_{nHI}k_{eHI}e^2\overrightarrow{D_{HI}}}{D_{HI}^3+\beta^3} - \frac{k_{nHJ}k_{eHJ}e^2\overrightarrow{D_{3h}}}{D_{HJ}^3+\beta^3} + \frac{k_{nH\Gamma}k_{eH\Gamma}e^2\overrightarrow{D_{H\Gamma}}}{D_{H\Gamma}^3+\beta^3} - \frac{k_{nH\Sigma}k_{eH\Sigma}e^2\overrightarrow{D_{H\Sigma}}}{D_{H\Sigma}^3+\beta^3} + \frac{k_{nH\Omega}k_{eH\Omega}e^2\overrightarrow{D_{H\Omega}}}{D_{H\Omega}^3+\beta^3} - \frac{k_{nH\Phi}k_{eH\Phi}e^2\overrightarrow{D_{H\Phi}}}{D_{H\Phi}^3+\beta^3}$$

By projecting on the axis O_3Z_3:

$$\begin{aligned}
力_{hz3} = {} & \frac{k_{nHA}k_{eHA}e^2\left[z_0 - z_3 - \frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2}\right]}{D_{HA}^3+\beta^3} - \frac{k_{nHF}k_{eHF}e^2\left[z_0 - z_3 + \frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2}\right]}{D_{HF}^3+\beta^3} \\
& + \frac{k_{nHI}k_{eHI}e^2\left[\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2} + z_0 - z_3\right]}{D_{HI}^3+\beta^3} \\
& - \frac{k_{nHJ}k_{eHJ}e^2\left[-\frac{r\sqrt{3}}{2}\cos(\omega t) + \frac{z}{2} + z_0 - z_3\right]}{D_{HJ}^3+\beta^3} \\
& + \frac{k_{nH\Gamma}k_{eH\Gamma}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t) - \frac{z_6}{2} - r\frac{\sqrt{3}}{2} - \Delta_6 - z_3\right]}{D_{H\Gamma}^3+\beta^3} \\
& - \frac{k_{nH\Sigma}k_{eH\Sigma}e^2\left[-r\frac{\sqrt{3}}{2}\cdot\sin(\omega t) - \frac{z_6}{2} - r\frac{\sqrt{3}}{2} - \Delta_6 - z_3\right]}{D_{H\Sigma}^3+\beta^3} \\
& + \frac{k_{nH\Omega}k_{eH\Omega}e^2\left[-r\frac{\sqrt{3}}{2}\cdot\sin(\omega t) - \frac{z_6}{2} - r\frac{\sqrt{3}}{2} - \Delta_6 - z_3\right]}{D_{H\Omega}^3+\beta^3} \\
& - \frac{k_{nH\Phi}k_{eH\Phi}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t) - \frac{z_6}{2} - r\frac{\sqrt{3}}{2} - \Delta_6 - z_3\right]}{D_{H\Phi}^3+\beta^3}
\end{aligned}$$

By making a change of scale, the equation becomes:

$$中_{H\#} \cdot \ddot{z_{3x}} = -\frac{k_{nHAx}k_{eHAx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) - z_{0x} + z_{3x} - \frac{z_x}{2}\right]}{D_{HAx}^3 + \beta_x{}^3} - \frac{k_{nHFx}k_{eHFx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + z_{0x} - z_{3x} + \frac{z_x}{2}\right]}{D_{HFx}^3 + \beta_x{}^3} + \frac{k_{nHIx}k_{eHIx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) + \frac{z_x}{2} + z_{0x} - z_{3x}\right]}{D_{HIx}^3 + \beta_x{}^3} + \frac{k_{nHJx}k_{eHJx}e_x^2\left[\frac{r_x\sqrt{3}}{2}\cos(\omega_x t_x) - \frac{z_x}{2} - z_{0x} + z_{3x}\right]}{D_{HJx}^3 + \beta_x{}^3} + \frac{k_{nH\Gamma x}k_{eH\Gamma x}e_x^2\left[r_x\frac{\sqrt{3}}{2}\sin(\omega_x t_x) - \frac{z_{6x}}{2} - r_x\frac{\sqrt{3}}{2} - \Delta_{6x} - z_{3x}\right]}{D_{H\Gamma x}^3 + \beta_x^3} + \frac{k_{nH\Sigma x}k_{eH\Sigma x}e_x^2\left[r_x\frac{\sqrt{3}}{2}\sin(\omega_x t_x) + \frac{z_{6x}}{2} + r_x\frac{\sqrt{3}}{2} + \Delta_{6x} + z_{3x}\right]}{D_{H\Sigma x}^3 + \beta_x^3} - \frac{k_{nH\Omega x}k_{eH\Omega x}e_x^2\left[r_x\frac{\sqrt{3}}{2}\sin(\omega_x t_x) + \frac{z_{6x}}{2} + r_x\frac{\sqrt{3}}{2} + \Delta_{6x} + z_{3x}\right]}{D_{H\Omega x}^3 + \beta_x^3} - \frac{k_{nH\Phi x}k_{eH\Phi x}e_x^2\left[r_x\frac{\sqrt{3}}{2}\sin(\omega_x t_x) - \frac{z_{6x}}{2} - r_x\frac{\sqrt{3}}{2} - \Delta_{6x} - z_{3x}\right]}{D_{H\Phi x}^3 + \beta_x^3}$$

Project the dynamic equation of electrinettes B and C onto the O_4Z_4 axis:

$$m_{BC} \cdot \ddot{z_4} = 力_{ez_4}$$

Equation 27 - Nucleonette differential equation 3

Where:

- m_{BC} : is the overall mass of the electrinette B + the overall mass of the electrinette C. For a linear speed much lower than c, $m_B = 中_{B\#}$ and $m_C = 中_{C\#}$.
- $力_{ez4}$: is the electric force experienced by the electrinette B + the electric force experienced by the electrinette C on the axis O_4Z_4.

The force $\overrightarrow{力_b}$ experienced by the B-electrinette is as follows:

$$\overrightarrow{力_b} = -\frac{k_{nBF}k_{eBF}e^2\overrightarrow{D_{BF}}}{D_{BF}^3 + \beta^3} + \frac{k_{nBA}k_{eBA}e^2\overrightarrow{D_{BA}}}{D_{BA}^3 + \beta^3} - \frac{k_{nBD}k_{eBD}e^2\overrightarrow{D_{BD}}}{D_{BD}^3 + \beta^3} + \frac{k_{nBE}k_{eBE}e^2\overrightarrow{D_{BE}}}{D_{BE}^3 + \beta^3}$$

The force $\overrightarrow{力_c}$ experienced by the C-electrinette is as follows:

$$\overrightarrow{力_c} = \frac{k_{nCF}k_{eCF}e^2\overrightarrow{D_{CF}}}{D_{CF}^3 + \beta^3} - \frac{k_{nCA}k_{eCA}e^2\overrightarrow{D_{CA}}}{D_{CA}^3 + \beta^3} + \frac{k_{nCD}k_{eCD}e^2\overrightarrow{D_{CD}}}{D_{CD}^3 + \beta^3} - \frac{k_{nCE}k_{eCE}e^2\overrightarrow{D_{CE}}}{D_{CE}^3 + \beta^3}$$

The force $\overrightarrow{力_{BC}}$ experienced by the charginette BC is as follows:

$$\overrightarrow{力_{BC}} = -\frac{k_{nBF}k_{eBF}e^2\overrightarrow{D_{BF}}}{D_{BF}^3+\beta^3} + \frac{k_{nBA}k_{eBA}e^2\overrightarrow{D_{BA}}}{D_{BA}^3+\beta^3} - \frac{k_{nBD}k_{eBD}e^2\overrightarrow{D_{BD}}}{D_{BD}^3+\beta^3} + \frac{k_{nBE}k_{eBE}e^2\overrightarrow{D_{BE}}}{D_{BE}^3+\beta^3} + \frac{k_{nCF}k_{eCF}e^2\overrightarrow{D_{CF}}}{D_{CF}^3+\beta^3} - \frac{k_{nCA}k_{eCA}e^2\overrightarrow{D_{CA}}}{D_{CA}^3+\beta^3} + \frac{k_{nCD}k_{eCD}e^2\overrightarrow{D_{CD}}}{D_{CD}^3+\beta^3} - \frac{k_{nCE}k_{eCE}e^2\overrightarrow{D_{CE}}}{D_{CE}^3+\beta^3}$$

By projecting onto the O_4Z_4 axis whose vector is:

$$k_4\begin{pmatrix}x_4\\y_4\\z_4\end{pmatrix} = \begin{pmatrix}-1 & 0 & 0\\ 0 & -\frac{1}{2} & -\frac{\sqrt{3}}{2}\\ 0 & -\frac{\sqrt{3}}{2} & \frac{1}{2}\end{pmatrix}\begin{pmatrix}0\\0\\1\end{pmatrix} = \begin{pmatrix}0\\ -\frac{\sqrt{3}}{2}\\ \frac{1}{2}\end{pmatrix}$$

$$\begin{aligned}力_{BCz4} = &\frac{k_{nBF}k_{eBF}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)+z_4+\frac{\Delta}{2}+\frac{z_0}{2}-\frac{z}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{BF}^3+\beta^3}\\
&+\frac{k_{nBA}k_{eBA}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)-z_4-\frac{\Delta}{2}-\frac{z_0}{2}+\frac{z}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{BA}^3+\beta^3}\\
&-\frac{k_{nBD}k_{eBD}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)-\frac{3z_4}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{BD}^3+\beta^3}\\
&-\frac{k_{nBE}k_{eBE}e^2\left[-r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+\frac{3z_4}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{BE}^3+\beta^3}\\
&-\frac{k_{nCF}k_{eCF}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)+z_4+\frac{\Delta}{2}+\frac{z_0}{2}-\frac{z}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{CF}^3+\beta^3}\\
&-\frac{k_{nCA}k_{eCA}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)-z_4-\frac{\Delta}{2}-\frac{z_0}{2}+\frac{z}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{CA}^3+\beta^3}\\
&+\frac{k_{nCD}k_{eCD}e^2\left[-r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)-\frac{3z_4}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{CD}^3+\beta^3}\\
&+\frac{k_{nCE}k_{eCE}e^2\left[-r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+\frac{3z_4}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{CE}^3+\beta^3}\end{aligned}$$

Project the dynamic equation of the electrinettes Σ and Γ onto the axis O_6Z_6:

$$m_{\Sigma\Gamma} \cdot \ddot{z}_6 = 力_{ez_6}$$

Equation 28 - Nucleonette differential equation 4

Where:

- $m_{\Sigma\Gamma}$: is the overall mass of the electrinette Σ + the overall mass of the electrinette Γ. For a linear speed much lower than c, m_{Σ} = $中_{\Sigma\#}$ and m_{Γ} = $中_{\Gamma\#}$.
- $力_{ez6}$: is the electric force experienced by the electrinette Σ + the electric force experienced by the electrinette Γ on the axis O_6Z_6.

The force $\overrightarrow{力_\sigma}$ experienced by the Σ-electrinette is as follows:

$$\overrightarrow{力_\sigma} = -\frac{k_{n\Sigma H}k_{e\Sigma H}e^2\overrightarrow{D_{\Sigma H}}}{D_{\Sigma H}^3+\beta^3} + \frac{k_{n\Sigma G}k_{e\Sigma G}e^2\overrightarrow{D_{\Sigma G}}}{D_{\Sigma G}^3+\beta^3} + \frac{k_{n\Sigma\Omega}k_{e\Sigma\Omega}e^2\overrightarrow{D_{\Sigma\Omega}}}{D_{\Sigma\Omega}^3+\beta^3} - \frac{k_{n\Sigma\Phi}k_{e\Sigma\Phi}e^2\overrightarrow{D_{\Sigma\Phi}}}{D_{\Sigma\Phi}^3+\beta^3}$$

The force $\overrightarrow{力_\gamma}$ experienced by the electrinette Γ is as follows:

$$\overrightarrow{力_\gamma} = \frac{k_{n\Gamma H}k_{e\Gamma H}e^2\overrightarrow{D_{\Gamma H}}}{D_{\Gamma H}^3+\beta^3} - \frac{k_{n\Gamma G}k_{e\Gamma G}e^2\overrightarrow{D_{\Gamma G}}}{D_{\Gamma G}^3+\beta^3} - \frac{k_{n\Gamma\Omega}k_{e\Gamma\Omega}e^2\overrightarrow{D_{\Gamma\Omega}}}{D_{\Gamma\Omega}^3+\beta^3} + \frac{k_{n\Gamma\Phi}k_{e\Gamma\Phi}e^2\overrightarrow{D_{\Gamma\Phi}}}{D_{\Gamma\Phi}^3+\beta^3}$$

The force $\overrightarrow{力_{\Sigma\Gamma}}$ experienced by the charginette ΣΓ is as follows:

$$\overrightarrow{力_{\Sigma\Gamma}} = -\frac{k_{n\Sigma H}k_{e\Sigma H}e^2\overrightarrow{D_{\Sigma H}}}{D_{\Sigma H}^3+\beta^3} + \frac{k_{n\Sigma G}k_{e\Sigma G}e^2\overrightarrow{D_{\Sigma G}}}{D_{\Sigma G}^3+\beta^3} + \frac{k_{n\Sigma\Omega}k_{e\Sigma\Omega}e^2\overrightarrow{D_{\Sigma\Omega}}}{D_{\Sigma\Omega}^3+\beta^3} - \frac{k_{n\Sigma\Phi}k_{e\Sigma\Phi}e^2\overrightarrow{D_{\Sigma\Phi}}}{D_{\Sigma\Phi}^3+\beta^3} + \frac{k_{n\Gamma H}k_{e\Gamma H}e^2\overrightarrow{D_{\Gamma H}}}{D_{\Gamma H}^3+\beta^3} - \frac{k_{n\Gamma G}k_{e\Gamma G}e^2\overrightarrow{D_{\Gamma G}}}{D_{\Gamma G}^3+\beta^3} - \frac{k_{n\Gamma\Omega}k_{e\Gamma\Omega}e^2\overrightarrow{D_{\Gamma\Omega}}}{D_{\Gamma\Omega}^3+\beta^3} + \frac{k_{n\Gamma\Phi}k_{e\Gamma\Phi}e^2\overrightarrow{D_{\Gamma\Phi}}}{D_{\Gamma\Phi}^3+\beta^3}$$

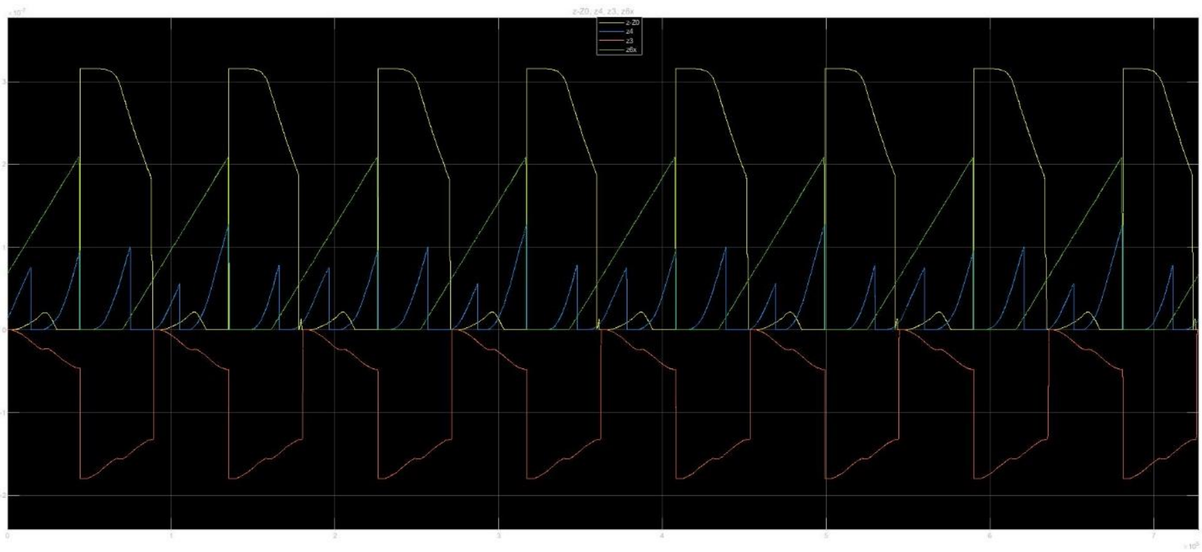
By projecting onto the O_6Z_6 axis whose vector is:

$$k_6\begin{pmatrix}x_6\\y_6\\z_6\end{pmatrix} = \begin{pmatrix}\frac{1}{2} & \frac{-3}{4} & \frac{\sqrt{3}}{4}\\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2}\\ \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{4} & -\frac{1}{4}\end{pmatrix}\begin{pmatrix}0\\0\\1\end{pmatrix} = \begin{pmatrix}\frac{\sqrt{3}}{4}\\ -\frac{\sqrt{3}}{2}\\ -\frac{1}{4}\end{pmatrix}$$

$$
\begin{aligned}
力_{\Sigma\Gamma z6} = & \frac{k_{n\Sigma H}k_{e\Sigma H}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+z_6+\frac{\Delta_6}{2}+\frac{z_3}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{\Sigma H}^3+\beta^3} \\
& +\frac{k_{n\Sigma G}k_{e\Sigma G}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)-z_6-\frac{\Delta_6}{2}-\frac{z_3}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{\Sigma G}^3+\beta^3} \\
& +\frac{k_{n\Sigma\Omega}k_{e\Sigma\Omega}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)-\frac{3z_6}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{\Sigma\Omega}^3+\beta^3} \\
& +\frac{k_{n\Sigma\Phi}k_{e\Sigma\Phi}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)+\frac{3z_6}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{\Sigma\Phi}^3+\beta^3} \\
& -\frac{k_{n\Gamma H}k_{e\Gamma H}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)+z_6+\frac{\Delta_6}{2}+\frac{z_3}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{\Gamma H}^3+\beta^3} \\
& -\frac{k_{n\Gamma G}k_{e\Gamma G}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(3\omega t)-z_6-\frac{\Delta_6}{2}-\frac{z_3}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{\Gamma G}^3+\beta^3} \\
& -\frac{k_{n\Gamma\Omega}k_{e\Gamma\Omega}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)-\frac{3z_6}{2}-\frac{\sqrt{3}}{2}r\right]}{D_{\Gamma\Omega}^3+\beta^3} \\
& -\frac{k_{n\Gamma\Phi}k_{e\Gamma\Phi}e^2\left[r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)+\frac{3z_6}{2}+\frac{\sqrt{3}}{2}r\right]}{D_{\Gamma\Phi}^3+\beta^3}
\end{aligned}
$$

4.8.4.6 Solving Differential Equations Using Matlab-Simulink Software Package Tool

By solving the equations system with Simulink, we obtain the curves z, z_3, z_4 and z_6:



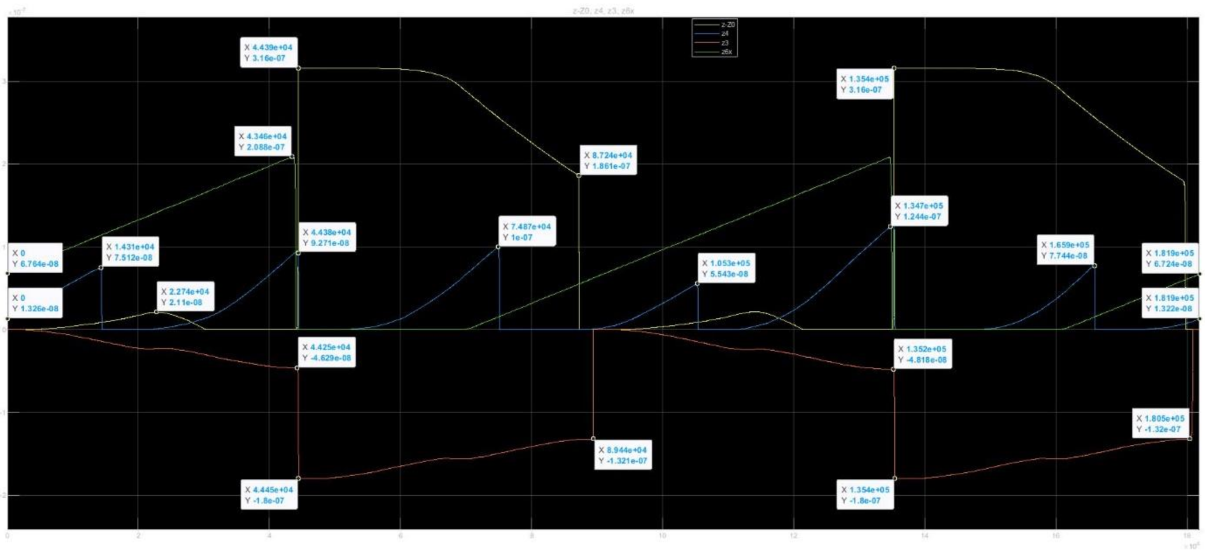


Figure 37 - Nucleonette charginette oscillation

Further details are given in: Appendix A.3.

The coefficients of each curve are:

- $Z\text{-}z_0$: 10^{-5}.
- Z_3 : 10^{-5}.
- Z_4 : 10^{-5}.
- Z_6 : 1.

The interpretation:

1. 1. The trajectories of the 9 charginettes represented by z, z_3, z_4 and z_6 are periodic. The period T_{1x} = 182248.8079 is that of rotation of the AF charginette.
2. The displacement amplitudes a_x of the charginettes in the interval [$1.279*10^{-12}$; $3.16*10^{-7}$] are relatively small compared to their diameter r_x = 0.36373.
3. At t_x = 0, $(z_x\text{-}z_{0x})$ = 0. z_{3x} = 0. The charginettes AF, GH and IJ are in the tightest position for the chrominette AFGHIJ from the core of the nucleonette. $Z_{4x} = 1.326*10^{-13}$ and $z_{6x} = 6.764*10^{-8}$. The exterior chrominettes BCDEAF, ΣΓΩΦGH, and ΛΠΘΨIJ are expanding.
4. Between t_x = 0 and $t_x = T_{1x}/4$, the charginette AF (z_x), first deviates slightly from its inner limit position, then returns to this limit position. It's the same thing for the charginette IJ (z_x). The charginette GH (z_{3x}), gradually deviates from its inner limit position z_{3x} = 0 towards $z_{3x} = -4.632*10^{-13}$. The charginette ΣΓ (z_{x6}), deviates linearly from its initial position $z_{6x} = 6.764*10^{-8}$ to $z_{6x} = 2.081*10^{-7}$. The same goes for the charginette ΩΦ. The charginette BC (z_{4x}), deviates linearly from its initial position $z_{4x} = 1.326*10^{-13}$ towards $z_{4x} = 7.533*10^{-13}$ at $t_x = T_{1x}/12$. Then quickly return to the position z_{4x} = 0 to gradually return to $z_{4x} = 9.506*10^{-13}$. The same goes for the charginettes DE, ΛΠ and ΘΨ.
5. At $t_x = T_{1x}/4$, the charginette AF (z_x), deviates very quickly from its inner limit position $(z_x\text{-}z_{0x})$ = 0, to the furthest position $(z_x\text{-}z_{0x}) = 3.16*10^{-12}$. It's the same thing for the charginette IJ (z_x). The charginette GH (z_{3x}), deviates very quickly from its position $z_{3x} = -4.632*10^{-13}$ towards $z_{3x} = -1.8*10^{-12}$ the outer limit. The chrominette AFGHIJ is in the most expanded state. During this time, the charginette BC (z_{4x}), quickly falls from the position $z_{4x} = 9.506*10^{-13}$ towards z_{4x} = 0. The same goes for the charginettes DE, ΛΠ and ΘΨ. The chrominettes BCDEAF and

ΛΠΘΨIJ are in the tightest condition. The charginette ΣΓ (z_{6x}), quickly falls from the position $z_{6x} = 2.081*10^{-7}$ towards $z_{6x} = 0$. The same goes for the charginette ΩΦ. The chrominette ΣΓΩΦGH is in the tightest condition.

6. Between $t_x = T_{1x}/4$ and $t_x = T_{1x}/2$, the charginette AF (z_x), first remains at its outer limit position, then moves away from this limit position $(z_x-z_{0x}) = 3.16*10^{-12}$ to an intermediate position $(z_x-z_{0x}) = 2.008*10^{-12}$. It's the same thing for the charginette IJ (z_x). The charginette GH (z_{3x}), gradually deviates from its outer limit position $z_{3x} = -1.8*10^{-12}$ to an intermediate position $z_{3x} = -1.325*10^{-13}$. The charginette ΣΓ (z_{6x}), stay in position $z_{6x} = 0$. Then deviates linearly from this position $z_{6x} = 0$ towards $z_{6x} = 6.99*10^{-8}$. The same goes for the charginette ΩΦ. The charginette BC (z_{4x}), gradually deviates from the position $z_{4x} = 0$ towards $z_{4x} = 9.943*10^{-13}$ at $t_x = 5T_{1x}/12$. Then quickly return to the position $z_{4x} = 0$. The same goes for the charginettes DE, ΛΠ and ΘΨ.
7. At $t_x = T_{1x}/2$, the charginette AF (z_x), falls very quickly from its intermediate position $(z_x-z_{0x}) = 2.008*10^{-12}$, to the inner limit position $(z_x-z_{0x}) = 0$. It's the same thing for the charginette IJ (z_x). The charginette GH (z_{3x}), falls very quickly from its intermediate position $z_{3x} = -1.325*10^{-13}$ towards $z_{3x} = 0$ the internal limit. The chrominette AFGHIJ is in the tightest condition. Meanwhile, the charginette BC (z_{4x}), stay in position $z_{4x} = 0$. The same goes for the charginettes DE, ΛΠ and ΘΨ. The chrominettes BCDEAF and ΛΠΘΨIJ are not in borderline condition. The charginette ΣΓ (z_{6x}), keeps his position $z_{6x} = 6.99*10^{-8}$. The same goes for the charginette ΩΦ. The chrominette ΣΓΩΦGH is in intermediate state.
8. Between $t_x = T_{1x}/2$ and $t_x = T_{1x}$, the charginettes AF (z_x), IJ (z_x) and GH (z_{3x}), follow roughly the same behavior as during the first half-period. But the charginettes BC (z_{4x}), ΣΓ (z_{6x}), as well as their equivalents have a significantly different behavior from the first half-period.
9. Between $t_x = T_{1x}/2$ and $t_x = 3T_{1x}/4$, the charginette BC (z_{4x}) gradually deviates from the position $z_{4x} = 0$ towards $z_{4x} = 5.51*10^{-13}$ at $t_x = 7T_{1x}/12$. Then quickly return to the position $z_{4x} = 0$. Then start to gradually move away from the position again $z_{4x} = 0$ towards $z_{4x} = 1.271*10^{-12}$ at $t_x = 3T_{1x}/4$. The same goes for the charginettes DE, ΛΠ and ΘΨ. The charginette ΣΓ (z_{6x}), continues to move away towards the position $z_{6x} = 2.32*10^{-7}$.
10. At $t_x = 3T_{1x}/4$, the charginette BC (z_{4x}), pass from position $z_{4x} = 1.271*10^{-12}$ to $z_{4x} = 0$. The same goes for the charginettes DE, ΛΠ and ΘΨ. The chrominettes BCDEAF and ΛΠΘΨIJ are in the internal limit state. The charginette ΣΓ (z_{6x}), passes from his position $z_{6x} = 2.32*10^{-7}$ to $z_{6x} = 0$. The same goes for the charginette ΩΦ. The chrominette ΣΓΩΦGH is in the internal limit state (the tightest).
11. Between $t_x = 3T_{1x}/4$ and $t_x = T_{1x}$, the charginette BC (z_{4x}) gradually deviates from the position $z_{4x} = 0$ towards $z_{4x} = 7.823*10^{-13}$ at $t_x = 11T_{1x}/12$. Then quickly return to the position $z_{4x} = 0$. Then start to gradually move away from the position again $z_{4x} = 0$ towards $z_{4x} = 1.326*10^{-13}$ at $t_x = T_{1x}$. The same goes for the charginettes DE, ΛΠ and ΘΨ. The charginette ΣΓ (z_{6x}), gradually deviates from the position $z_{6x} = 0$ to the position $z_{6x} = 6.662*10^{-8}$.
12. At $t_x = T_{1x}$, the chrominettes are in the same states as at $t_x = 0$.

In summary:

Neglecting the small movements of the charginettes, the 3 external chrominettes of the nucleonette are glued to the chrominette of the core by the 3 contact points of the latter.

4.8.5 Stability of quarks U^+

An up quark is composed of 1 up chrominette and 1 positron. Its stability is relatively low. Indeed, the center of the chrominette C_{chr} can host a positron for 2 following reasons:

1. The potential energy at point C_{chr} is minimal compared to its surroundings. But the difference is relatively small.
2. The electric potential at point C_{chr} is minimally negative compared to its surroundings. But the difference is relatively small because of the electrical neutralization of the constituent charginettes.

At rest, the positron is stable at the C_{chr} point. But if the up quark undergoes too much acceleration, the weak coupling of the positron and the chrominette will separate. This explains the observed instability of the up quark in laboratories.

4.8.6 Stability of quarks D^-

A down quark is composed of 1 down chrominette and 1 electron. Its stability is relatively low. Indeed, the C_{chr} center of the chrominette can host an electron for 2 following reasons:

1. The potential energy at point C_{chr} is minimal compared to its surroundings. But the difference is relatively small.
2. The electric potential at point C_{chr} is maximally positive compared to its surroundings. But the difference is relatively small because of the electrical neutralization of the constituent charginettes.

At rest, the electron is stable at the C_{chr} point. But if the down quark is accelerated too much, the weak coupling of the electron and the chrominette will separate. This explains the observed instability of the down quark in laboratories.

4.8.7 Proton stability H^+

A proton is composed of 1 down nucleonette, 2 positrons and 1 electron. Its stability is very high. Indeed, the core has 3 contact points connecting the 3 external chrominettes. Each contact point has a high potential energy. Which constitutes a potential energy barrier that closes the openings of the 2 chrominettes connected by this contact point. Therefore, the 3 external chrominettes each enclose their electrinettes. Which makes the proton very stable.

4.8.8 Neutron stability n^0

A neutron is composed of 1 up nucleonette, 2 positrons and 2 electrons. Its stability is also very high.

For the same reasons as for the proton, the 3 outer chrominettes enclose their electrinettes.

For the core, each of its 2 openings is closed by 3 contact points. So, the core electron is also enclosed. Which makes the neutron very stable.

4.8.9 Stability of nucleonette 品 ^{u}

The structure of the up nucleonette is similar to the down one. Here only the difference will be described.

To establish the dynamic behavior of the 9 charginettes within the nucleonette, we will proceed in the following 5 steps:

1. Use the coordinates of the electrinettes and the distances between them determined previously.
2. Determine the mass of each electrinette
3. Use the electrical interactions between the electrinettes determined previously.
4. Use the dynamic equations governing each electrinette determined previously.
5. Solving Differential Equations Using Matlab-Simulink Software Package Tool

4.8.9.1 Determine the mass of each electrinette

The electrinettes will be numbered as follows:

19. Electrinette F : speed v_1, la masse 中 $_{F\#}$ global.
20. Electrinette A : speed v_1, la masse 中 $_{F\#}$ global.
21. Electrinette J : speed v_1, la mass 中 $_{F\#}$ global.
22. Electrinette I : speed v_1, la mass 中 $_{F\#}$ global.
23. Electrinette G : speed v_3, la mass 中 $_{H\#}$ global.
24. Electrinette H : speed v_3, la mass 中 $_{H\#}$ global.
25. Electrinette B : speed v_3, la mass 中 $_{B\#}$ global.
26. Electrinette C : speed v_3, la mass 中 $_{B\#}$ global.
27. Electrinette D : speed v_3, la mass 中 $_{B\#}$ global.
28. Electrinette E : speed v_3, la mass 中 $_{B\#}$ global.
29. Electrinette Θ : speed v_3, la mass 中 $_{B\#}$ global.
30. Electrinette Ψ : speed v_3, la mass 中 $_{B\#}$ global.
31. Electrinette Π : speed v_3, la mass 中 $_{B\#}$ global.
32. Electrinette Λ : speed v_3, la mass 中 $_{B\#}$ global.
33. Electrinette Γ : speed v_1, la mass 中 $_{Γ\#}$ global.
34. Electrinette Σ : speed v_1, la mass 中 $_{Γ\#}$ global.
35. Electrinette Ω : speed v_1, la mass 中 $_{Γ\#}$ global.
36. Electrinette Φ : speed v_1, la mass 中 $_{Γ\#}$ global.

The overall mass of the electrinette F is expressed by the following formula:

$$中_{F\#} = 中_{F} + \frac{1}{2c^2} \cdot (E_{eFI} + E_{eFG} + E_{eFC} + E_{eFE})$$

Where:

- 中 $_{F\#}$: represents the overall inert mass of the electrinette F.
- 中 $_{F}$: is the neutral charge of the electrinette F
- E_{eFp} : is the electric potential energy between the electrinette F and the electrinette p having a sign opposite to that of the electrinette F. In addition, the distance between the electrinettes F and p varies between 0 and d > 0. With p = I, G, C or E.

To calculate the potential energy E_{eFp}, we need to know the average of the distance between them. Neglecting the displacements of the charginettes relative to the equilateral triangle, the distances are written as:

- $D_{FI} = r*f_{FI} = 0.36373 *10^{-15}*1.757 = 0.63907361*10^{-15}$ m
- $D_{FG} = r*f_{FG} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{FC} = r*f_{FC} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{FE} = r*f_{FE} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{HA} = r*f_{HA} = 0.36373 *10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{HI} = r*f_{HI} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{H\Gamma} = r*f_{H\Gamma} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{H\Omega} = r*f_{H\Omega} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{BE} = r*f_{BE} = 0.36373*10^{-15}*1.757 = 0.63907361*10^{-15}$ m
- $D_{BA} = r*f_{BA} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m
- $D_{\Sigma\Omega} = r*f_{\Sigma\Omega} = 0.36373*10^{-15}*1.757 = 0.63907361*10^{-15}$ m
- $D_{\Sigma G} = r*f_{\Sigma G} = 0.36373*10^{-15}*1.65 = 0.6001545*10^{-15}$ m

The overall mass of the electrinette F becomes:

$$中_{F\#} = 中_{F} + \frac{k_e e^2}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{F0}中_{I0}}{D_{FI}} + \frac{中_{F0}中_{G0}}{D_{FG}} + \frac{中_{F0}中_{C0}}{D_{FC}} + \frac{中_{F0}中_{E0}}{D_{FE}} \right)$$

With the orbital speed of the charginettes much lower than c, 中 $_F$ =中 $_{F0}$. So we have:

$$中_{F\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{F0}}{D_{FI}} + \frac{中_{H0}}{D_{FG}} + \frac{中_{H0}}{D_{FC}} + \frac{中_{H0}}{D_{FE}} \right)$$

$$中_{F\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}} \right)$$

By symmetry, 中 $_{A\#}$ =中 $_{I\#}$ =中 $_{J\#}$ =中 $_{F\#}$.

The overall mass of the H-electrinette is expressed by the following formula:

$$中_{H\#} = 中_{H} + \frac{1}{2c^2} \cdot (E_{eHA} + E_{eHI} + E_{eH\Gamma} + E_{eH\Omega})$$

Where:

- 中 $_{H\#}$: represents the overall inert mass of the electrinette H.
- 中 $_H$: is the neutral charge of the electrinette H
- E_{eHp} : is the electric potential energy between the H-electrinette and the p-electrinette. With p = A, I, Γ or Ω.

$$中_{H\#} = 中_{H} + \frac{k_e e^2}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{H0}中_{A0}}{D_{HA}} + \frac{中_{H0}中_{I0}}{D_{HI}} + \frac{中_{H0}中_{\Gamma}}{D_{H\Gamma}} + \frac{中_{H0}中_{\Omega}}{D_{H\Omega}} \right)$$

$$中_{H\#} = 中_{H0} + \frac{k_e e^2 中_{H0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{HA}} + \frac{中_{F0}}{f_{HI}} + \frac{中_{F0}}{f_{H\Gamma}} + \frac{中_{F0}}{f_{H\Omega}}\right)$$

$$中_{H\#} = 中_{H0} + \frac{k_e e^2 中_{H0} \cdot 中_{F0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{1}{f_{HA}} + \frac{1}{f_{HI}} + \frac{1}{f_{H\Gamma}} + \frac{1}{f_{H\Omega}}\right)$$

By symmetry, $中_{G\#} = 中_{H\#}$.

The overall mass of the electrinette B is expressed by the following formula:

$$中_{B\#} = 中_{B} + \frac{1}{2c^2} \cdot (E_{eBA} + E_{eBE})$$

Where:

- $中_{B\#}$: represents the overall inert mass of the electrinette B.
- $中_{B}$: is the neutral charge of the electrinette B
- E_{eBp} : is the electric potential energy between electrinette B and electrinette p having a sign opposite to that of electrinette B. In addition, the distance between electrinettes B and p varies between 0 and d > 0. With p = A or E.

$$中_{B\#} = 中_{B} + \frac{k_e e^2}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{B0} 中_{F0}}{D_{BA}} + \frac{中_{B0} 中_{E0}}{D_{BE}}\right)$$

$$中_{B\#} = 中_{H0} + \frac{k_e e^2 中_{H0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{BA}} + \frac{中_{H0}}{f_{BE}}\right)$$

By symmetry, $中_{C\#} = 中_{D\#} = 中_{E\#} = 中_{\Theta\#} = 中_{\Psi\#} = 中_{\Pi\#} = 中_{\Lambda\#} = 中_{B\#}$.

The overall mass of the electrinette Σ is expressed by the following formula:

$$中_{\Sigma\#} = 中_{\Sigma} + \frac{1}{2c^2} \cdot (E_{e\Sigma G} + E_{e\Sigma\Omega})$$

Where:

- $中_{\Sigma\#}$: represents the overall inert mass of the electrinette Σ.
- $中_{\Sigma}$: is the neutral charge of the electrinette Σ
- $E_{e\Sigma p}$: is the electric potential energy between the Σ electrinette and the p electrinette having a sign opposite to that of the Σ electrinette. In addition, the distance between the Σ and p electrinettes varies between 0 and d > 0. With p = G or Ω.

$$中_{\Sigma\#} = 中_{\Sigma} + \frac{k_e e^2}{2c^2 中_{ref}^2} \cdot \left(\frac{中_{\Sigma 0} 中_{G0}}{D_{\Sigma G}} + \frac{中_{\Sigma 0} 中_{\Omega 0}}{D_{\Sigma\Omega}}\right)$$

$$中_{\Sigma\#} = 中_{F0} + \frac{k_e e^2 中_{F0}}{2c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right)$$

By symmetry, 中 $_{\Gamma\#}$ =中 $_{\Omega\#}$ =中 $_{\Phi\#}$ =中 $_{\Sigma\#}$.

The overall mass of the nucleonette is:

$$中_{nucl} = \sum_{p=1}^{18} 中_{p\#}$$

$$中_{nucl} = 4 \cdot 中_{F\#} + 2 \cdot 中_{H\#} + 8 \cdot 中_{B\#} + 4 \cdot 中_{\Sigma\#}$$

$$中_{nucl} = 4 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}}\right) + 2 \cdot 中_{H0} + \frac{k_e e^2 中_{H0} \cdot 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{1}{f_{HA}} + \frac{1}{f_{HI}} + \frac{1}{f_{H\Gamma}} + \frac{1}{f_{H\Omega}}\right) + 8 \cdot 中_{H0} + \frac{4k_e e^2 中_{H0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{BA}} + \frac{中_{H0}}{f_{BE}}\right) + 4 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right)$$

$$中_{nucl} = 8 \cdot 中_{F0} + \frac{2k_e e^2 中_{F0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}} + \frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right) + 10 \cdot 中_{H0} + \frac{k_e e^2 中_{H0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{中_{F0}}{f_{HA}} + \frac{中_{F0}}{f_{HI}} + \frac{中_{F0}}{f_{H\Gamma}} + \frac{中_{F0}}{f_{H\Omega}} + \frac{4\ 中_{F0}}{f_{BA}} + \frac{4\ 中_{H0}}{f_{BE}}\right)$$

The mass of the nucleonette is equal to the mass of the proton – the mass of 2 positrons and the electron:

$$中_{nucl} = 中_{p+} - 中_{e+} = 938.272\ MeV - 3 \cdot 511\ KeV = 936.739\ MeV$$

Due to:

$$r = \frac{k_e 中_{H0} e^2}{4中_{ref}^2} \cdot \left(\frac{k_n}{v_1^2}\right)$$

$$r = \frac{k_e 中_{F0} e^2}{4中_{ref}^2} \cdot \left[\frac{k_n}{(3v_1)^2}\right] = \frac{k_e 中_{F0} e^2}{4中_{ref}^2 \cdot 9} \cdot \left[\frac{k_n}{(v_1)^2}\right]$$

By combining the two:

$$\frac{r}{中_{H0}} = \frac{9r}{中_{F0}}$$

$$中_{F0} = 9 \cdot 中_{H0}$$

The previous equality becomes:

$$中_{nucl} = 8 \cdot 9\ 中_{H0} + \frac{2k_e e^2 9\ 中_{H0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{9\ 中_{H0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}} + \frac{中_{H0}}{f_{\Sigma G}} + \frac{9\ 中_{H0}}{f_{\Sigma\Omega}}\right) + 10 \cdot 中_{H0} + \frac{k_e e^2 中_{H0}}{c^2 中_{ref}^2 \cdot r} \cdot \left(\frac{9\ 中_{H0}}{f_{HA}} + \frac{9\ 中_{H0}}{f_{HI}} + \frac{9\ 中_{H0}}{f_{H\Gamma}} + \frac{9\ 中_{H0}}{f_{H\Omega}} + \frac{4 \cdot 9\ 中_{H0}}{f_{BA}} + \frac{4 \cdot 中_{H0}}{f_{BE}}\right)$$

$$中_{nucl} = 82 中_{H0} + \frac{k_e e^2 中_{H0}^2}{c^2 中_{ref}^2 \cdot r} \cdot \left[\left(\frac{162}{f_{FI}} + \frac{18}{f_{FG}} + \frac{18}{f_{FC}} + \frac{18}{f_{FE}} + \frac{18}{f_{\Sigma G}} + \frac{162}{f_{\Sigma\Omega}}\right) + \left(\frac{9}{f_{HA}} + \frac{9}{f_{HI}} + \frac{9}{f_{H\Gamma}} + \frac{9}{f_{H\Omega}} + \frac{36}{f_{BA}} + \frac{4}{f_{BE}}\right)\right]$$

We have a second degree equation with respect to 中 $_{F0}$.

$$a = \frac{k_e e^2}{c^2 中_{ref}^2 \cdot r}\left[\frac{162}{f_{FI}} + \frac{18}{f_{FG}} + \frac{18}{f_{FC}} + \frac{18}{f_{FE}} + \frac{18}{f_{\Sigma G}} + \frac{162}{f_{\Sigma\Omega}} + \frac{9}{f_{HA}} + \frac{9}{f_{HI}} + \frac{9}{f_{H\Gamma}} + \frac{9}{f_{H\Omega}} + \frac{36}{f_{BA}} + \frac{4}{f_{BE}}\right]$$

$$b = 82$$

$$c_s = -中_{nucl} = -中_{nucl} \cdot \frac{e}{c^2} = -\frac{936.739 \cdot 1.602177 \cdot 10^6 \cdot 10^{-19}}{2.997525^2 \cdot 10^{16}} = -1{,}67033456 \cdot 10^{-27} \cdot kg$$

$$[\Sigma_f] = \frac{162}{1.757} + \frac{18}{1.65} + \frac{18}{1.65} + \frac{18}{1.65} + \frac{18}{1.65} + \frac{162}{1.757} + \frac{9}{1.65} + \frac{9}{1.65} + \frac{9}{1.65} + \frac{9}{1.65} + \frac{36}{1.65} + \frac{4}{1.757}$$

$$[\Sigma_f] = \frac{162 + 162 + 4}{1.757} + \frac{18 \cdot 4 + 9 \cdot 4 + 36}{1.65}$$

$$[\Sigma_f] = \frac{328}{1.757} + \frac{144}{1.65}$$

$$[\Sigma_f] = 273{,}954571325$$

$$\frac{a_n}{a_d} = \frac{k_e e^2}{c^2 中_{ref}^2 \cdot r}$$

$$\frac{a_n}{a_d} = \frac{8.987552 \cdot 1.602177^2 \cdot 10^9 \cdot 10^{-38}}{2.997525^2 \cdot 9.109382^2 \cdot 0.36373 \cdot 10^{16} \cdot 10^{-62} \cdot 10^{-15}} = 8{,}5070664 \cdot 10^{30}$$

$$a = \frac{a_n}{a_d}[\Sigma_f] = 8{,}5070664 \cdot 10^{30} \cdot 273{,}954571325 = 2{,}330\ 549\ 728\ 846 \cdot 10^{33}$$

$$中_{H0} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2 \cdot a} = \frac{-82 \pm \sqrt{82^2 + 4 \cdot 2.330549728 \cdot 10^{33} \cdot 1{,}67033456 \cdot 10^{-27}}}{2 \cdot 2.330549728846 \cdot 10^{33}}$$

$$中_{H0} = \frac{-82 \pm 3946.88675079}{4.661099458 \cdot 10^{33}} = 8{,}29179206669 \cdot 10^{-31} kg$$

$$中_{F0} = 9 \cdot 中_{H0} = 7{,}46261286 \cdot 10^{-30} kg$$

$$v_1^2 = \frac{k_e 中_{H0} e^2}{4中_{ref}^2} \cdot \left(\frac{k_n}{r}\right) = \frac{8.987552 \cdot 8.29179206669 \cdot 1.602177^2 \cdot 10^9 10^{-31} 10^{-38}}{4 \cdot 9.109382^2 \cdot 10^{-62}} \cdot \frac{10^{-11+15}}{0.36373}$$

$$v_1^2 = 1{,}584505904 \cdot 10^6$$

$$v_1 = 1{,}258771585 \cdot 10^3 m/s$$

$$v_3 = 3{,}776314756 \cdot 10^3 m/s$$

Determine the angular velocity:

$$\omega_1 = \frac{v_1}{r} = \frac{1{,}258771585 \cdot 10^3}{0.36373 \cdot 10^{-15}} = 3.460730721 \cdot 10^{-5} \cdot 10^{23}\ radian/s$$

$$\omega_{1x} = 3.460730721 \cdot 10^{-5}$$

$$T_1 = \frac{2\pi r}{v_1} = 1.815566079 \cdot 10^5 \cdot 10^{-23}\ s$$

$$中_{F\#} = 中_{F0} + \frac{a_n}{a_d} \cdot \frac{中_{F0}}{2} \cdot \left(\frac{中_{F0}}{f_{FI}} + \frac{中_{H0}}{f_{FG}} + \frac{中_{H0}}{f_{FC}} + \frac{中_{H0}}{f_{FE}}\right)$$

$$中_{F\#} \cdot 10^{31} = 74{,}6261286 + 0{,}850707 \cdot \frac{74{,}6261286}{2} \cdot \left(\frac{74{,}6261286}{1.757} + \frac{8{,}29179206669}{1.65} + \frac{8{,}29179206669}{1.65} + \frac{8{,}29179206669}{1.65}\right)$$

$$中_{F\#} \cdot 10^{31} = 1901{,}393227111$$

$$中_{F\#} = 1901{,}393227111 \cdot 10^{-31} kg$$

$$2\ 中_{F\#} = 3802{,}786454222 \cdot 10^{-31} kg$$

$$中_{H\#} = 中_{H0} + \frac{a_n}{a_d} \cdot \frac{中_{H0} \cdot 中_{F0}}{2} \cdot \left(\frac{1}{f_{HA}} + \frac{1}{f_{HI}} + \frac{1}{f_{H\Gamma}} + \frac{1}{f_{H\Omega}}\right)$$

$$中_{H\#} \cdot 10^{31} = 8{,}29179206669 + 0{,}850707 \cdot \frac{8{,}29179206669 \cdot 74{,}6261286}{2} \cdot \left(\frac{1}{1.65} + \frac{1}{1.65} + \frac{1}{1.65} + \frac{1}{1.65}\right)$$

$$中_{H\#} = 646{,}357453253 \cdot 10^{-31} kg$$

$$中_{B\#} = 中_{H0} + \frac{a_n}{a_d} \cdot \frac{中_{H0}}{2} \cdot \left(\frac{中_{F0}}{f_{BA}} + \frac{中_{H0}}{f_{BE}}\right)$$

$$中_{B\#} \cdot 10^{31} = 8{,}291792067 + 0{,}850707 \cdot \frac{8{,}291792067}{2} \cdot \left(\frac{74{,}6261286}{1.65} + \frac{8{,}291792067}{1.757}\right)$$

$$中_{B\#} = 184{,}452872212 \cdot 10^{-31} kg$$

$$2中_{B\#} = 368{,}905744424 \cdot 10^{-31}kg$$

$$中_{\Sigma\#} = 中_{F0} + \frac{a_n}{a_d} \cdot \frac{中_{F0}}{2} \cdot \left(\frac{中_{H0}}{f_{\Sigma G}} + \frac{中_{F0}}{f_{\Sigma\Omega}}\right)$$

$$中_{\Sigma\#} \cdot 10^{31} = 74{,}6261286 + 0{,}850707 \cdot \frac{74{,}6261286}{2} \cdot \left(\frac{8{,}291792067}{1.65} + \frac{74{,}6261286}{1.757}\right)$$

$$中_{\Sigma\#} = 1582{,}360396518 \cdot 10^{-31}kg$$

$$2\ 中_{\Sigma\#} = 3164.720793036 \cdot 10^{-31}kg$$

Verification:

$$中_{nucl} = 4中_{F\#} + 2中_{H\#} + 8中_{B\#} + 4中_{\Sigma\#}$$

$$中_{nucl} = 4 \cdot 1901{,}393 + 2 \cdot 646{,}357 + 8 \cdot 184{,}453 + 4 \cdot 1582{,}360 = 16703.35 \cdot 10^{-31}\ kg$$

This value corresponds well to the mass of the proton – the mass of 3 electrinettes.

Comparing the value of $中_{F0}$ with that of $中_{H0}$ of the low nucleonette, we have approximately equality. It is the same for the value of $中_{H0}$ with that of $中_{F0}$ of the down nucleonette. Which allows us to say that the model of the nucleonettes is good. At least, we have not found any incompatibilities.

4.9 Modeling of atomic nuclei

Within the nucleus of an atom, there may be several protons and several neutrons, perhaps even small nucleons. Between these nucleons, there is a binding force. It is a question of modeling these connections.

The nucleon and nucleonette structures lead to distinguishing the following 11 types of connection:

1. Connection between the "free" electrinettes of the proton and the "free" electrinettes of the neutron. Here, the word "free" means that the electrinette does not belong to a charginette.
2. Bond between the "free" electrinettes of the first proton-neutron pair (type 1) and the "free" electrinettes of the second proton-neutron pair (type 1). This bond can be generalized between 2 groups of nucleons. Each group of nucleons is composed of nucleons connected by type 1 bonds.
3. Connection between the “bound” electrinettes of the proton and those “bound” of the neutron.
4. Bond between the “bound” electrinettes of a first proton and those “bound” of a second proton.
5. Connection between the “bound” electrinettes of a first neutron and those “bound” of a second neutron.

Remark:

Theoretically, there are two half-neutrons, an antiproton and an antineutron:

- ½ down neutron: 1 down nucleonette + 1 electron + 1 positron
- ½ up neutron: 1 up nucleonette + 1 electron + 1 positron
- antineutron: 1 down nucleonette + 2 electrons + 2 positrons
- antiproton: 1 up nucleonette + 2 electrons + 1 positron

Plus, there are the nucleonettes.

These particles are not studied here.

4.9.1 Modeling of connections between free electrinettes

This type of connection can only exist between a proton and a neutron. The following diagram shows a view of a stacked proton and neutron.

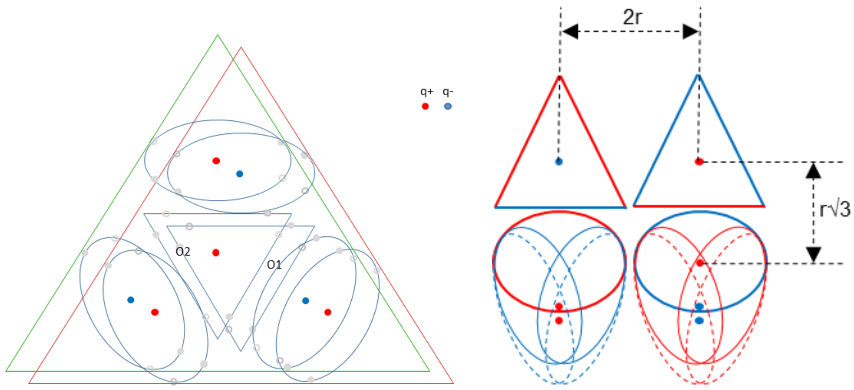


Figure 38 - Connection between free electrinettes

To simplify the illustrations, the following symbol will be used for an axial L0 bond between a proton and a neutron:

To calculate the binding energy, one must first determine the coordinates of the free electrinettes within the nucleons.

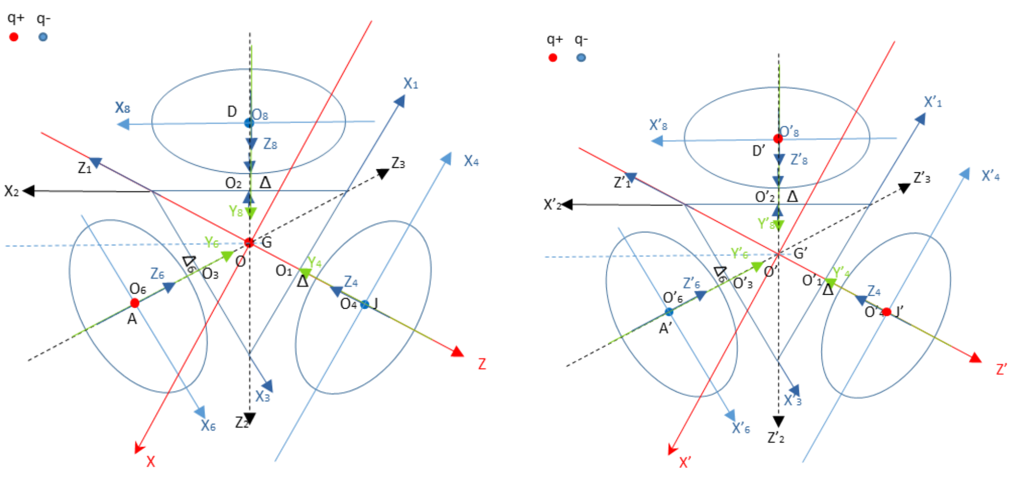


Figure 39 - Top view of shifted neutron-proton

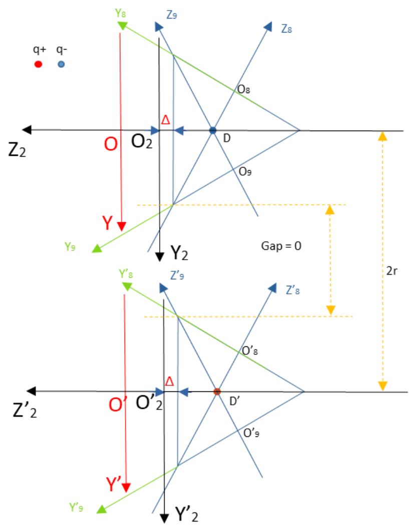


Figure 40 - Right neutron-proton view

The coordinates of points D, D’, J, J’, A, A’, G and G’ in the global frame are:

$$\overrightarrow{OD} = 2 \cdot \overrightarrow{OO_2}$$

$$D(x,y,z) = 2O_2\left(-\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = D\left(-\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = D(-r, 0, -\frac{r}{\sqrt{3}})$$

$$D'(x,y,z) = D'(-r, -2r, -\frac{r}{\sqrt{3}})$$

$$A(x,y,z) = 2O_3\left(\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = A\left(\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = A(r, 0, -\frac{r}{\sqrt{3}})$$

$$A'(x,y,z) = A'(r, -2r, -\frac{r}{\sqrt{3}})$$

$$J(x,y,z) = 2O_1(0,0,z_0) = J\left(0,0,2\frac{r}{\sqrt{3}}\right) = J(0,0,\frac{2r}{\sqrt{3}})$$

$$J'(x,y,z) = J'(0, -2r, \frac{2r}{\sqrt{3}})$$

$$G(x,y,z) = G(0,0,0)$$

$$G'(x,y,z) = G'(0, -2r, 0)$$

Determine the potential energies between pairs of electric charges:

$$E = E_A^{A'} + E_D^{D'} + E_J^{J'} + E_D^{J'} + E_J^{D'} + E_G^{A'} - E_A^{D'} - E_A^{J'} - E_D^{A'} - E_J^{A'} - E_G^{D'} - E_G^{J'}$$

$$E_x^{y'} = k_e \frac{中_x \cdot 中_{y\prime}}{中_{ref}^2} \cdot \frac{e^2}{d_x^{y'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_x \cdot 中_{\delta x}\right)\left(中_{ref} + \alpha_{y\prime} \cdot 中_{\delta y\prime}\right) e^2}{中_{ref}^2 \cdot d_x^{y'}}$$

Definition of terms:

- $中_{ref}$: the neutral charge of an electrinette at rest.

- α_x : the coefficient of participation of the neutral charge of the neighborhood of the electrinette x.
- 中 $_{\delta x}$: the neutral charge of the neighborhood of the electrinette x.
- $\alpha_{y'}$: the coefficient of participation of the neutral charge of the neighborhood of the electrinette y'.
- 中 $_{\delta y'}$: the neutral charge of the neighborhood of the electrinette y'.

$$E_{A}^{A'} = k_e \frac{中_A \cdot 中_{A'}}{中_{ref}^{2}} \cdot \frac{e^2}{d_A^{A'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)\left(中_{ref} + \alpha_{A'} \cdot 中_{\delta A'}\right) e^2}{中_{ref}^{2} \cdot d_A^{A'}}$$

$$中_{\delta x} = 中_{\delta A} = 6\left(中_F + 中_F + 中_H\right) + 6\left(中_H + 中_H + 中_F\right)$$

$$中_{\delta y'} = 中_{\delta A'} = 中_{\delta A}$$

To simplify the calculations, we neglect the difference between the neutral charge of the neutron quarks and that of the proton.

$$中_F = \frac{8.261782 \cdot 10^{-31} + 8.291792 \cdot 10^{-31}}{2} = 8.276787 \cdot 10^{-31}\, kg$$

$$中_H = 9 \cdot 中_F = 7.449108 \cdot 10^{-30}\, kg$$

First, we assume that:

$$\alpha_A = \alpha_{A'} = \alpha_{x'} = \alpha_{y'}$$

We therefore have:

$$中_{\delta A} = 18\ 中_F + 18\ 中_H = 1489.821\,606 \cdot 10^{-31}\, kg$$

$$中_{\delta A'} = 中_{\delta A}$$

For other potential energy terms:

$$中_{\delta D} = 中_{\delta J} = 中_{\delta G} = 中_{\delta A} = 中_{\delta D'} = 中_{\delta J'} = 中_{\delta A'}$$

$$\frac{E \cdot 中_{ref}^{2}}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2} = \frac{1}{d_A^{A'}} + \frac{1}{d_D^{D'}} + \frac{1}{d_J^{J'}} + \frac{1}{d_D^{J'}} + \frac{1}{d_J^{D'}} + \frac{1}{d_G^{A'}} - \frac{1}{d_A^{D'}} - \frac{1}{d_A^{J'}} - \frac{1}{d_D^{A'}} - \frac{1}{d_J^{A'}} - \frac{1}{d_G^{D'}} - \frac{1}{d_G^{J'}}$$

$$d_A^{A'} = 2r = d_D^{D'} = d_J^{J'}$$

$$d_D^{J'} = \sqrt{r^2 + (2r)^2 + \left(\frac{3r}{\sqrt{3}}\right)^2} = r \cdot \sqrt{1+4+3} = 2\sqrt{2} \cdot r$$

$$d_J^{D'} = 2\sqrt{2} \cdot r$$

$$d_G^{A'} = \sqrt{r^2 + (2r)^2 + \left(\frac{r}{\sqrt{3}}\right)^2} = r \cdot \sqrt{1+4+\frac{1}{3}} = \frac{4}{\sqrt{3}} \cdot r$$

$$d_A^{D'} = \sqrt{(2r)^2 + (2r)^2 + 0} = 2\sqrt{2} \cdot r$$

$$d_A^{J'} = \sqrt{r^2 + (2r)^2 + \left(\frac{3r}{\sqrt{3}}\right)^2} = r \cdot \sqrt{1+4+3} = 2\sqrt{2} \cdot r$$

$$d_D^{A'} = \sqrt{(2r)^2 + (2r)^2 + 0} = 2\sqrt{2} \cdot r$$

$$d_J^{A'} = \sqrt{r^2 + (2r)^2 + \left(\frac{3r}{\sqrt{3}}\right)^2} = r \cdot \sqrt{1+4+3} = 2\sqrt{2} \cdot r$$

$$d_G^{D'} = \sqrt{r^2 + (2r)^2 + \left(\frac{r}{\sqrt{3}}\right)^2} = r \cdot \sqrt{1+4+\frac{1}{3}} = \frac{4}{\sqrt{3}} \cdot r$$

$$d_G^{J'} = \sqrt{0 + (2r)^2 + \left(\frac{2r}{\sqrt{3}}\right)^2} = 2r \cdot \sqrt{1+\frac{1}{3}} = \frac{4}{\sqrt{3}} \cdot r$$

$$\frac{E \cdot 中_{ref}^2}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2} = \frac{1}{2r} + \frac{1}{2r} + \frac{1}{2r} + \frac{1}{2\sqrt{2} \cdot r} + \frac{1}{2\sqrt{2} \cdot r} + \frac{1}{\frac{4}{\sqrt{3}} \cdot r} - \frac{1}{2\sqrt{2} \cdot r} - \frac{1}{2\sqrt{2} \cdot r} - \frac{1}{2\sqrt{2} \cdot r} - \frac{1}{2\sqrt{2} \cdot r} - \frac{1}{\frac{4}{\sqrt{3}} \cdot r} - \frac{1}{\frac{4}{\sqrt{3}} \cdot r}$$

$$\frac{E \cdot 中_{ref}^2}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2} = \frac{3}{2r} - \frac{1}{\sqrt{2} \cdot r} - \frac{1}{\frac{4}{\sqrt{3}} \cdot r} = \frac{1}{4r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]$$

$$E = \frac{k_e \cdot e^2}{4r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right] \frac{\left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2}{中_{ref}^2}$$

$$\frac{E \cdot 中_{ref}^2 \cdot 4r}{k_e \cdot e^2 \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]} = \left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2$$

$$\sqrt{\frac{E \cdot 中_{ref}^{2} \cdot 4r}{k_e \cdot e^2 \cdot [6 - 2\sqrt{2} - \sqrt{3}]}} = 中_{ref} + \alpha_A \cdot 中_{\delta A}$$

$$\alpha_A \cdot 中_{\delta A} = \sqrt{\frac{E \cdot 中_{ref}^{2} \cdot 4r}{k_e \cdot e^2 \cdot [6 - 2\sqrt{2} - \sqrt{3}]}} - 中_{ref}$$

$$\alpha_A \cdot 中_{\delta A} = \sqrt{\frac{3.564\,360\,233 \cdot 10^{-13} \cdot 82.81 \cdot 10^{-62} \cdot 4 \cdot 0.36373 \cdot 10^{-15}}{8.987552 \cdot 1.602177^2 \cdot 10^{-29} \cdot [6 - 2\sqrt{2} - \sqrt{3}]}} - 9.1 \cdot 10^{-31}$$

$$\alpha_A \cdot 中_{\delta A} = \sqrt{\frac{3.564\,360\,233 \cdot 82.81 \cdot 4 \cdot 0.36373 \cdot 10^{-61}}{8.987552 \cdot 1.602177^2 \cdot [6 - 2\sqrt{2} - \sqrt{3}]}} - 9.1 \cdot 10^{-31}$$

$$\alpha_A \cdot 中_{\delta A} = \sqrt{12.93072 \cdot 10^{-61}} - 9.1 \cdot 10^{-31}$$

$$\alpha_A \cdot 中_{\delta A} = 11.371332376 \cdot 10^{-31} - 9.1 \cdot 10^{-31}$$

$$\alpha_A \cdot 中_{\delta A} = 2.271\,332\,376 \cdot 10^{-31}$$

$$\alpha_A \cdot 1489.821\,606 \cdot 10^{-31} = 2.271\,332\,376 \cdot 10^{-31}$$

$$\alpha_A = 0.001\,524\,567$$

Verification:

$$E = \frac{k_e \cdot e^2}{4r} \cdot [6 - 2\sqrt{2} - \sqrt{3}] \frac{\left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2}{中_{ref}^{2}}$$

$$\frac{\left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2}{中_{ref}^{2}} = \frac{(9.1 \cdot 10^{-31} + 0.001524567 \cdot 1489.821\,606 \cdot 10^{-31})^2}{(9.1 \cdot 10^{-31})^2}$$

$$= \frac{(11.371332376 \cdot 10^{-31})^2}{82.81 \cdot 10^{-62}} = 1.561\,492\,573$$

$$E = \frac{8.987552 \cdot 1.602177^2}{4 \cdot 0.36373} \cdot 10^{9-38+15} [6 - 2\sqrt{2} - \sqrt{3}] \cdot 1.561492573$$

$$E = 22.826620318 \cdot 10^{-14} \cdot 1.561492573 \cdot J = 3.564\,3598\,103 \cdot 10^{-13}\,J$$

$$E_{L0} = -2.224694\ \text{MeV} = -3.564\,3598\,103 \cdot 10^{-13}\,J$$

These electrinettes being free, the length of each electron-positron pair is equal to 2r. (Reminder: r is the radius of the charginettes)

The overall neutrality of the neutron requires close proximity and perfect alignment of the electrinettes in the axes of symmetry.

Once the bond is established, it is between three pairs of static charges, and therefore relatively stable. This static aspect implies that there is no bond energy to release when the bond is broken. Energy must even be provided.

The position of the electrinettes is assumed to be at the center of each chrominette. The reality is different. Indeed, coupling two electrinettes of opposite signs would tend to bring them closer together. While coupling two electrinettes of identical signs would tend to push them apart. This changes the initial position of the electrinettes. But the exact position is a little difficult to determine.

So, the previously obtained value is an approximate value.

4.9.2 Modeling of the connections between free electrinettes: LL_0

This bond can exist between two proton-neutron pairs. The following diagram shows one view.

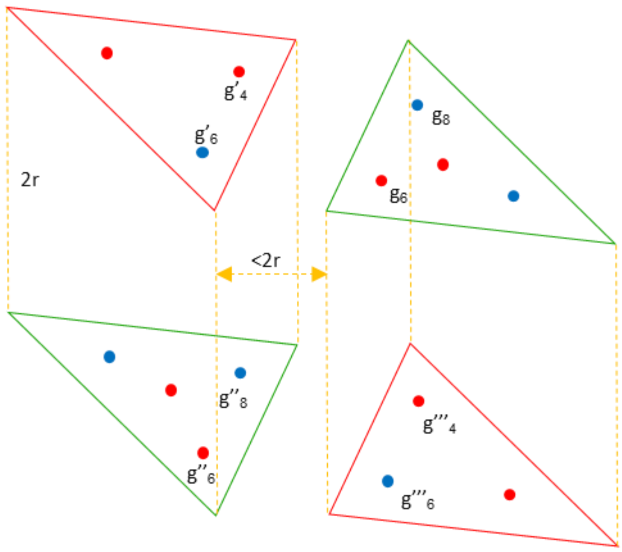
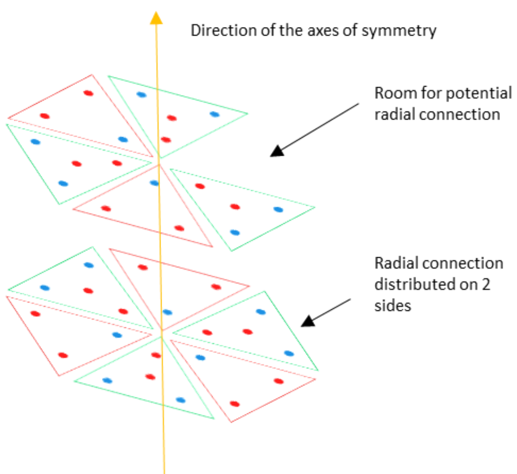
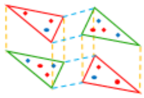


Figure 41 - Radial connection of 2 Proton-Neutron pairs

There is another special case:



To simplify the illustrations, the following symbol will be used for a radial LL_0 bond between two proton and neutron pairs:



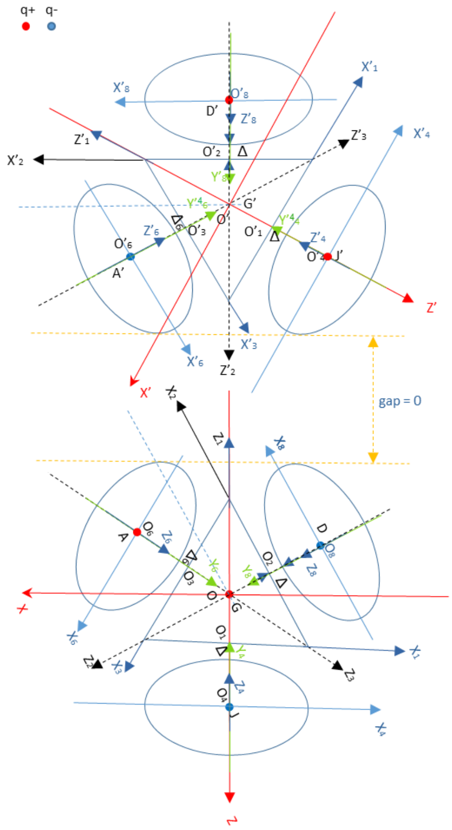


Figure 42 - Coordinates of a proton and a neutron side by side

Determine the coordinates of O_6 and O_8:

$$M_6 = \begin{pmatrix} \frac{1}{2} & \frac{-3}{4} & \frac{\sqrt{3}}{4} & \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2} \\ \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{4} & -\frac{1}{4} & -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$O_6 = M_6 \otimes O_{6R6} = \begin{pmatrix} \frac{1}{2} & \frac{-3}{4} & \frac{\sqrt{3}}{4} & \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 0 & -\frac{1}{2} & \frac{-\sqrt{3}}{2} & -\frac{r}{2} \\ \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{4} & -\frac{1}{4} & -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

To determine the coordinates of O_8, we use the symmetry between O_6 and O_8 with respect to the OYZ plane:

$$O_8 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

By canceling the y component, we obtain the coordinates of g_6 and g_8:

$$g_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 0 \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

$$g_8 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ 0 \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

Adding 2r to the y component gives the coordinates of g'''_6 and g'''_4:

$$g'''_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 2r \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

$$g'''_4 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ 2r \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

Determine the coordinates of O'_6 and O'_4:

$$O'_{6R'} = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

Determine the angle where side Z is minimal for point Γ:

$$\Gamma\begin{pmatrix} x_\gamma \\ y_\gamma \\ z_\gamma \\ 1 \end{pmatrix} = \Gamma\begin{pmatrix} \frac{r}{2}\cdot\cos(\omega t) - \frac{3}{4}r\cdot\sin(\omega t) + z_6\frac{\sqrt{3}}{4} + \Delta_6\frac{\sqrt{3}}{2} + \frac{3r}{4} + z_0\frac{\sqrt{3}}{2} \\ -\frac{r}{2}\cdot\sin(\omega t) - z_6\frac{\sqrt{3}}{2} - \frac{r}{2} \\ r\frac{\sqrt{3}}{2}\cdot\cos(\omega t) + r\frac{\sqrt{3}}{4}\cdot\sin(\omega t) - \frac{z_6}{4} - \frac{r\sqrt{3}}{4} - \frac{\Delta_6}{2} - \frac{z_0}{2} \\ 1 \end{pmatrix}$$

$$z_\Gamma = r\frac{\sqrt{3}}{2}\cdot\cos(\omega t) + r\frac{\sqrt{3}}{4}\cdot\sin(\omega t) - \frac{z_6}{4} - \frac{r\sqrt{3}}{4} - \frac{\Delta_6}{2} - \frac{z_0}{2}$$

$$z'_\Gamma = r\frac{\sqrt{3}}{2}\cdot\sin(\omega t)\cdot\omega + r\frac{\sqrt{3}}{4}\cdot\cos(\omega t)\,\omega = 0$$

$$\frac{\sqrt{3}}{2}\cdot\sin(\omega t) + \frac{\sqrt{3}}{4}\cdot\cos(\omega t) = 0$$

$$2\cdot\sin(\omega t) + \cos(\omega t) = 0$$

$$\tan(\omega t) = -\frac{1}{2}$$

$$\omega t = -26.565\,051\,177° \; ou \; \omega t = -206.565\,051\,177°$$

So:

- α_{zmin} = -206.565 051 177°
- $z_{\Gamma min}$ = -0.614 679 576

The R' reference point is obtained with a displacement towards O', then a rotation of -60° around the OY axis. The coordinates of O':

$$O'\begin{pmatrix} x_{O'} \\ y_{O'} \\ z_{O'} \\ 1 \end{pmatrix} = O'\begin{pmatrix} 0 \\ 0 \\ 2z_{\Gamma min} \\ 1 \end{pmatrix} = O'\begin{pmatrix} 0 \\ 0 \\ -1.229\,359\,152 \\ 1 \end{pmatrix}$$

The transformation matrix is:

$$M_{OO'} = \begin{pmatrix} \cos\left(\frac{-\pi}{3}\right) & 0 & \sin\left(\frac{-\pi}{3}\right) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\left(\frac{-\pi}{3}\right) & 0 & \cos\left(\frac{-\pi}{3}\right) & 2z_{\Gamma min} \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$M_{OO'} = \begin{pmatrix} \frac{1}{2} & 0 & -\frac{\sqrt{3}}{2} & 0 \\ 0 & 1 & 0 & 0 \\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} & -1.229\,359\,152 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Determine the coordinates of O'_6 and O'_4:

$$O'_{6R'} = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

$$O'_6 = M_{OO'} \otimes O'_{6R'} = \begin{pmatrix} \frac{1}{2} & 0 & -\frac{\sqrt{3}}{2} & 0 \\ 0 & 1 & 0 & 0 \\ \frac{\sqrt{3}}{2} & 0 & \frac{1}{2} & 2z_{\Gamma min} \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

To determine the coordinates of O’$_4$, we use the symmetry between O’$_6$ and O’$_4$ with respect to the OYZ plane:

$$O'_4 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ -\frac{r}{2} \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

By canceling the y component, we obtain the coordinates of g’$_6$ and g’$_4$:

$$g'_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 0 \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

$$g'_4 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ 0 \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

Adding 2r to the y component, we obtain the coordinates of g’’$_6$ and g’’$_8$:

$$g''_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 2r \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

$$g''_8 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ 2r \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

The total bond energy is:

$$E_{total} = E_{PN1} + E_{PN2} + E_{2PN}$$

$$E_{PN1} = E_{PN2} = \frac{k_e \cdot e^2}{4r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right] \frac{\left(中_{ref} + \alpha_A \cdot 中_{\delta A}\right)^2}{中_{ref}^2}$$

Determine the potential energies between pairs of electric charges:

$$E_{2PN} = E_{g6}^{g6'} + E_{g8}^{g4'} + E_{g6''}^{g6'''} + E_{g8''}^{g4'''} + E_{g6}^{g8''} + E_{g8}^{g6''} + E_{g6'}^{g4'''} + E_{g4'}^{g6'''} - E_{g6}^{g4'} - E_{g8}^{g6'} - E_{g6''}^{g4'''} \\ - E_{g8''}^{g6'''} - E_{g6}^{g6''} - E_{g8}^{g8''} - E_{g6'}^{g6'''} - E_{g4'}^{g4'''}$$

$$E_x^{y'} = k_e \frac{中_x \cdot 中_{y'}}{中_{ref}^2} \cdot \frac{e^2}{d_x^{y'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_x \cdot 中_{\delta x}\right)\left(中_{ref} + \alpha_{y'} \cdot 中_{\delta y'}\right) e^2}{中_{ref}^2 \cdot d_x^{y'}}$$

Definition of terms:

- $中_{ref}$: the neutral charge of an electrinette at rest.
- α_x : the coefficient of participation of the neutral charge of the neighborhood of the electrinette x.
- $中_{\delta x}$: the neutral charge of the neighborhood of the electrinette x.
- $\alpha_{y'}$: the coefficient of participation of the neutral charge of the neighborhood of the electrinette y'.
- $中_{\delta y'}$: the neutral charge of the neighborhood of the electrinette y'.

$$E_g^{g'} = k_e \frac{中_g \cdot 中_{g'}}{中_{ref}^2} \cdot \frac{e^2}{d_g^{g'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)\left(中_{ref} + \alpha_{g'} \cdot 中_{\delta g'}\right) e^2}{中_{ref}^2 \cdot d_g^{g'}}$$

$$中_{\delta x} = 中_{\delta g} = 12\left(中_F + 中_F + 中_H\right) + 12\left(中_H + 中_H + 中_F\right)$$

$$中_{\delta y'} = 中_{\delta g'} = 中_{\delta g}$$

$$中_{\delta g} = 2979.643212 \cdot 10^{-31}\, kg$$

$$\frac{E \cdot 中_{ref}^{2}}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2} = \frac{1}{d_{g6}^{g6'}} + \frac{1}{d_{g8}^{g4'}} + \frac{1}{d_{g6''}^{g6'''}} + \frac{1}{d_{g8''}^{g4'''}} + \frac{1}{d_{g6}^{g8''}} + \frac{1}{d_{g8}^{g6''}} + \frac{1}{d_{g6'}^{g4'''}} + \frac{1}{d_{g4'}^{g6'''}} - \frac{1}{d_{g6}^{g4'}} - \frac{1}{d_{g8}^{g6'}} - \frac{1}{d_{g6''}^{g4'''}} - \frac{1}{d_{g8''}^{g6'''}} - \frac{1}{d_{g6}^{g6''}} - \frac{1}{d_{g8}^{g8''}} - \frac{1}{d_{g6'}^{g6'''}} - \frac{1}{d_{g4'}^{g4'''}}$$

$$g_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 0 \\ -\frac{1}{2}\Delta_6 - \frac{\sqrt{3}}{4}r - \frac{1}{2}z_0 \\ 1 \end{pmatrix}$$

$$g''_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 2r \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

$$g'_4 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ 0 \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

$$g'_6 = \begin{pmatrix} \frac{\sqrt{3}}{2}\Delta_6 + \frac{3}{4}r + \frac{\sqrt{3}}{2}z_0 \\ 0 \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

$$g''_8 = \begin{pmatrix} -\frac{\sqrt{3}}{2}\Delta_6 - \frac{3}{4}r - \frac{\sqrt{3}}{2}z_0 \\ 2r \\ \frac{1}{2}\Delta_6 + \frac{\sqrt{3}}{4}r + \frac{1}{2}z_0 + 2z_{\Gamma min} \\ 1 \end{pmatrix}$$

$$d_{g6}^{g6'} = \sqrt{\left(\Delta_6 + \frac{\sqrt{3}}{2}r + z_0 + 2 \cdot z_{\Gamma min}\right)^2} = -\Delta_6 - \frac{\sqrt{3}}{2}r - z_0 - 2 \cdot z_{\Gamma min}$$

$$d_{g8}^{g4'} = d_{g6''}^{g6'''} = d_{g8''}^{g4'''} = d_{g6}^{g6'} = 0.704\,360\,118$$

$$d_{g6}^{g8''} = \sqrt{\left(\sqrt{3}\Delta_6 + \frac{3}{2}r + \sqrt{3}z_0\right)^2 + (2r)^2 + \left(\Delta_6 + \frac{\sqrt{3}}{2}r + z_0 + 2 \cdot z_{\Gamma min}\right)^2}$$

$$d_{g8}^{g6''} = d_{g6'}^{g4'''} = d_{g4'}^{g6'''} = d_{g6}^{g8''} = 1.360\,953\,042$$

$$d_{g6}^{g4'} = \sqrt{\left(\sqrt{3}\Delta_6 + \frac{3}{2}r + \sqrt{3}z_0\right)^2 + \left(\Delta_6 + \frac{\sqrt{3}}{2}r + z_0 + 2 \cdot z_{\Gamma min}\right)^2}$$

$$d_{g8}^{g6'} = d_{g6''}^{g4'''} = d_{g8''}^{g6'''} = d_{g6}^{g4'} = 1.150\,215\,254$$

$$d_{g6}^{g6''} = \sqrt{(2r)^2 + \left(\Delta_6 + \frac{\sqrt{3}}{2}r + z_0 + 2 \cdot z_{\Gamma min}\right)^2}$$

$$d_{g8}^{g8''} = d_{g6'}^{g6'''} = d_{g4'}^{g4'''} = d_{g6}^{g6''} = 1.012\,581\,467$$

Digital application:

- $r = 0.36373 * 10^{-15}$ m
- $\Delta_6 = 0$
- $z_0 = r / \sqrt{3}$
- $z_{\Gamma min} = -0.614\,679\,576 * 10^{-15}$ m

$$\frac{E_{2PN} \cdot 中_{ref}^2}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2} = \frac{4}{d_{g6}^{g6'}} + \frac{4}{d_{g6}^{g8''}} - \frac{4}{d_{g6}^{g4'}} - \frac{4}{d_{g6}^{g6''}}$$

$$E_{total} = \frac{k_e \cdot e^2}{2r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right] \frac{\left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2}{中_{ref}^2} + k_e \cdot \frac{\left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2 e^2}{中_{ref}^2} \cdot \left[\frac{4}{d_{g6}^{g6'}} + \frac{4}{d_{g6}^{g8''}} - \frac{4}{d_{g6}^{g4'}} - \frac{4}{d_{g6}^{g6''}}\right]$$

$$\frac{E_{total} \cdot 中_{ref}^2}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2} = \frac{\left[6 - 2\sqrt{2} - \sqrt{3}\right]}{2r} + \frac{4}{d_{g6}^{g6'}} + \frac{4}{d_{g6}^{g8''}} - \frac{4}{d_{g6}^{g4'}} - \frac{4}{d_{g6}^{g6''}}$$

$$\frac{E_{total} \cdot 中_{ref}^2 \cdot 10^{-15}}{k_e \cdot e^2 \cdot \left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2} = 1.978\,833\,293 + \frac{4}{0.704\,360\,118} + \frac{4}{1.360\,953\,042} - \frac{4}{1.150\,215\,254} - \frac{4}{1.012\,581\,467} = 1.978\,833\,293 + 1.190\,120\,7 = 3.168\,953\,993$$

Where,

$E_{total} = E_{he000}$ = -28.297 499 001 MeV = -45.337 686 948*10^{-13} J.

We deduce the value of α_g:

$$\frac{E_{total} \cdot 中_{ref}^{2} \cdot 10^{-15}}{k_e \cdot e^2 \cdot [3.168\,953\,993]} = \left(中_{ref} + \alpha_g \cdot 中_{\delta g}\right)^2$$

$$\alpha_g \cdot 中_{\delta g} = \sqrt{\frac{E_{total} \cdot 中_{ref}^{2} \cdot 10^{-15}}{k_e \cdot e^2 \cdot [3.168\,953\,993]}} - \left(中_{ref}\right)$$

We have:

$$中_{\delta g} = 12\left(中_F + 中_F + 中_H\right) + 12\left(中_H + 中_H + 中_F\right) = 2979.643212 \cdot 10^{-31}\ kg$$

$$中_{ref} = 9.1 \cdot 10^{-31}$$

$$\alpha_g 中_{\delta g} = \sqrt{\frac{45.337686948 \cdot 10^{-13} \cdot 82.81 \cdot 10^{-62} \cdot 10^{-15}}{8.987552 \cdot 1.602177^2 \cdot 10^{-29} \cdot [3.168\,953\,993]}} - 9.1 \cdot 10^{-31}$$

$$\alpha_g 中_{\delta g} = \sqrt{\frac{3.380\,596\,505 \cdot 10^{-61}}{1.0}} - 9.1 \cdot 10^{-31}$$

$$\alpha_g 中_{\delta g} = 22.661\,147\,831 \cdot 10^{-31} - 9.1 \cdot 10^{-31}$$

$$\alpha_g \cdot 2979.643212 \cdot 10^{-31} = 13.561\,147\,831 \cdot 10^{-31}$$

$$\alpha_g = 0.004\,551\,266$$

4.9.3 Modeling of connections between bound electrinettes

This type of connection can exist between 2 nucleons. Nucleons are protons and neutrons or nucleonettes. The following diagram shows a top view of a proton and a neutron.

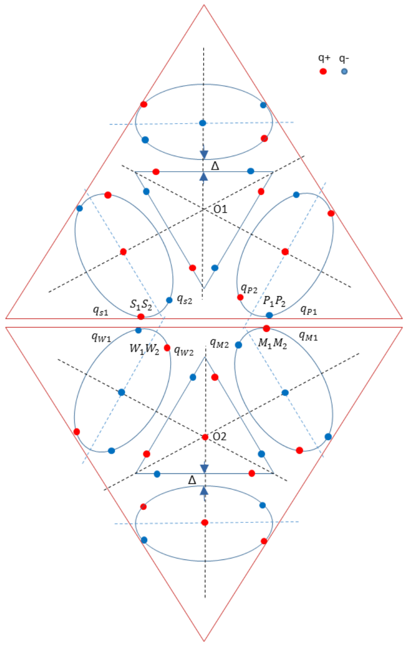


Figure 43 - Connection between bound electrinettes

The contact points are defined as follows:

1. The external charginettes of the O1 nucleon coming into contact with the O2 nucleon number 4 pairs.
2. Compared to the diagram, the two points of contact of the 2 upper charginettes are: S_1 and P_1.
3. Compared to the diagram, the two points of contact of the 2 lower charginettes are: S_2 and P_2.
4. The external charginettes of the O2 nucleon coming into contact with the O1 nucleon are necessarily 4 in number.
5. Compared to the diagram, the two points of contact of the 2 upper charginettes are: W_1 and M_1. W_1 is very close to S_1. M_1 is very close to P_1.
6. Compared to the diagram, the two points of contact of the 2 lower charginettes are: W_2 and M_2. W_2 is very close to S_2. M_2 is very close to P_2.
7. The electrinette q_{S1} and the electrinette q_{W1} meet at the contact point S_1 and W_1.
8. The q_{P1} electrinette and the q_{M1} electrinette meet at the contact point P_1 and M_1.
9. The q_{S2} electrinette and the q_{W2} electrinette meet at the contact point S_2 and W_2.
10. The q_{P2} electrinette and the q_{M2} electrinette meet at the contact point P_2 and M_2.

For the contact points between the two nucleons to be on the 6 planes forming the 2 large triangles, the rotations of the charginettes would all have to be synchronized.

So, for a fusion to take place, the nucleons must be synchronized. This is the same condition as for the chrominette and the nucleonette.

Apart from synchronization, there is no longer any constraint on the direction of rotation or on the energy level. Indeed, the 2 electrinettes approaching the contact point are of opposite signs. Therefore, they can (but do not necessarily) be of the same energy level and in the same direction of movement.

The contact points are not in the middle of the existing contact points. They are a little apart. But this does not prevent the connection from being made.

The contact points are made in groups of 4. This makes the connection stable.

There are 4 cases for each nucleon or nucleonette. Let's take the first nucleon O1:

1. The electrinettes q_{P1}, q_{P2}, q_{S1} and q_{S2} are of the same energy level E_1.
2. The electrinettes q_{P1}, q_{P2}, q_{S1} and q_{S2} are of the same energy level E_2. $E_2 > E_1$.
3. The electrinettes q_{P1}, q_{P2}, q_{S1} and q_{S2} are of the different energy level $E_{P1} = E_{P2} = E_1$ and $E_{S1} = E_{S2} = E_2$.
4. The electrinettes q_{P1}, q_{P2}, q_{S1} and q_{S2} are of the different energy level $E_{P1} = E_{P2} = E_2$ and $E_{S1} = E_{S2} = E_1$.

Combining with the 4 cases of the second O2 nucleonette, there are a total of 16 possible combinations. But due to symmetry, there are only 6 binding energy levels.

Which requires that the Q and W electrinettes also have the same energy level E_2. E_2 != E_1. Which requires that the Q and W electrinettes also have different energy levels E_2 and E_1. The first case corresponds to a proton-neutron connection. The second case corresponds to a proton-proton or neutron-neutron or proton-neutron connection.

4.9.3.1 Case 1: The electrinettes q_s and q_p are of the same energy level E_1

By combining with the 4 cases of the O2 nucleon, we obtain the following 4 combinations:

1. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_1.

$$L_{11} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_1 \\ E_1 & E_1 \\ E_1 & E_1 \\ E_1 & E_1 \end{pmatrix}$$

Since a charginette has two electrinettes, the binding energy is written:

$$E_{L11} = 2 \cdot 4 \cdot k_e \frac{中_{10} 中_{10}}{中_{ref}^2} \cdot \frac{e^2}{d}$$

It is necessary to determine the average distance d which separates the 2 electrinettes. As the two charginettes facing each other are in the same plane, d is equal to their diameter.

$d = 2*r = 2*0.36373*10^{-15}$ m $= 0.72746*10^{-15}$ m

$$E_{L11} = 2 \cdot 4k_e \frac{中_{10} 中_{10}}{中_{ref}^2} \cdot \frac{e^2}{d} = 2 \cdot 105.532549241 * 10^{-14}\, J = 13.173648 * \ 10^6\, eV$$

Digital application:

$中_{10} = 8.3 * 10^{-31}$ kg
$中_{ref} = 9.1 * 10^{-31}$ kg
$e = 1{,}602\ 176\ 565*10^{-19}$ C
$k_e = 8{,}987\ 551\ 787\ 368\ 176 * 10^9$ kg^{-1} m^{-1} A^{-2}

2. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_2. $E_2 > E_1$.

$$L_{12} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_2 \\ E_1 & E_2 \\ E_1 & E_2 \\ E_1 & E_2 \end{pmatrix}$$

The binding energy is written as:

$$E_{L12} = 2 \cdot 4k_e \frac{中_{10}中_{20}}{中^{2}_{ref}} \cdot \frac{e^2}{d} = \ 2 \cdot 940.892619526 * 10^{-14}\,J = 117.4518 * \ 10^6\ eV$$

3. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_1$ et $E_{M1} = E_{M2} = E_2$.

$$L_{13} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_1 \\ E_1 & E_1 \\ E_1 & E_2 \\ E_1 & E_2 \end{pmatrix}$$

The binding energy is written as:

$$E_{L13} = 2 \cdot 2k_e \frac{中_{10}中_{10}}{中^{2}_{ref}} \cdot \frac{e^2}{d} + 2 \cdot 2k_e \frac{中_{10}中_{20}}{中^{2}_{ref}} \cdot \frac{e^2}{d} = 2 \cdot 523.2126 * 10^{-14} J$$

$$E_{L13} = 65.31273 * 10^6\ eV$$

4. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_2$ et $E_{M1} = E_{M2} = E_1$.

$$L'_{14} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_2 \\ E_1 & E_2 \\ E_1 & E_1 \\ E_1 & E_1 \end{pmatrix}$$

Case L_{14} is equivalent to case L_{13}. So, there are only 3 connections of different energies.

4.9.3.2 *Case 2: The electrinettes q_s and q_p are of the same energy level E_2*

By combining with the 4 cases of the O2 nucleonette, we obtain the following 4 combinations:

1. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_1.

$$L'_{21} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_1 \\ E_2 & E_1 \\ E_2 & E_1 \\ E_2 & E_1 \end{pmatrix}$$

2. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_2. $E_2 > E_1$.

$$L_{22} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_2 \\ E_2 & E_2 \\ E_2 & E_2 \\ E_2 & E_2 \end{pmatrix}$$

The binding energy is written as:

$$E_{L22} = 2 \cdot 4k_e \frac{中_{20} 中_{20}}{中^2_{ref}} \cdot \frac{e^2}{d} = 2 \cdot 8388.681082 * 10^{-14}\, J = 1047.161 * 10^6\, eV$$

3. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_1$ et $E_{M1} = E_{M2} = E_2$.

$$L_{23} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_1 \\ E_2 & E_1 \\ E_2 & E_2 \\ E_2 & E_2 \end{pmatrix}$$

The binding energy is written as:

$$E_{L23} = 2 \cdot 2k_e \frac{中_{20} 中_{10}}{中^2_{ref}} \cdot \frac{e^2}{d} + 2 \cdot 2k_e \frac{中_{20} 中_{20}}{中^2_{ref}} \cdot \frac{e^2}{d} = 2 \cdot 4664.786844 * 10^{-14}\, J$$

$$E_{L23} = 582.3062 * \ 10^6\, eV$$

4. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_2$ et $E_{M1} = E_{M2} = E_1$.

$$L'_{24} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_2 \\ E_2 & E_2 \\ E_2 & E_1 \\ E_2 & E_1 \end{pmatrix}$$

Case L_{21} is equivalent to case L_{12}. Case L_{24} is equivalent to case L_{23}. So, there are only 2 connections of different energies.

4.9.3.3 Case 3: The electrinettes q_s and q_p are of different energy levels E_1 and E_2

By combining with the 4 cases of the O2 nucleonette, we obtain the following 4 combinations:

1. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_1.

$$L''_{31} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_1 \\ E_1 & E_1 \\ E_2 & E_1 \\ E_2 & E_1 \end{pmatrix}$$

2. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_2. $E_2 > E_1$.

$$L''_{32} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_2 \\ E_1 & E_2 \\ E_2 & E_2 \\ E_2 & E_2 \end{pmatrix}$$

3. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_1$ and $E_{M1} = E_{M2} = E_2$.

$$L_{33} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_1 \\ E_1 & E_1 \\ E_2 & E_2 \\ E_2 & E_2 \end{pmatrix}$$

The binding energy is written as:

$$E_{L33} = 2 \cdot 2k_e \frac{中_{10}中_{10}}{中_{ref}^{2}} \cdot \frac{e^2}{d} + 2 \cdot 2k_e \frac{中_{20}中_{20}}{中_{ref}^{2}} \cdot \frac{e^2}{d} = 2 \cdot 4247.1068158 * 10^{-14}\, J$$

$$E_{L33} = 530.1671 * \ 10^{6}\ eV$$

4. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_2$ and $E_{M1} = E_{M2} = E_1$.

$$L''_{34} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_1 & E_2 \\ E_1 & E_2 \\ E_2 & E_1 \\ E_2 & E_1 \end{pmatrix}$$

Case L_{31} is equivalent to case L_{13}. Case L_{32} is equivalent to case L_{23}. Case L_{34} is equivalent to case L_{12}. So, there is only 1 bond of different energies.

4.9.3.4 Case 4: The electrinettes q_s and q_p are of different energy levels E_2 and E_1

By combining with the 4 cases of the O2 nucleonette, we obtain the following 4 combinations:

1. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_1.

$$L'''_{41} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_1 \\ E_2 & E_1 \\ E_1 & E_1 \\ E_1 & E_1 \end{pmatrix}$$

2. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have the same energy level E_2. $E_2 > E_1$.

$$L'''_{42} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_2 \\ E_2 & E_2 \\ E_1 & E_2 \\ E_1 & E_2 \end{pmatrix}$$

3. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_1$ and $E_{M1} = E_{M2} = E_2$.

$$L'_{43} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_1 \\ E_2 & E_1 \\ E_1 & E_2 \\ E_1 & E_2 \end{pmatrix}$$

4. The electrinettes q_{W1}, q_{W2}, q_{M1} and q_{M2} have 2 different energy levels $E_{W1} = E_{W2} = E_2$ and $E_{M1} = E_{M2} = E_1$.

$$L'_{44} = \begin{pmatrix} S_1 & W_1 \\ S_2 & W_2 \\ P_1 & M_1 \\ P_2 & M_2 \end{pmatrix} = \begin{pmatrix} E_2 & E_2 \\ E_2 & E_2 \\ E_1 & E_1 \\ E_1 & E_1 \end{pmatrix}$$

Case L_{41} is equivalent to case L_{12}. Case L_{42} is equivalent to case L_{23}. Case L_{43} is equivalent to case L_{12}. Case L_{44} is equivalent to case L_{33}. Therefore, there are only 0 bonds of different energies.

4.9.3.5 Conclusion

The energy connection balance has 6 different levels.

Connection number	Couple SP, WM	Energy level in MeV	Possible configurations	No
L_{11}	**(E_1, E_1), (E_1, E_1)**	**13.173648**	**Proton – proton**	**1**
L_{12}	(E_1, E_1), (E_2, E_2)	117.4518	Proton – neutron	3
L_{13}	(E_1, E_1), (E_1, E_2)	65.31273	Proton – nucleon	2
L_{14}	(E_1, E_1), (E_2, E_1)	65.31273	Proton – nucleon	2
L_{21}	(E_2, E_2), (E_1, E_1)	117.4518	Neutron - Proton	3
L_{22}	**(E_2, E_2), (E_2, E_2)**	**1047.161**	**Neutron – neutron**	**6**
L_{23}	(E_2, E_2), (E_1, E_2)	582.3062	Neutron – nucleon	5
L_{24}	(E_2, E_2), (E_2, E_1)	582.3062	Neutron – nucleon	5
L_{31}	(E_1, E_2), (E_1, E_1)	65.31273	Nucleon – Proton	2
L_{32}	(E_1, E_2), (E_2, E_2)	582.3062	Nucleon – neutron	5
L_{33}	(E_1, E_2), (E_1, E_2)	530.1671	Nucleon – Nucleon	4
L_{34}	(E_1, E_2), (E_2, E_1)	117.4518	Nucleon – Nucleon	3
L_{41}	(E_2, E_1), (E_1, E_1)	65.31273	Nucleon – Proton	2
L_{42}	(E_2, E_1), (E_2, E_2)	582.3062	Nucleon – neutron	5
L_{43}	(E_2, E_1), (E_1, E_2)	117.4518	nucleon – nucleon	3
L_{44}	(E_2, E_1), (E_2, E_1)	530.1671	Nucleon – Nucleon	4

The values in this table are approximate.

The connection with the least energy, and therefore the most stable, is between 2 protons. However, the existence of two positive charges imposes a repulsive force which weakens this connection.

The connection with the most energy, and therefore the least stable, is between 2 neutrons.

4.9.4 Modeling of the connections between 2 nucleonettes

The connection between the electrinettes of 2 nucleonettes remains similar to that between 2 pure nucleons of type 2. It is possible to combine 6 nucleonettes in a looped chain in the same plane. Then to continue on the periphery in the same plane.

The difference with nucleons is that there are no free electrinettes to be able to stack another plane in parallel to the first plane.

A block of 2 nucleonettes could be the neutrino ν_τ of the standard model whose mass is 1.777 GeV.

4.9.5 Modeling of the deuterium nucleus

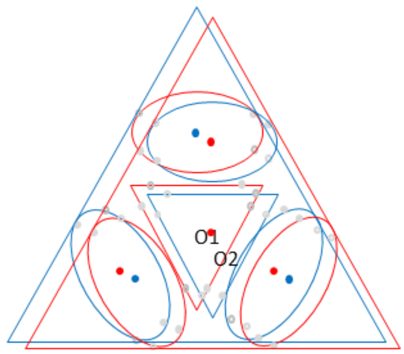
The deuterium nucleus is composed of a proton and a neutron. What is the relative position between these two nucleons?

There are 15 possible connections (all lines except L_{11} and L_{22}). Their energy level is ranked in ascending order: E_{L0}, E_{L2}, E_{L3}, E_{L4} et E_{L5}.

4.9.5.1 Case 0: The energy level E_{de0}

By taking the combination having a negative energy, we have:

$$E_{de0} = E_{L0} = -2.224694 \text{ MeV}$$

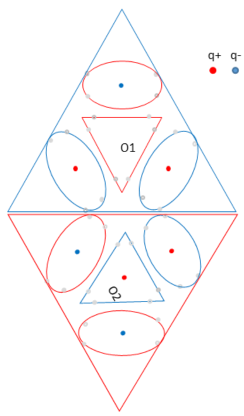


This case occurs when the environment is sufficiently cooled. Indeed, if the environment is that of plasmas, low energy bonds are broken, such as those between electrons and the nucleus of an atom. This is the last bond established during the cooling process.

4.9.5.2 Case 2: The energy level E_{de2}

By taking the combination having an energy E_{L2}, we have:

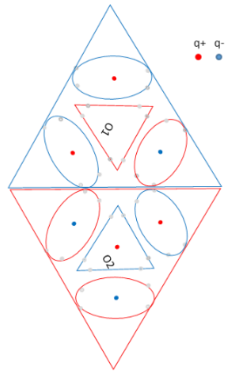
$$E_{de2} = E_{L2} = 65.313 \text{ MeV}$$



4.9.5.3 Case 3: The energy level E_{de3}

By taking the combination having an energy E_{L3}, we have:

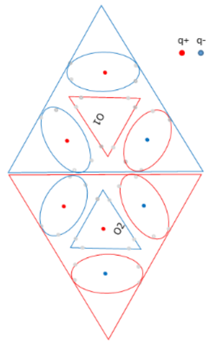
$$E_{de3} = E_{L3} = 117.45 \text{ MeV}$$



4.9.5.4 Case 4: The energy level E_{de4}

By taking the combination having an energy E_{L4}, we have:

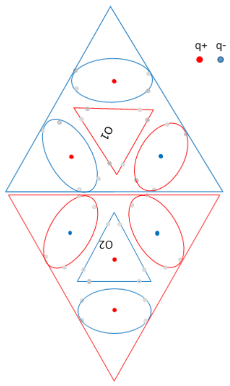
$$E_{de4} = E_{L4} = 530.17 \text{ MeV}$$



4.9.5.5 Case 5: The energy level E_{de5}

By taking the combination having an energy E_{L5}, we have:

$$E_{de5} = E_{L5} = 582.31 \text{ MeV}$$



This combination has the highest energy. This case is formed when the energy level of the environment exceeds a certain value. This is the first case that appears during cooling after fusion.

4.9.5.6 Conclusion

The liaison balance has 5 different levels.

No	Combi-nation	Binding energy	Static stability	Dynamic stability	Electrical stability	Comment
1	De0	-2.224694	10	1	10	Stacking rate +
2	De2	65.313	1	60	0	low energy rate n_0
3	De3	117.45	1	100	20	low energy rate ++
4	De4	530.17	1	500	-20	middle energy rate --
5	De5	582.31	1	600	0	middle energy rate n_0

During the cooling process, deuterium nuclei occur in descending order of the 5 levels. First, deuterium nuclei of energy E_{de4}. Then, the temperature drops, deuterium nuclei of energy E_{de3}. And so on.

Of course, except for the E_{L0} case, the nucleons must satisfy the synchronization conditions.

4.9.6 Modeling of the tritium nucleus

The tritium nucleus is composed of one proton and two neutrons. What is the relative position between these three nucleons?

The connection between the proton and the first neutron has the same possibilities as for deuterium.

To connect the remaining neutron, there are multiple possibilities to glue it to the already fixed neutron or to the proton.

4.9.6.1 Case 0n: The energy level E_{tr0n}

By taking the combination having a negative energy EL0, we have:

$$E_{tr0n} = -4.241\ 082 \text{ MeV}$$

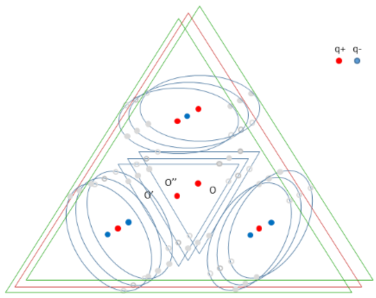
The first connection is L_{tr0n}. The proton is in parallel with the first neutron.

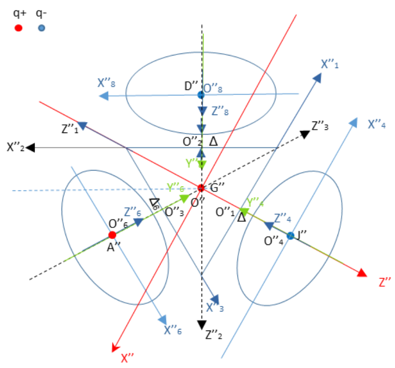
4.9.6.1.1 Case 00: The energy level E_{tr00}

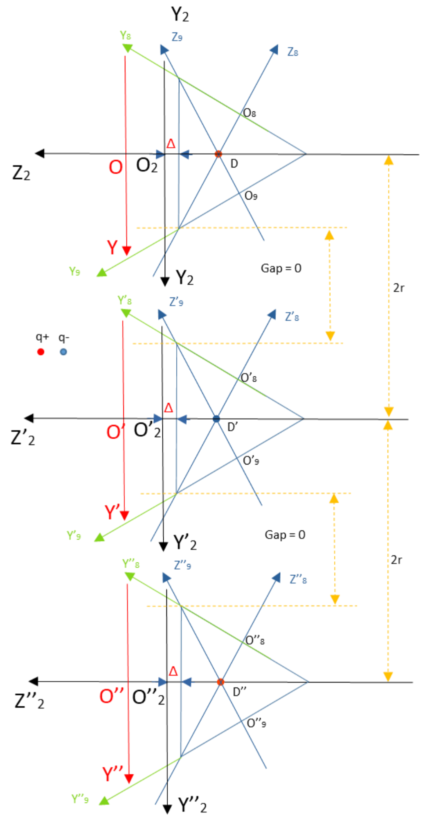
By taking the combination having a negative energy for the second neutron, we have:

$$E_{tr00} = -8.482\ 164 \text{ MeV (experimental value)}$$

The two connections are noted L_{tr00}. The second neutron is in parallel with the proton.







These are the last connections made during the cooling process.

Binding energies can be calculated in the same way as for deuterium.

The coordinates of points D, D’, D’’, J, J’, J’’, A, A’, A’’, G, G’ and G’’ in the global reference frame are:

$$\overrightarrow{OD} = 2 \cdot \overrightarrow{OO_2}$$

$$D(x,y,z) = 2O_2\left(-\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = D\left(-\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = D(-r, 0, -\frac{r}{\sqrt{3}})$$

$$D'(x,y,z) = D'(-r, -2r, -\frac{r}{\sqrt{3}})$$

$$D''(x,y,z) = D''(-r, -4r, -\frac{r}{\sqrt{3}})$$

$$A(x,y,z) = 2O_3\left(\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = A\left(\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = A(r, 0, -\frac{r}{\sqrt{3}})$$

$$A'(x,y,z) = A'(r, -2r, -\frac{r}{\sqrt{3}})$$

$$A''(x,y,z) = A''(r, -4r, -\frac{r}{\sqrt{3}})$$

$$J(x,y,z) = 2O_1(0,0,z_0) = J\left(0,0,2\frac{r}{\sqrt{3}}\right) = J(0,0,\frac{2r}{\sqrt{3}})$$

$$J'(x,y,z) = J'(0, -2r, \frac{2r}{\sqrt{3}})$$

$$J''(x,y,z) = J''(0, -4r, \frac{2r}{\sqrt{3}})$$

$$G(x,y,z) = G(0,0,0)$$

$$G'(x,y,z) = G'(0, -2r, 0)$$

$$G''(x,y,z) = G''(0, -4r, 0)$$

Determine the potential energies between the electric charge pairs of the first neutron and the proton:

$$E = E_A^{A'} + E_D^{D'} + E_J^{J'} + E_D^{J'} + E_J^{D'} + E_G^{A'} - E_A^{D'} - E_A^{J'} - E_D^{A'} - E_J^{A'} - E_G^{D'} - E_G^{J'}$$

$$E_x^{y'} = k_e \frac{中_x \cdot 中_{y'}}{中_{ref}^2} \cdot \frac{e^2}{d_x^{y'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_B \cdot 中_{\delta y''}\right)\left(中_{ref} + \alpha_B \cdot 中_{\delta y''}\right) e^2}{中_{ref}^2 \cdot d_x^{y'}}$$

The additional terms are defined as follows:

- α_B : the coefficient of proportionality of the neutral charge affecting tritium.
- $中_{\delta y''}$: the neutral charge of tritium without the static electrinettes.

$$E = \frac{k_e \cdot e^2}{4r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right] \frac{\left(中_{ref} + \alpha_B \cdot 中_{\delta y''}\right)^2}{中_{ref}^2}$$

here,

$$E = E_{tr00}/2 = -4.241\ 082 \text{ MeV} = 6.794976759*10^{-13} \text{ J}.$$

We deduce the value of α_B:

$$\frac{E \cdot 中_{ref}^{2} \cdot 4r}{k_e \cdot e^2 \cdot [6 - 2\sqrt{2} - \sqrt{3}]} = \left(中_{ref} + \alpha_B \cdot 中_{\delta y\prime\prime}\right)^2$$

$$\alpha_B \cdot 中_{\delta y\prime\prime} = \sqrt{\frac{E \cdot 中_{ref}^{2} \cdot 4r}{k_e \cdot e^2 \cdot [6 - 2\sqrt{2} - \sqrt{3}]}} - \left(中_{ref}\right)$$

We have:

$$中_{\delta y\prime\prime} = 8\left(中_F + 中_F + 中_H\right) + 10\left(中_H + 中_H + 中_F\right) = 2300.946\,702 \cdot 10^{-31}\,kg$$

$$中_{ref} = 9.1 \cdot 10^{-31}$$

$$\alpha_B 中_{\delta y\prime\prime} = \sqrt{\frac{6.794976759 \cdot 10^{-13} \cdot 82.81 \cdot 10^{-62} \cdot 4 \cdot 0.36373 \cdot 10^{-15}}{8.987552 \cdot 1.602177^2 \cdot 10^{-29} \cdot [6 - 2\sqrt{2} - \sqrt{3}]}} - 9.1 \cdot 10^{-31}$$

$$\alpha_B 中_{\delta y\prime\prime} = \sqrt{\frac{24.650693695 \cdot 10^{-61}}{1.0}} - 9.1 \cdot 10^{-31}$$

$$\alpha_B 中_{\delta y\prime\prime} = 15.700\,539\,384 \cdot 10^{-31} - 9.1 \cdot 10^{-31}$$

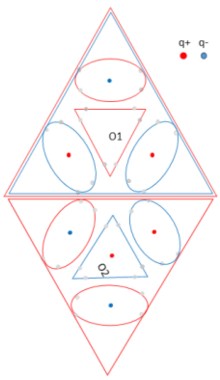
$$\alpha_B \cdot 2300.946702 \cdot 10^{-31} = 6.600\,539\,384 \cdot 10^{-31}$$

$$\alpha_B = 0.002\,868\,619$$

4.9.6.1.2 Case 02: The energy level E_{tr02}

By taking the combination having an energy E_{L2} for the second neutron, we have:

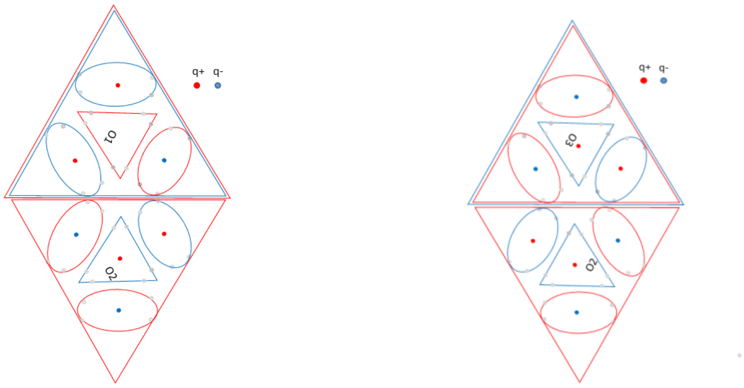
$$E_{tr02} = E_{tr0n} + E_{L2} = 65.313 - 4.241\,082\text{ MeV} = 61.072\text{ MeV}$$



4.9.6.1.3 Case 03: The energy level E_{tr03}

By taking the combination having an energy E_{L3} for the second neutron, we have:

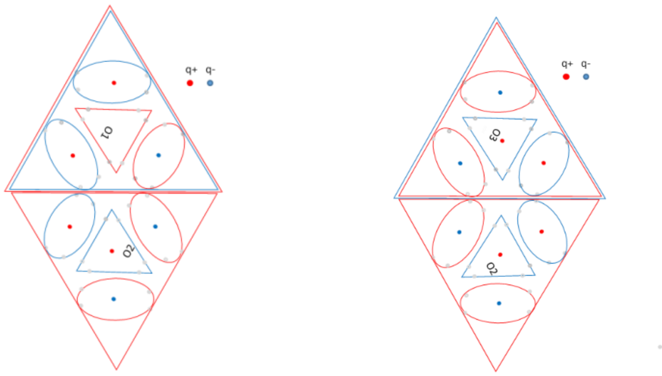
$$E_{tr03} = E_{tr0n} + E_{L3} = 117.45 - 4.241\,082\text{ MeV} = 113.209\text{ MeV}$$



4.9.6.1.4 Case 04: The energy level E_{tr04}

By taking the combination having an energy E_{L4} for the second neutron, we have:

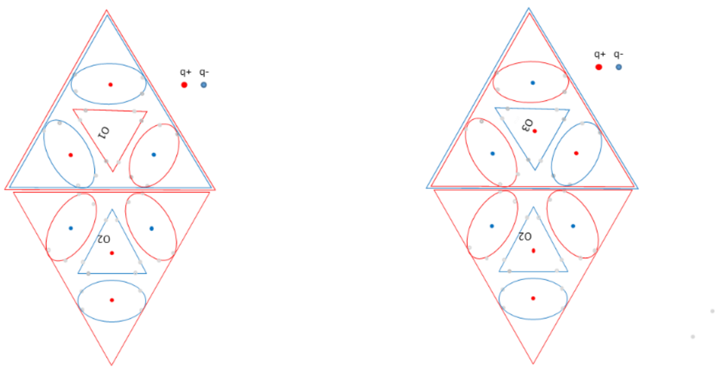
$$E_{tr04} = E_{tr0n} + E_{L4} = 530.1671 - 4.241\,082 \text{ MeV} = 525.926 \text{ MeV}$$



4.9.6.1.5 Case 05: The energy level E_{tr05}

By taking the combination having an energy E_{L5} for the second neutron, we have:

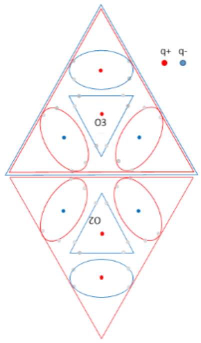
$$E_{tr05} = E_{tr0n} + E_{L5} = 582.3062 - 4.241\,082 \text{ MeV} = 578.065 \text{ MeV}$$



4.9.6.1.6 Case 06: The energy level E_{tr06}

By taking the combination having an energy E_{L6} for the second neutron, we have:

$$E_{tr06} = E_{tr0n} + E_{L6} = 1047.161 - 4.241\,082 \text{ MeV} = 1042.92 \text{ MeV}$$



4.9.6.2 *Case 2n: The energy level E_{tr2n}*

By taking the combination having an energy E_{L2}, we have:

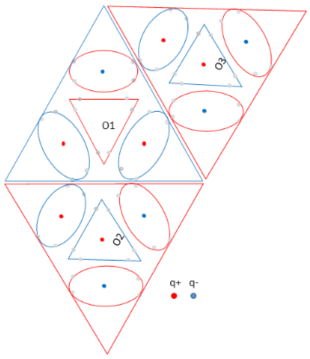
$$E_{tr2n} = E_{L2} = 65.31273 \text{ MeV}$$

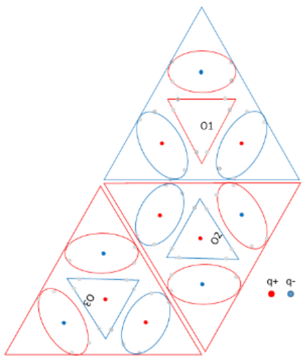
The first connection is L_{2n}. The proton is side by side with the first neutron.

4.9.6.2.1 Case 23: The energy level E_{tr23}

By taking the combination having an energy E_{L3} for the second neutron, we have:

$$E_{tr23} = E_{L2} + E_{L3} = 65.31273 + 117.4518 \text{ MeV} = 182.76 \text{ MeV}$$

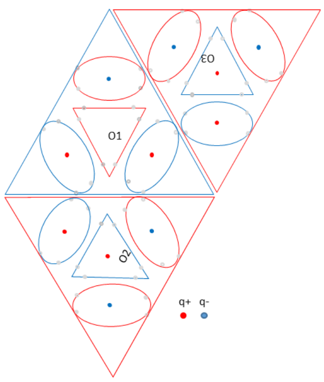


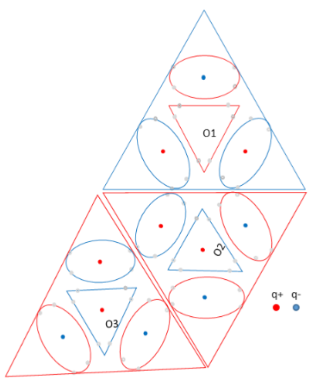


4.9.6.2.2 Case 24: The energy level E_{tr24}

By taking the combination having an energy E_{L4} for the second neutron, we have:

$$E_{tr24} = E_{L2} + E_{L4} = 65.31273 + 530.1671 \text{ MeV} = 595.48 \text{ MeV}$$

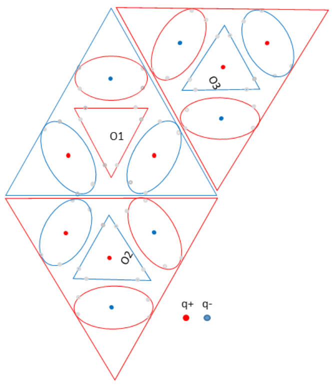


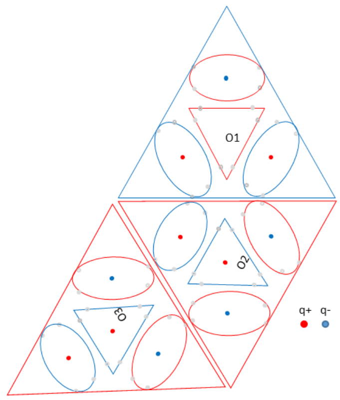


4.9.6.2.3 Case 25: The energy level E_{tr25}

By taking the combination having an energy E_{L5} for the second neutron, we have:

$$E_{tr25} = E_{L2} + E_{L5} = 65.31273 + 582.3062 \text{ MeV} = 647.62 \text{ MeV}$$

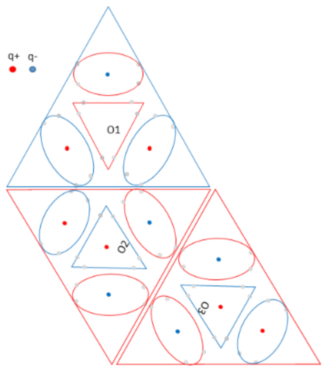




4.9.6.2.4 Case26: The energy level E_{tr26}

By taking the combination having an energy E_{L6} for the second neutron, we have:

$$E_{tr26} = E_{L2} + E_{L6} = 65.31273 + 1047.161 \text{ MeV} = 1112.47 \text{ MeV}$$



4.9.6.3 Case 3n: The energy level E_{tr3n}

By taking the combination having an energy E_{L3}, we have:

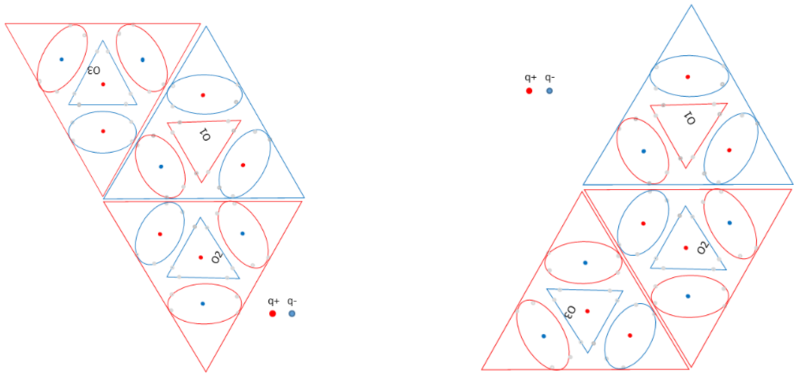
$$E_{tr3n} = E_{L3} = 117.4518 \text{ MeV}$$

The first connection is L_{3n}. The proton is side by side with the first neutron.

4.9.6.3.1 Case 33: The energy level E_{tr33}

By taking the combination having an energy E_{L3} for the second neutron, we have:

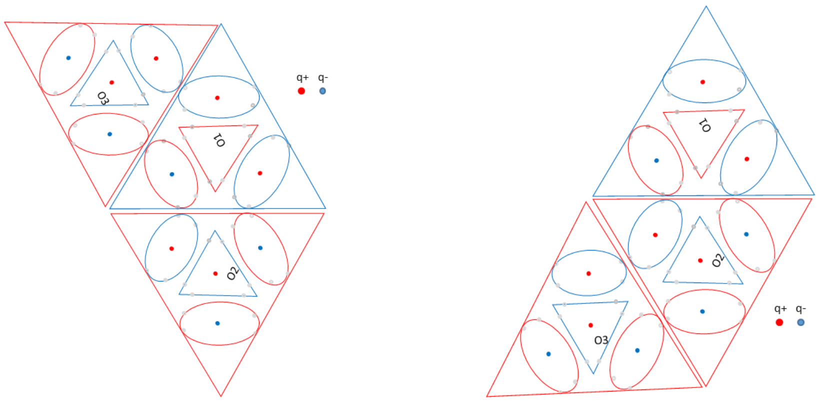
$$E_{tr33} = E_{L3} + E_{L3} = 117.4518 + 117.4518 \text{ MeV} = 234.90 \text{ MeV}$$



4.9.6.3.2 Case 34: The energy level E_{tr34}

By taking the combination having an energy E_{L4} for the second neutron, we have:

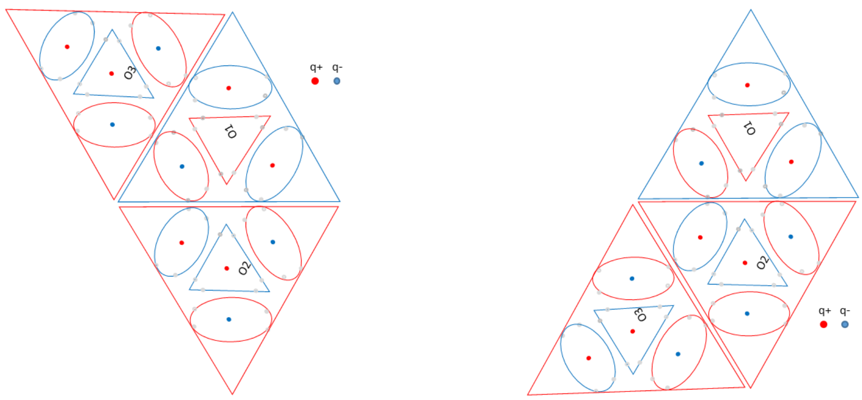
$$E_{tr34} = E_{L3} + E_{L4} = 117.4518 + 530.1671 \text{ MeV} = 647.62 \text{ MeV}$$



4.9.6.3.3 Case 35: The energy level E_{tr35}

By taking the combination having an energy E_{L5} for the second neutron, we have:

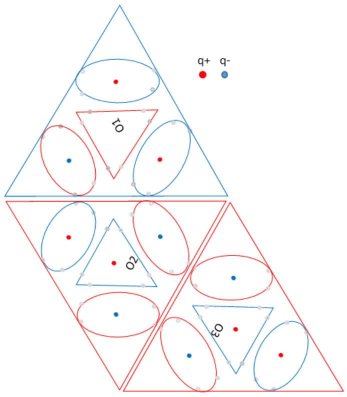
$$E_{tr35} = E_{L3} + E_{L5} = 117.4518 + 582.3062 \text{ MeV} = 699.76 \text{ MeV}$$



4.9.6.3.4 Case 36: The energy level E_{tr36}

By taking the combination having an energy E_{L6} for the second neutron, we have:

$$E_{tr36} = E_{L3} + E_{L6} = 117.4518 + 1047.161 \text{ MeV} = 1164.61 \text{ MeV}$$



4.9.6.4 *Case 4n: The energy level E_{tr4n}*

By taking the combination having an energy E_{L4}, we have:

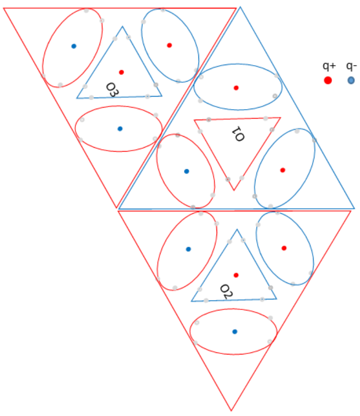
$$E_{tr4n} = E_{L4} = 530.1671 \text{ MeV}$$

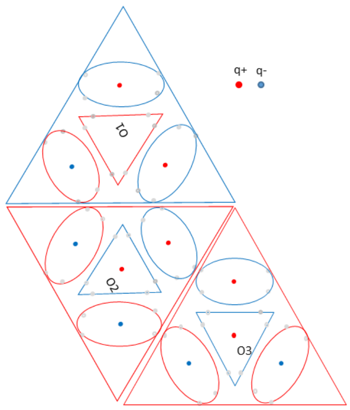
The first connection is L_{4n}. The proton is side by side with the first neutron.

4.9.6.4.1 Case 44: The energy level E_{tr44}

By taking the combination having an energy E_{L4} for the second neutron, we have:

$$E_{tr44} = E_{L4} + E_{L4} = 530.1671 + 530.1671 \text{ MeV} = 1060.33 \text{ MeV}$$

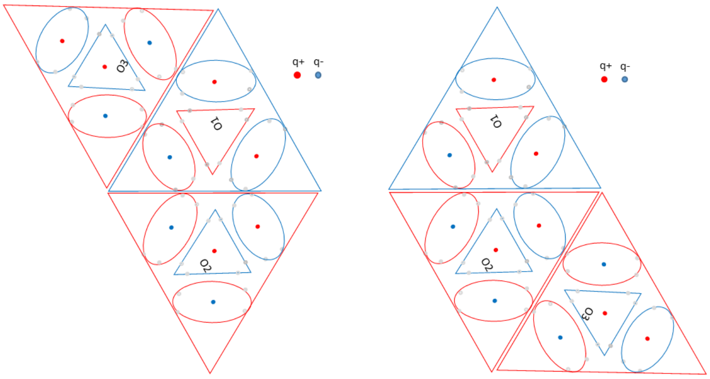




4.9.6.4.2 Case 45: The energy level E_{tr45}

By taking the combination having an energy E_{L5} for the second neutron, we have:

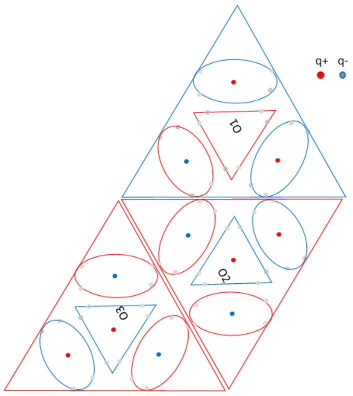
$$E_{tr45} = E_{L4} + E_{L5} = 530.1671 + 582.3062 \text{ MeV} = 1112.47 \text{ MeV}$$



4.9.6.4.3 Case 46: The energy level E_{tr46}

By taking the combination having an energy E_{L6} for the second neutron, we have:

$$E_{tr46} = E_{L4} + E_{L6} = 530.1671 + 1047.161 \text{ MeV} = 1577.33 \text{ MeV}$$



4.9.6.5 Case 5n: The energy level E_{tr4n}

By taking the combination having an energy E_{L5}, we have:

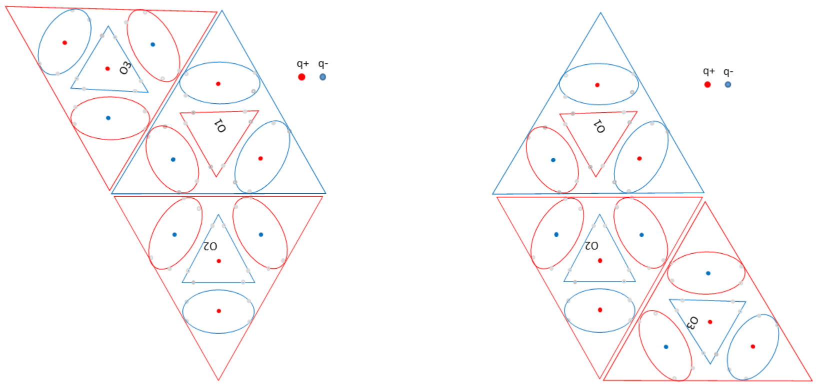
$$E_{tr5n} = E_{L5} = 582.3062 \text{ MeV}$$

The first connection is L_{5n}. The proton is side by side with the first neutron.

4.9.6.5.1 Case 55: The energy level E_{tr55}

By taking the combination having an energy E_{L5} for the second neutron, we have:

$$E_{tr55} = E_{L5} + E_{L5} = 582.3062 + 582.3062 \text{ MeV} = 1164.61 \text{ MeV}$$



4.9.6.6 Conclusion

The bond balance has 18 different energy levels.

No	Combi-nation	Binding energy	Static stability	Dynamic stability	Electrical stability	Comment
1	Tr00	-8.4822	10	1	10	Stacking rate +
2	Tr02	61.072	10	60	0	low energy rate n0
3	Tr03	113.209	10	100	20	low energy rate ++
4	Tr23	182.76	1	200	20	low energy rate ++
5	Tr33	234.90	1	200	40	low energy rate ++++
6	Tr04	525.93	10	500	-20	middle energy rate --
7	Tr05	578.07	10	600	0	middle energy rate n0
8	Tr24	595.48	1	600	-20	middle energy rate --
9	Tr25	647.62	1	600	0	middle energy rate n0
10	Tr34	647.62	1	600	0	middle energy rate n0
11	Tr35	699.76	1	700	20	middle energy rate ++
12	Tr06	1042.92	10	1000	-20	high energy rate --
13	Tr44	1060.33	1	1000	-40	high energy rate ----
14	Tr26	1112.47	1	1000	-20	high energy rate --
15	Tr45	1112.47	1	1100	-20	high energy rate --
16	Tr36	1164.61	1	1000	0	high energy rate n0
17	Tr55	1164.61	1	1100	0	high energy rate n0
18	Tr46	1577.33	1	1500	-40	high energy rate ----

The Tr33 configuration appears as a stable low energy case with a high presence rate.

4.9.7 Modeling the helium 4 nucleus

The helium 4 nucleus is composed of two protons and two neutrons. What is the relative position between these four nucleons?

4.9.7.1 Case 0n: The energy level E_{he0n}

By taking the combination having a negative energy for the first connection, we have:

$$E_{he0n} = -9.432\,500 \text{ MeV}$$

The first connection is L_{he0n}. The first proton is in parallel with the first neutron.

4.9.7.1.1 Case 00 : The energy level E_{he00}

By taking the combination having a negative energy for the second neutron, we have:

$$E_{he00} = E_{L0} + E_{L0} = -18.865\ 00\ \text{MeV}$$

The two connections are noted L_{he00}. The second neutron is in parallel with the first proton.

The P-N-P case is not studied here.

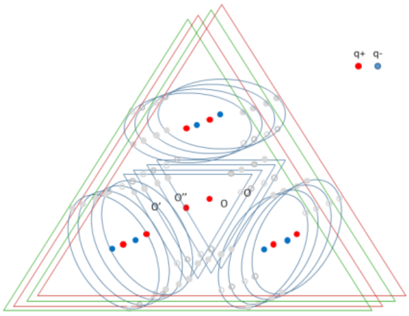
4.9.7.1.1.1 Case 000: The energy level E_{he000}

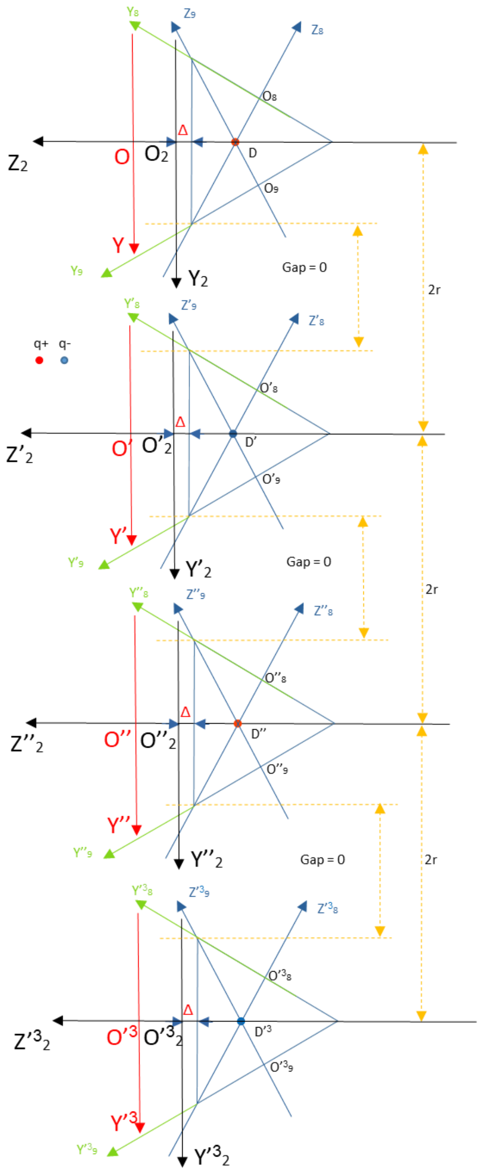
The last proton takes the negative energy:

$$E_{he000} = E_{he0n} + E_{he0n} + E_{he0n} = -28.\ 297\ 499\ \text{MeV}$$

The 4 nucleons are stacked in the following way:

- N-P-N-P





Binding energies can be calculated in the same way as for tritium.

The coordinates of points D, D', D'', D'3, J, J', J'', J'3, A, A', A'', A'3, G, G', G'' and G'3 in the global reference frame are:

$$\overrightarrow{OD} = 2 \cdot \overrightarrow{OO_2}$$

$$D(x, y, z) = 2O_2\left(-\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = D\left(-\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = D(-r, 0, -\frac{r}{\sqrt{3}})$$

$$D'(x, y, z) = D'(-r, -2r, -\frac{r}{\sqrt{3}})$$

$$D''(x, y, z) = D''(-r, -4r, -\frac{r}{\sqrt{3}})$$

$$D'^3(x, y, z) = D'^3(-r, -6r, -\frac{r}{\sqrt{3}})$$

$$A(x,y,z) = 2O_3\left(\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = A\left(\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = A(r, 0, -\frac{r}{\sqrt{3}})$$

$$A'(x,y,z) = A'(r, -2r, -\frac{r}{\sqrt{3}})$$

$$A''(x,y,z) = A''(r, -4r, -\frac{r}{\sqrt{3}})$$

$$A'^3(x,y,z) = A'^3(r, -6r, -\frac{r}{\sqrt{3}})$$

$$J(x,y,z) = 2O_1(0,0,z_0) = J\left(0,0,2\frac{r}{\sqrt{3}}\right) = J(0,0,\frac{2r}{\sqrt{3}})$$

$$J'(x,y,z) = J'(0, -2r, \frac{2r}{\sqrt{3}})$$

$$J''(x,y,z) = J''(0, -4r, \frac{2r}{\sqrt{3}})$$

$$J'^3(x,y,z) = J'^3(0, -6r, \frac{2r}{\sqrt{3}})$$

$$G(x,y,z) = G(0,0,0)$$

$$G'(x,y,z) = G'(0, -2r, 0)$$

$$G''(x,y,z) = G''(0, -4r, 0)$$

$$G'^3(x,y,z) = G'^3(0, -6r, 0)$$

Determine the potential energies between the electric charge pairs of the first neutron and the proton:

$$E = E_A^{A'} + E_D^{D'} + E_J^{J'} + E_D^{J'} + E_J^{D'} + E_G^{A'} - E_A^{D'} - E_A^{J'} - E_D^{A'} - E_J^{A'} - E_G^{D'} - E_G^{J'}$$

$$E_x^{y'} = k_e \frac{中_x \cdot 中_{y\prime}}{中_{ref}^2} \cdot \frac{e^2}{d_x^{y'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_C \cdot 中_{\delta y\prime 3}\right)^2 e^2}{中_{ref}^2 \cdot d_x^{y'}}$$

The additional terms are defined as follows:

- α_C : the coefficient of proportionality of the neutral charge affecting helium.
- $中_{\delta y'3}$: the neutral charge of helium without the static electrinettes.

$$E = \frac{k_e \cdot e^2}{4r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right] \frac{\left(中_{ref} + \alpha_C \cdot 中_{\delta y'3}\right)^2}{中_{ref}^{\ 2}}$$

here,

E = E_{he000} /3 = -9.432 499 667 MeV = -15.112 562 316*10^{-13} J.

We deduce the value of α_C:

$$\frac{E \cdot 中_{ref}^{\ 2} \cdot 4r}{k_e \cdot e^2 \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]} = \left(中_{ref} + \alpha_C \cdot 中_{\delta y'3}\right)^2$$

$$\alpha_C \cdot 中_{\delta y'3} = \sqrt{\frac{E \cdot 中_{ref}^{\ 2} \cdot 4r}{k_e \cdot e^2 \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]}} - \left(中_{ref}\right)$$

We have:

$$中_{\delta y'3} = 12\left(中_F + 中_F + 中_H\right) + 12\left(中_H + 中_H + 中_F\right) = 2979.643212 \cdot 10^{-31}\ kg$$

$$中_{ref} = 9.1 \cdot 10^{-31}$$

$$\alpha_C 中_{\delta y'3} = \sqrt{\frac{15.112562316 \cdot 10^{-13} \cdot 82.81 \cdot 10^{-62} \cdot 4 \cdot 0.36373 \cdot 10^{-15}}{8.987552 \cdot 1.602177^2 \cdot 10^{-29} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]}} - 9.1 \cdot 10^{-31}$$

$$\alpha_C 中_{\delta y'3} = \sqrt{\frac{54.825080027 \cdot 10^{-61}}{1.0}} - 9.1 \cdot 10^{-31}$$

$$\alpha_C 中_{\delta C} = 23.414\,756\,037 \cdot 10^{-31} - 9.1 \cdot 10^{-31}$$

$$\alpha_C \cdot 2979.643212 \cdot 10^{-31} = 14.314\,756\,037 \cdot 10^{-31}$$

$$\alpha_C = 0.004\,804\,185$$

Compare to the coefficient calculated with the He0330 configuration, but with negative energy radial bonds:

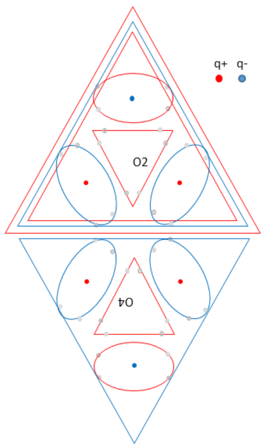
$$\alpha_g = 0.004\,551\,266$$

Roughly, they are equivalent.

4.9.7.1.1.2 Case 001: The energy level E_{he001}

The last proton takes the energy level E_{L1}:

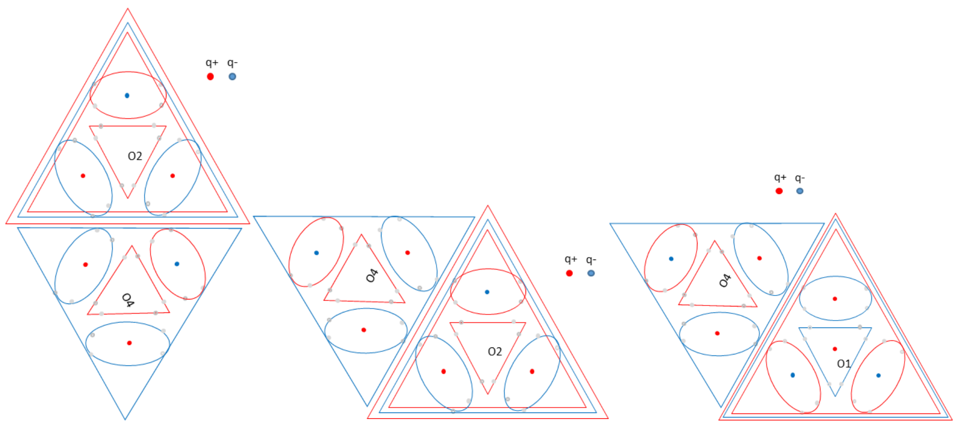
E_{he001} = E_{he00} + E_{L1} = 13.173648 -18.865 = -5.691 351 MeV



4.9.7.1.1.3 Case 002: The energy level E_{he002}

The last proton takes the energy level E_{L2}:

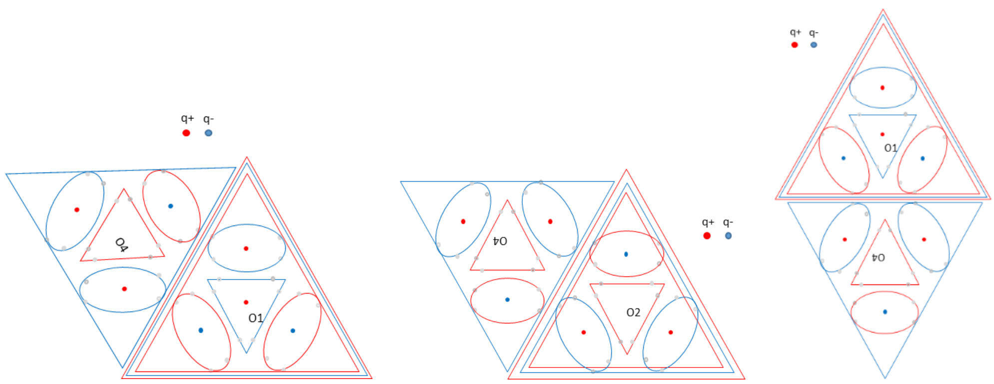
$$E_{he002} = E_{he00} + E_{L2} = 65.31273 - 18.865 = 46.448 \text{ MeV}$$



4.9.7.1.1.4 Case 003: The energy level E_{he003}

The last proton takes the energy level E_{L3} :

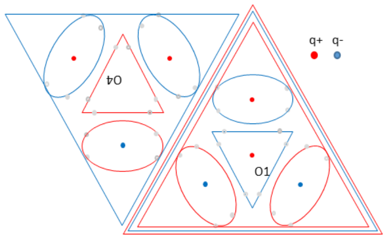
$$E_{he003} = E_{he00} + E_{L3} = 117.45 - 18.865 \text{ MeV} = 98.585 \text{ MeV}$$

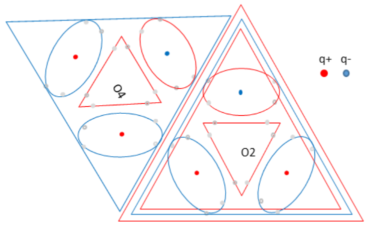


4.9.7.1.1.5 Case 004: The energy level E_{he004}

The last proton takes the energy level E_{L4}:

$$E_{he004} = E_{he00} + E_{L4} = 530.1671 - 18.865 \text{ MeV} = 511.302 \text{ MeV}$$

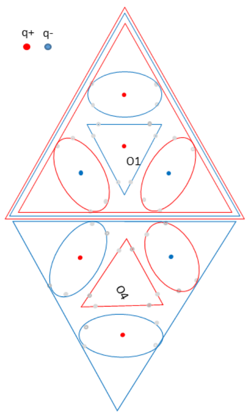




4.9.7.1.1.6 Case 005: The energy level E_{he005}

The last proton takes the energy level E_{L5}:

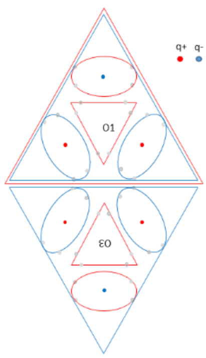
$$E_{he005} = E_{he00} + E_{L5} = 582.3062 - 18.865 \text{ MeV} = 563.441 \text{ MeV}$$



4.9.7.1.2 Case 01: The energy level E_{he01}

By taking the combination having an energy E_{L1} for the second neutron, we have:

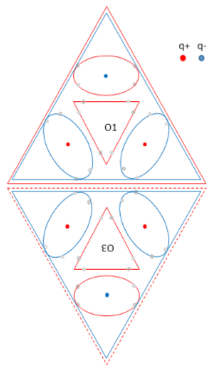
$$E_{he01} = E_{he0n} + E_{L1} = 13.173648 - 9.4325 \text{ MeV} = 3.741\,147\,667 \text{ MeV}$$



4.9.7.1.2.1 Case 010: The energy level E_{he010}

The last proton takes the energy level E_{he0n}:

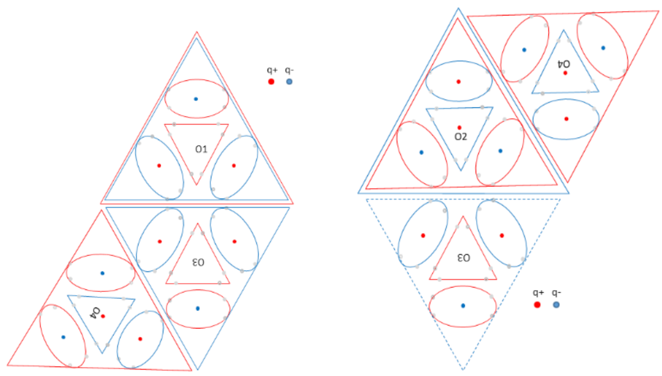
$$E_{he010} = E_{he0n} + E_{L1} + E_{he0n} = -\,9.4325 + 13.173648 - 9.4325 = -5.691\,351 \text{ MeV}$$



4.9.7.1.2.2 Case 013: The energy level E_{he013}

The last proton takes the energy level E_{L3}:

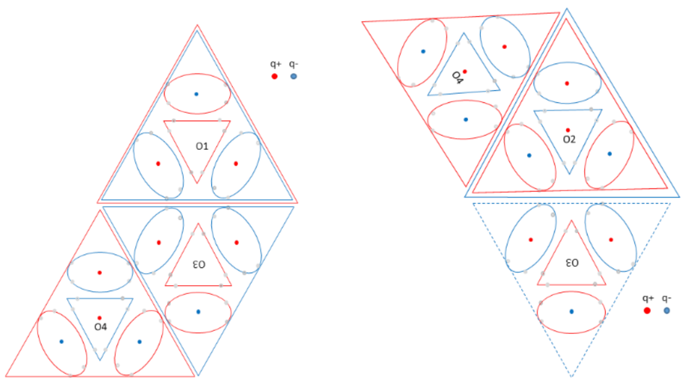
$$E_{he013} = E_{he0n} + E_{L1} + E_{L3} = 117.4518 + 13.173648 - 9.4325 = 121.191 \text{ MeV}$$



4.9.7.1.2.3 Case 014: The energy level E_{he014}

The last proton takes the energy level E_{L4}:

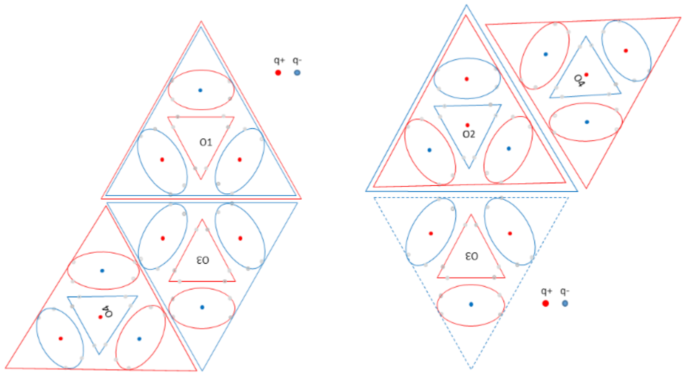
$$E_{he014} = E_{he0n} + E_{L1} + E_{L4} = 530.1671 + 13.173648 - 9.4325 = 533.908 \text{ MeV}$$



4.9.7.1.2.4 Case 015: The energy level E_{he015}

The last proton takes the energy level E_{L5}:

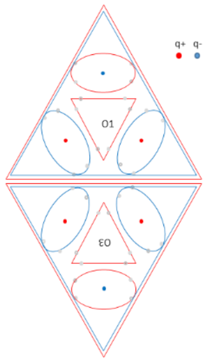
$$E_{he015} = E_{he0n} + E_{L1} + E_{L5} = 582.3062 + 13.173648 - 9.4325 = 586.047348 \text{ MeV}$$



4.9.7.1.2.5 Case 0160: The energy level E_{he0160}

The last proton takes the energy level E_{L6} and energy level E_{he0n}:

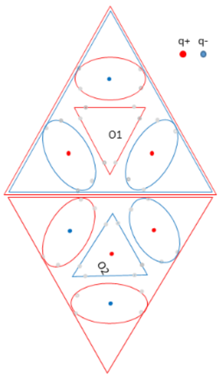
$$E_{he0160} = E_{he0n} + E_{L1} + E_{L6} + E_{he0n} = 1047.161 + 13.173648 - 9.4325 - 9.4325 = 1041.469648 \text{ MeV}$$



4.9.7.1.3 Case 02: The energy level E_{he02}

By taking the combination having an energy E_{L2} for the second neutron, we have:

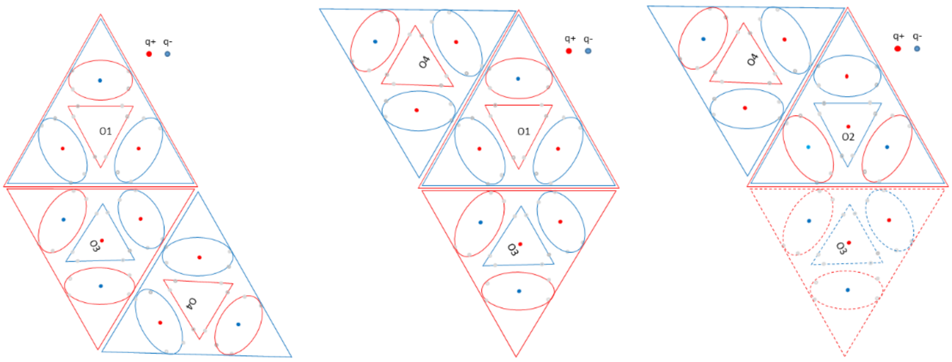
$$E_{he02} = E_{he0n} + E_{L2} = 65.313 - 9.4325 \text{ MeV} = 55.8805 \text{ MeV}$$



4.9.7.1.3.1 Case 022: The energy level E_{he022}

The last proton takes the energy level E_{L2}:

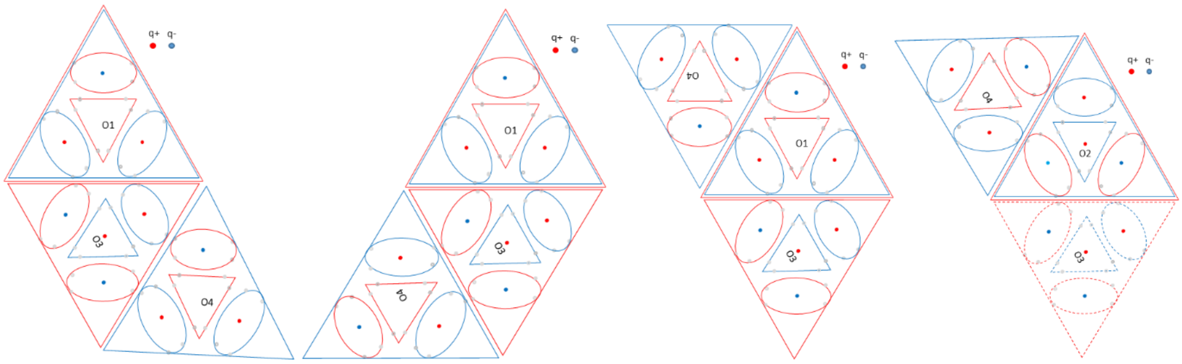
$$E_{he022} = E_{he0n} + E_{L2} + E_{L2} = 65.31273 + 65.31273 - 9.4325 = 121.19296 \text{ MeV}$$



4.9.7.1.3.2 Case 023: The energy level E_{he023}

The last proton takes the energy level E_{L3}:

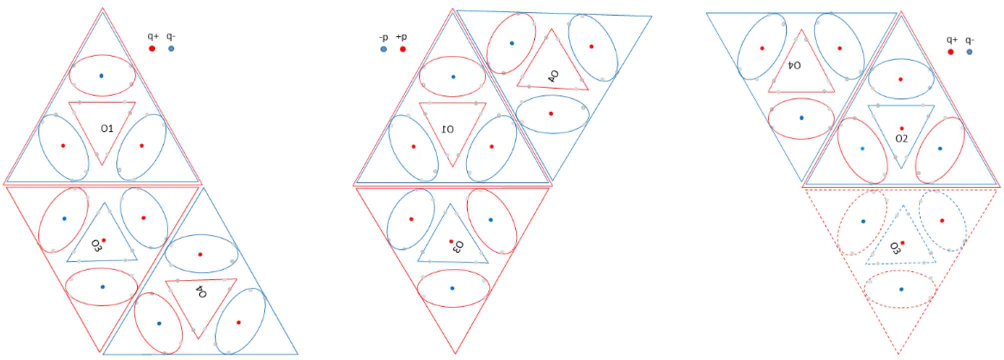
$$E_{he023} = E_{he0n} + E_{L2} + E_{L3} = 117.4518 + 65.31273 - 9.4325 = 173.33203 \text{ MeV}$$



4.9.7.1.3.3 Case 024: The energy level E_{he024}

The last proton takes the energy level E_{L4}:

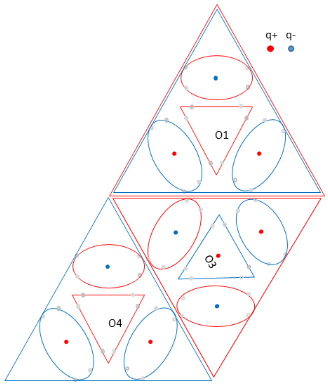
$$E_{he024} = E_{he0n} + E_{L2} + E_{L4} = 530.1671 + 65.31273 - 9.4325 = 586.04733 \text{ MeV}$$



4.9.7.1.3.4 Case 025: The energy level E_{he025}

The last proton takes the energy level E_{L5}:

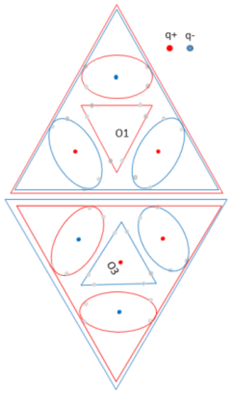
$$E_{he025} = E_{he0n} + E_{L2} + E_{L5} = 582.3062 + 65.31273 - 9.4325 = 638.18643 \text{ MeV}$$



4.9.7.1.3.5 Case 0250: The energy level E_{he0250}

The last proton takes the energy level E_{L5} and energy level E_{L0}:

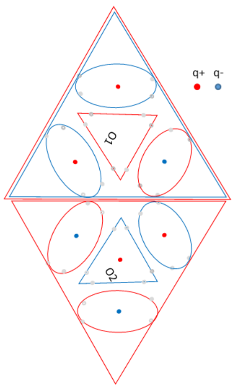
$$E_{he022} = E_{he0n} + E_{L2} + E_{L5} + E_{he0n} = 582.3062 + 65.31273 - 9.4325 - 9.4325 = 628.75393 \text{ MeV}$$

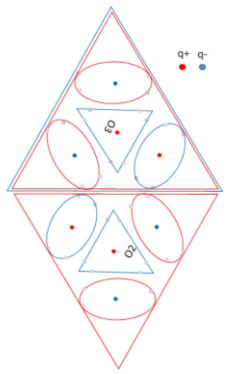


4.9.7.1.4 Case 03: The energy level E_{he03}

By taking the combination having an energy E_{L3} for the second neutron, we have:

$$E_{he03} = E_{he0n} + E_{L3} = 117.45 - 9.4325 \text{ MeV} = 108.0193 \text{ MeV}$$

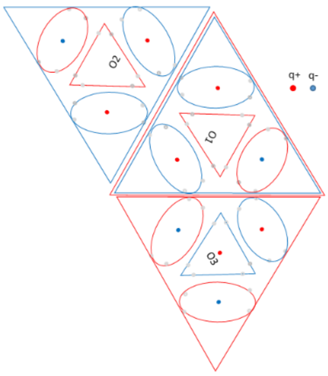




4.9.7.1.4.1 Case 031: The energy level E_{he031}

The last proton takes the energy level E_{L1}:

$$E_{he031} = E_{he0n} + E_{L3} + E_{L1} = 13.173648 + 117.4518 - 9.4325 = 121.192948 \text{ MeV}$$



4.9.7.1.4.2 Case 032: The energy level E_{he032}

The last proton takes the energy level E_{L2}:

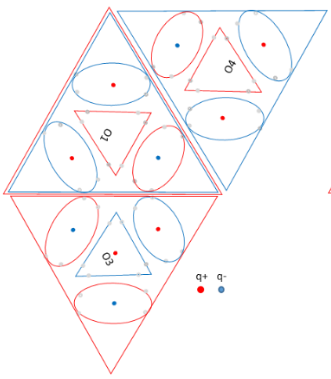
$$E_{he032} = E_{he0n} + E_{L3} + E_{L2} = 65.31273 + 117.4518 - 9.4325 = 173.33203 \text{ MeV}$$

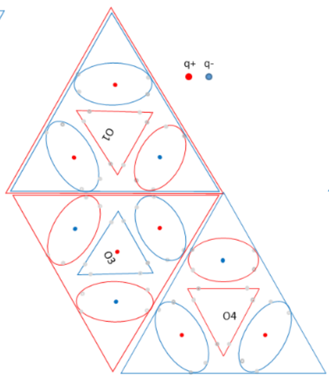
Ce cas est identique au cas E_{he012}.

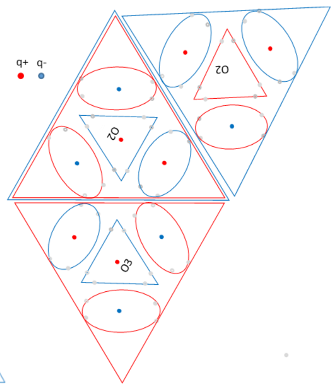
4.9.7.1.4.3 Case 033: The energy level E_{he033}

The last proton takes the energy level E_{L3}:

$$E_{he033} = E_{he0n} + E_{L3} + E_{L3} = 117.4518 + 117.4518 - 9.4325 = 225.4711 \text{ MeV}$$



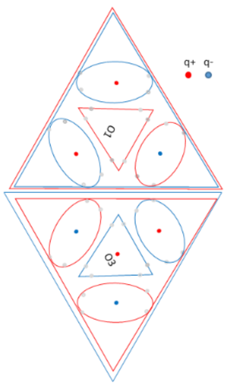




4.9.7.1.4.4 Case 0330: The energy level E_{he0330}

The last proton takes the energy level E_{L3} and energy level 0:

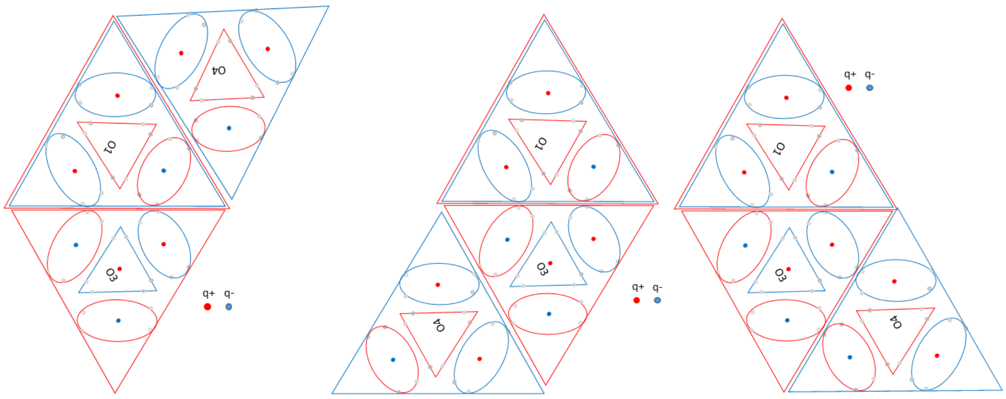
$$E_{he022} = E_{he0n} + E_{L3} + E_{L3} + E_{he0n} = 117.4518 + 117.4518 - 9.4325 - 9.4325 = 216.0386 \text{ MeV}$$



4.9.7.1.4.5 Case 034: The energy level E_{he034}

The last proton takes the energy level E_{L4}:

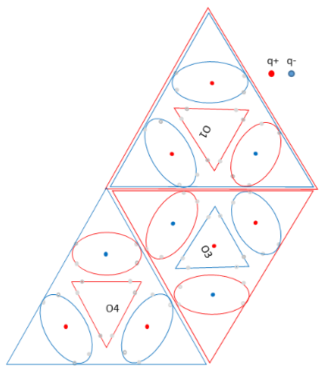
$$E_{he034} = E_{he0n} + E_{L3} + E_{L4} = 530.1671 + 117.4518 - 9.4325 = 638.1864 \text{ MeV}$$



4.9.7.1.4.6 Case 035: The energy level E_{he035}

The last proton takes the energy level E_{L5}:

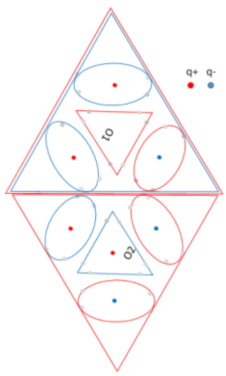
$$E_{he035} = E_{he0n} + E_{L3} + E_{L5} = 582.3062 + 117.4518 - 9.4325 = 690.3255 \text{ MeV}$$

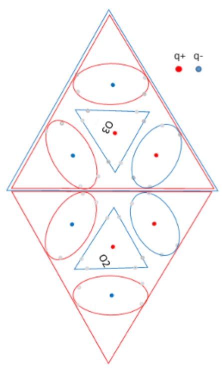


4.9.7.1.5 Case 04: The energy level E_{he04}

By taking the combination having an energy E_{L4} for the second neutron, we have:

$$E_{he04} = E_{he0n} + E_{L4} = 530.1671 - 9.4325 \text{ MeV} = 520.7346 \text{ MeV}$$

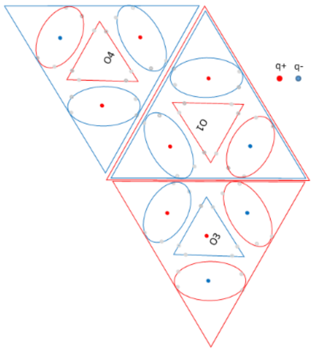




4.9.7.1.5.1 Case 041: The energy level E_{he041}

The last proton takes the energy level E_{L1}:

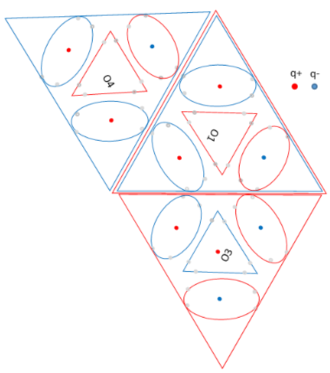
$$E_{he041} = E_{he0n} + E_{L4} + E_{L1} = 13.173648 + 530.1671 - 9.4325 = 533.908248 \text{ MeV}$$

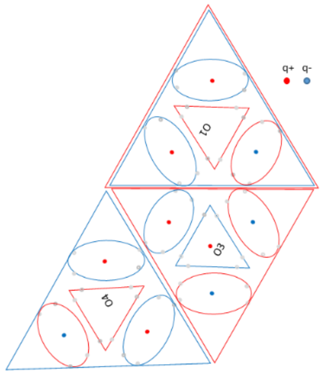


4.9.7.1.5.2 Case 042: The energy level E_{he042}

The last proton takes the energy level E_{L2}:

$$E_{he042} = E_{he0n} + E_{L4} + E_{L2} = 65.31273 + 530.1671 - 9.4325 = 586.04733 \text{ MeV}$$

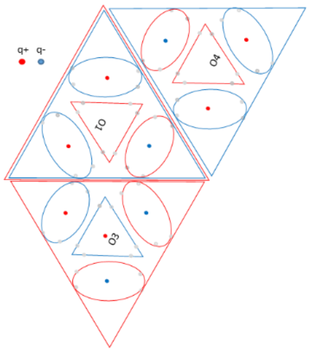


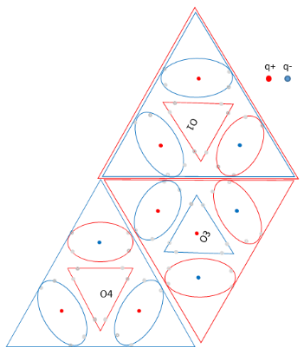


4.9.7.1.5.3 Case 043: The energy level E_{he043}

The last proton takes the energy level E_{L3}:

$$E_{he043} = E_{he0n} + E_{L4} + E_{L3} = 117.4518 + 530.1671 - 9.4325 = 638.1864 \text{ MeV}$$

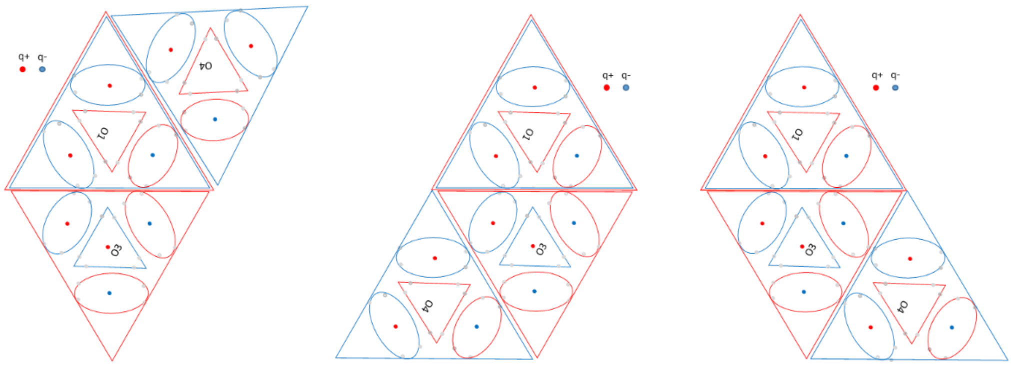




4.9.7.1.5.4 Case 044: The energy level E_{he044}

The last proton takes the energy level E_{L3}:

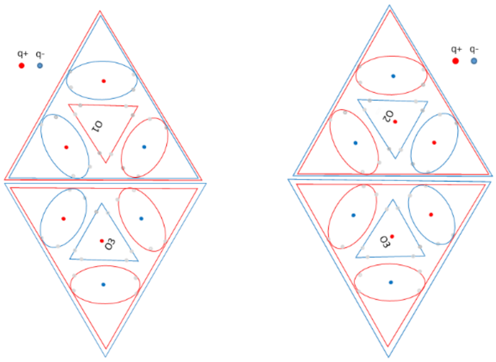
$$E_{he044} = E_{he0n} + E_{L4} + E_{L4} = 530.1671 + 530.1671 - 9.4325 = 1050.9017 \text{ MeV}$$



4.9.7.1.5.5 Case 0440: The energy level E_{he0440}

The last proton takes the energy level E_{L4} and energy level E_{L0}:

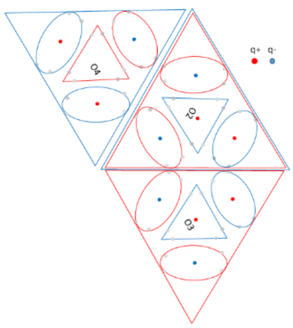
$$E_{he044} = E_{he0n} + E_{L4} + E_{L4} + E_{he0n} = 530.1671 + 530.1671 - 9.4325 - 9.4325 = 1041.4692 \text{ MeV}$$



4.9.7.1.5.6 Case 045: The energy level E_{he045}

The last proton takes the energy level E_{L5}:

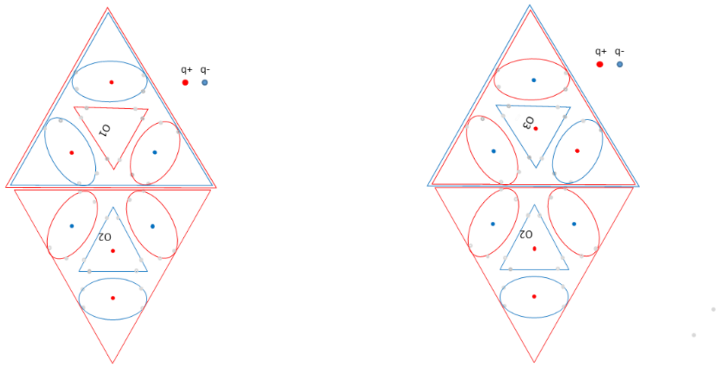
$$E_{he045} = E_{he0n} + E_{L4} + E_{L5} = 530.1671 + 582.3062 - 9.4325 = 1103.0408 \text{ MeV}$$



4.9.7.1.6 Case 05: The energy level E_{he05}

By taking the combination having an energy E_{L5} for the second neutron, we have:

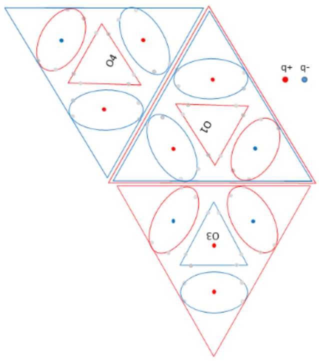
$$E_{he05} = E_{he0n} + E_{L5} = 582.3062 - 9.4325 \text{ MeV} = 572.8737 \text{ MeV}$$



4.9.7.1.6.1 Case 051: The energy level E_{he051}

The last proton takes the energy level E_{L1}:

$$E_{he051} = E_{he0n} + E_{L5} + E_{L1} = 13.173648 + 582.3062 - 9.4325 = 586.047348 \text{ MeV}$$



4.9.7.1.6.2 Case 052: The energy level E_{he052}

The last proton takes the energy level E_{L2}:

$$E_{he052} = E_{he0n} + E_{L5} + E_{L2} = 65.31273 + 582.3062 - 9.4325 = 638.18643 \text{ MeV}$$

Ce cas est identique au cas E_{he025}.

4.9.7.1.6.3 Case 053: The energy level E_{he053}

The last proton takes the energy level E_{L3}:

$$E_{he053} = E_{he0n} + E_{L5} + E_{L3} = 117.4518 + 582.3062 - 9.4325 = 690.3255 \text{ MeV}$$

Ce cas est identique au cas E_{he035}.

4.9.7.1.6.4 Case 054: The energy level E_{he054}

The last proton takes the energy level E_{L4}:

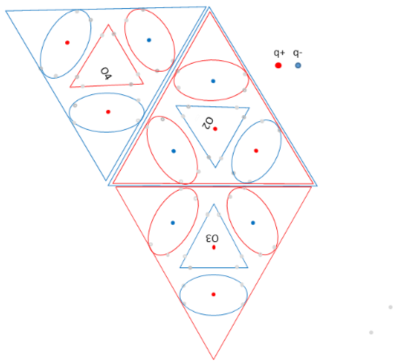
$$E_{he054} = E_{he0n} + E_{L5} + E_{L4} = 530.1671 + 582.3062 - 9.4325 = 1103.0408 \text{ MeV}$$

Ce cas est identique au cas E_{he045}.

4.9.7.1.6.5 Case 055: The energy level E_{he055}

The last proton takes the energy level E_{L5}:

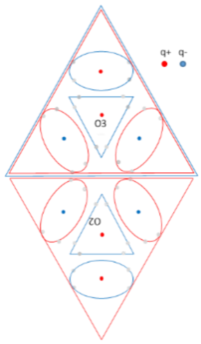
$$E_{he055} = E_{he0n} + E_{L5} + E_{L5} = 582.3062 + 582.3062 - 9.4325 = 1155.1799 \text{ MeV}$$



4.9.7.1.7 Case 06: The energy level E_{he06}

By taking the combination having an energy E_{L6} for the second neutron, we have:

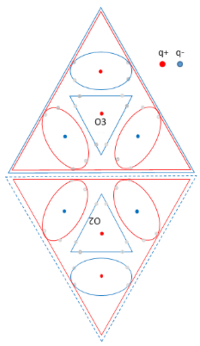
$$E_{he06} = E_{he0n} + E_{L6} = 1047.161 - 9.4325 \text{ MeV} = 1037.7285 \text{ MeV}$$



4.9.7.1.7.1 Case 060: The energy level E_{he060}

The last proton takes the energy level E_{L0}:

$$E_{he060} = E_{he0n} + E_{L6} + E_{he0n} = - 9.4325 + 1047.161 - 9.4325 = 1028.296 \text{ MeV}$$



4.9.7.1.7.2 Case 0610: The energy level E_{he0610}

The last proton takes the energy level E_{L1} and energy level E_{L0}:

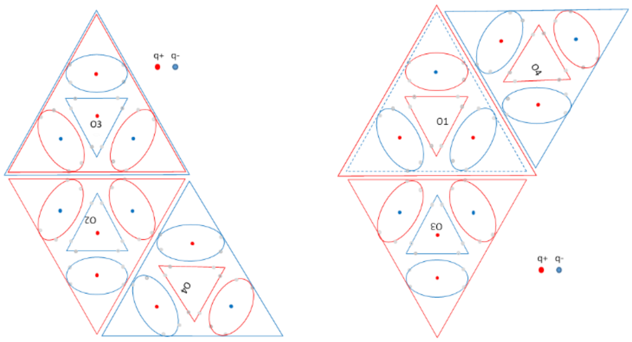
$$E_{he0610} = E_{he0n} + E_{L6} + E_{L1} + E_{he0n} = 13.173648 + 1047.161 - 9.4325 - 9.4325 = 1041.469648 \text{ MeV}$$

Ce cas est identique au cas E_{he0160}.

4.9.7.1.7.3 Case 062: The energy level E_{he062}

The last proton takes the energy level E_{L2}:

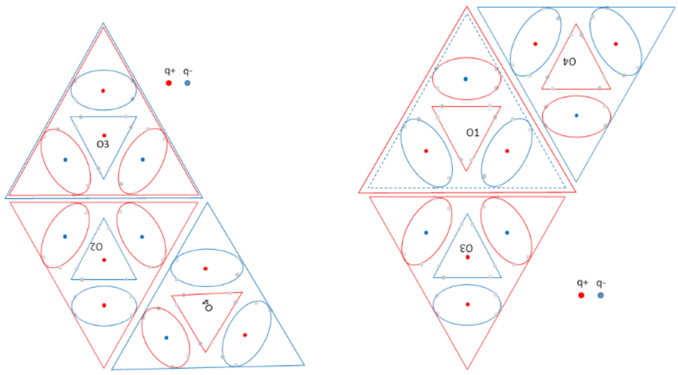
$$E_{he062} = E_{he0n} + E_{L6} + E_{L2} = 65.31273 + 1047.161 - 9.4325 = 1103.04123 \text{ MeV}$$



4.9.7.1.7.4 Case 063: The energy level E_{he063}

The last proton takes the energy level E_{L3}:

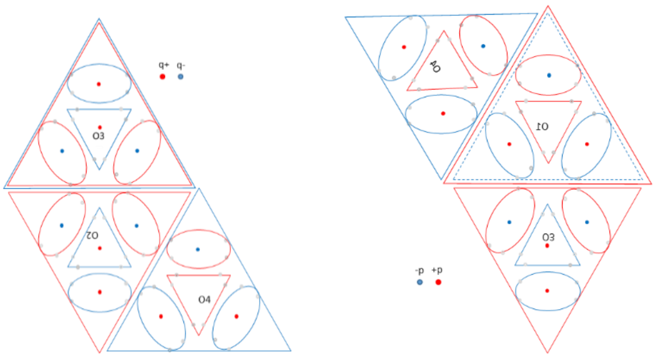
$$E_{he063} = E_{he0n} + E_{L6} + E_{L3} = 117.4517 + 1047.161 - 9.4325 = 1155.1802 \text{ MeV}$$



4.9.7.1.7.5 Case 064: The energy level E_{he064}

The last proton takes the energy level E_{L4}:

$$E_{he064} = E_{he0n} + E_{L6} + E_{L4} = 530.1671 + 1047.161 - 9.4325 = 1567.8956 \text{ MeV}$$

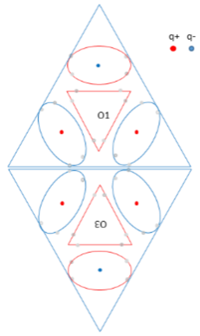


4.9.7.2 Case 1n: The energy level E_{he1n}

By taking the combination having an energy E_{L1} for the first connection, we have:

$$E_{he1n} = E_{L1} = 13.173648 \text{ MeV}$$

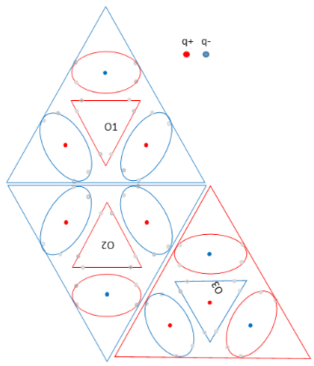
The first connection is L_{1n}. The first proton is side by side with the second proton.



4.9.7.2.1 Case 13 : The energy level E_{he13}

By taking the combination having an energy E_{L3} for the first neutron, we have:

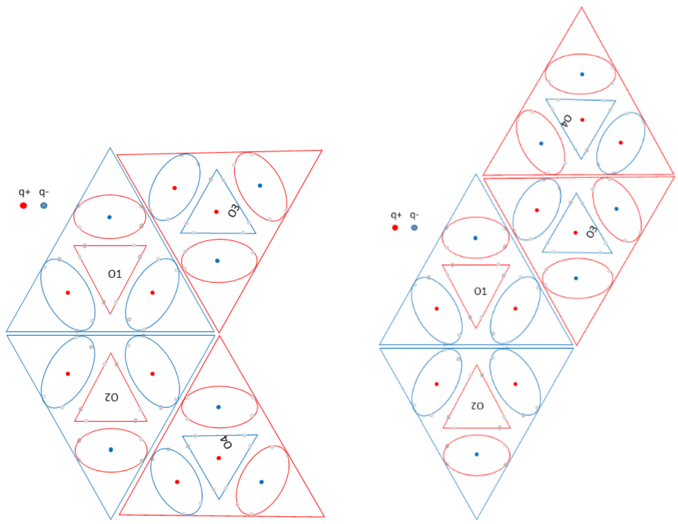
$$E_{he13} = E_{L1} + E_{L3} = 13.173648 + 117.4518 \text{ MeV} = 130.63 \text{ MeV}$$



4.9.7.2.1.1 Case 133: The energy level E_{he133}

The last neutron takes the energy level E_{L3}:

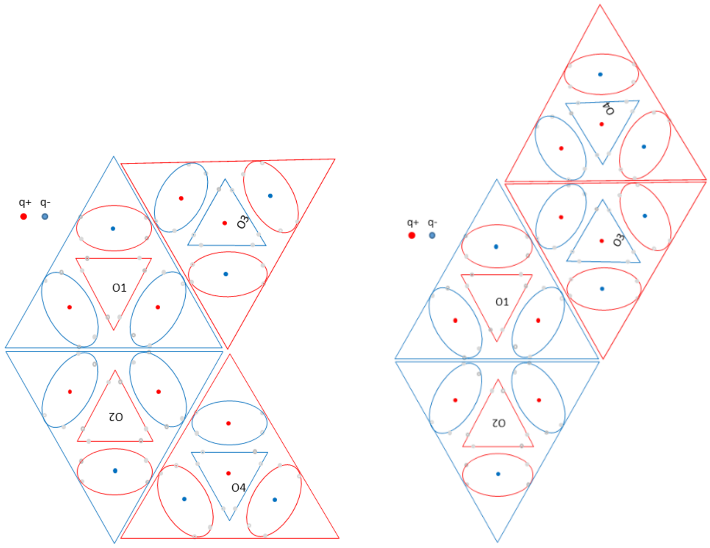
$$E_{he133} = E_{L1} + E_{L3} + E_{L3} = 13.173648 + 117.4518 + 117.4518 \text{ MeV} = 248.08 \text{ MeV}$$



4.9.7.2.1.2 Case 134: The energy level E_{he134}

The last neutron takes the energy level E_{L4}:

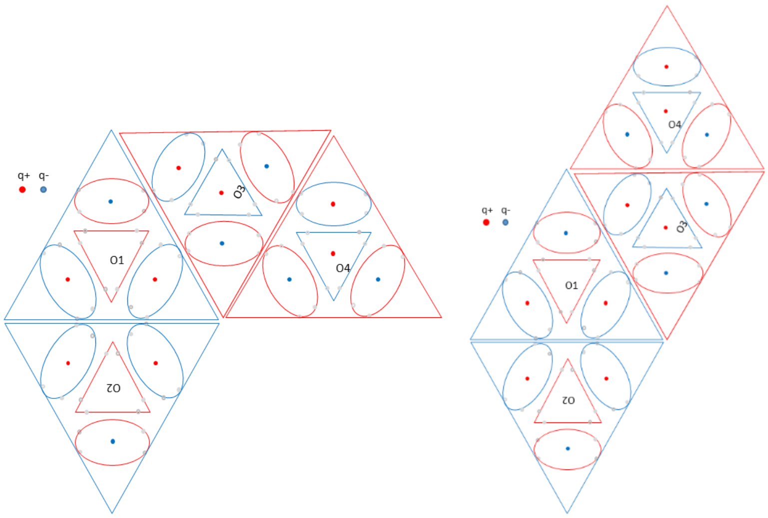
$$E_{he134} = E_{L1} + E_{L3} + E_{L4} = 13.173648 + 117.4518 + 530.1671 \text{ MeV} = 660.79 \text{ MeV}$$



4.9.7.2.1.3 Case 135: The energy level E_{he135}

The last neutron takes the energy level E_{L5}:

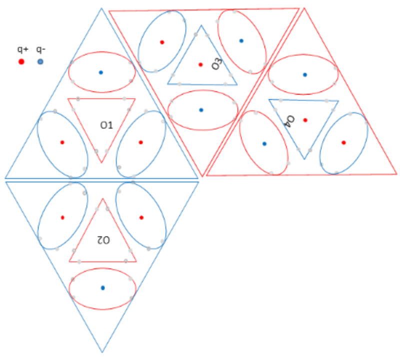
$$E_{he135} = E_{L1} + E_{L3} + E_{L5} = 13.173648 + 117.4518 + 582.3062 \text{ MeV} = 712.93 \text{ MeV}$$



4.9.7.2.1.4 Case 136: The energy level E_{he136}

The last neutron takes the energy level E_{L6}:

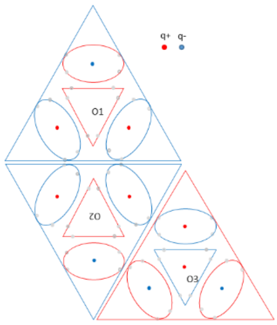
$$E_{he136} = E_{L1} + E_{L3} + E_{L6} = 13.173648 + 117.4518 + 1047.161 \text{ MeV} = 1177.79 \text{ MeV}$$



4.9.7.2.2 Case 14: The energy level E_{he14}

By taking the combination having an energy E_{L4} for the first neutron, we have:

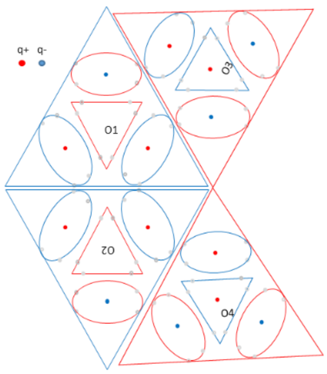
$$E_{he14} = E_{L1} + E_{L4} = 13.173648 + 530.1671 \text{ MeV} = 543.34 \text{ MeV}$$

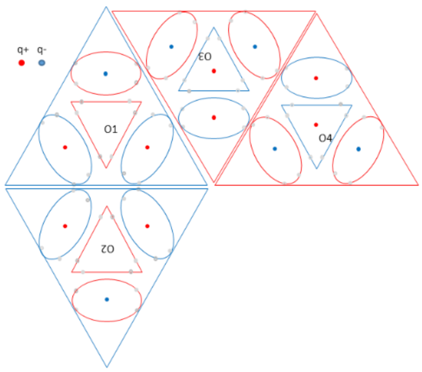


4.9.7.2.2.1 Case 143: The energy level E_{he143}

The last neutron takes the energy level E_{L3}:

$$E_{he143} = E_{L1} + E_{L4} + E_{L3} = 13.173648 + 530.1671 + 117.4518 \text{ MeV} = 660.79 \text{ MeV}$$

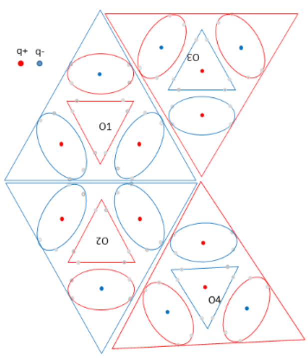


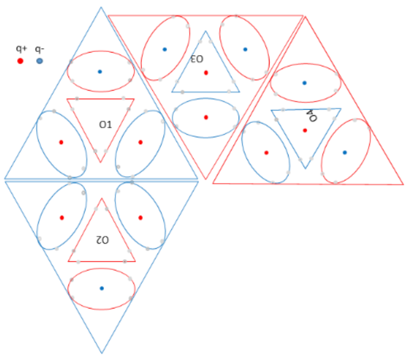


4.9.7.2.2.2 Case 144: The energy level E_{he144}

The last neutron takes the energy level E_{L4}:

$$E_{he144} = E_{L1} + E_{L4} + E_{L4} = 13.173648 + 530.1671 + 530.1671 \text{ MeV} = 1073.51 \text{ MeV}$$

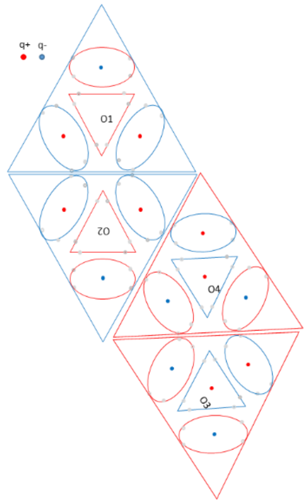




4.9.7.2.2.3 Case 145: The energy level E_{he145}

The last neutron takes the energy level E_{L5}:

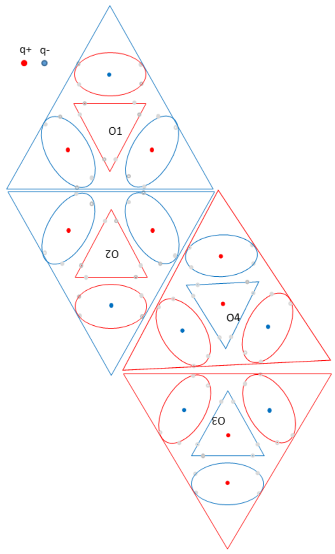
$$E_{he145} = E_{L1} + E_{L4} + E_{L5} = 13.173648 + 530.1671 + 582.3062 \text{ MeV} = 1125.65 \text{ MeV}$$



4.9.7.2.2.4 Case 146: The energy level E_{he146}

The last neutron takes the energy level E_{L6}:

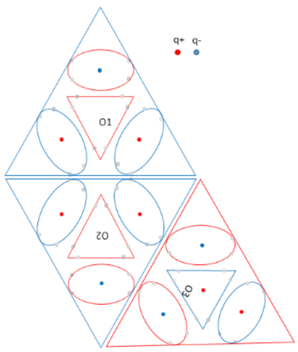
$$E_{he146} = E_{L1} + E_{L4} + E_{L6} = 13.173648 + 530.1671 + 1047.161 \text{ MeV} = 1590.50 \text{ MeV}$$



4.9.7.2.3 Case 15: The energy level E_{he15}

By taking the combination having an energy E_{L5} for the second neutron, we have:

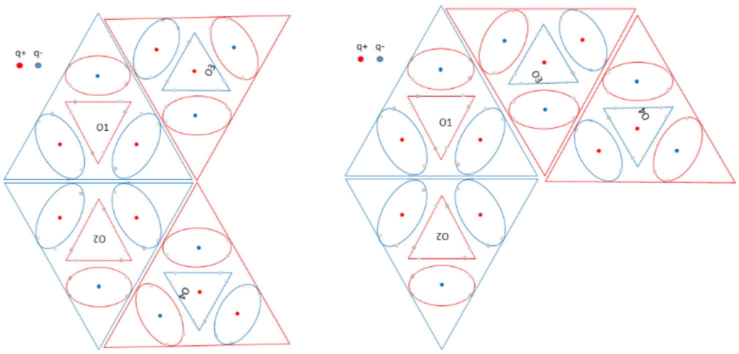
$$E_{he15} = E_{L1} + E_{L5} = 13.173648 + 582.3062 \text{ MeV} = 595.48 \text{ MeV}$$



4.9.7.2.3.1 Case 153: The energy level E_{he153}

The last neutron takes the energy level E_{L3}:

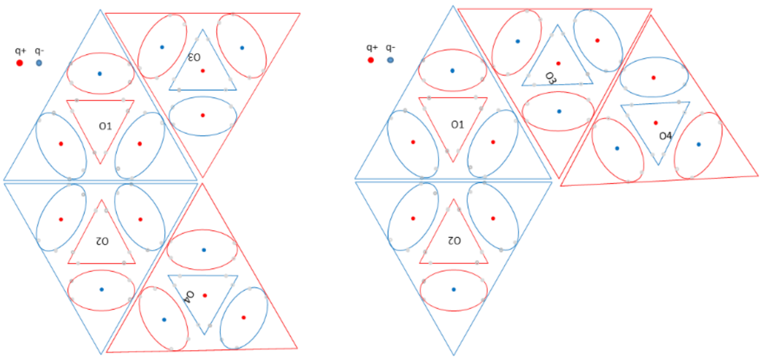
$$E_{he153} = E_{L1} + E_{L5} + E_{L3} = 13.173648 + 582.3062 + 117.4518 \text{ MeV} = 712.93 \text{ MeV}$$



4.9.7.2.3.2 Case 154: The energy level E_{he154}

The last neutron takes the energy level E_{L4}:

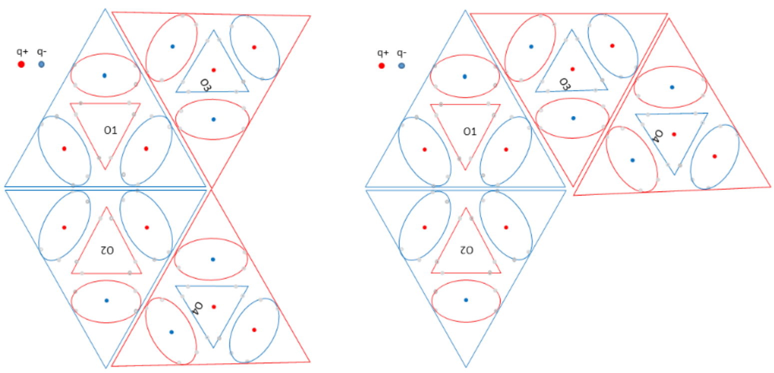
$$E_{he154} = E_{L1} + E_{L5} + E_{L4} = 13.173648 + 582.3062 + 530.1671 \text{ MeV} = 1125.65 \text{ MeV}$$



4.9.7.2.3.3 Case 155: The energy level E_{he155}

The last neutron takes the energy level E_{L5}:

$$E_{he155} = E_{L1} + E_{L5} + E_{L5} = 13.173648 + 582.3062 + 582.3062 \text{ MeV} = 1177.79 \text{ MeV}$$

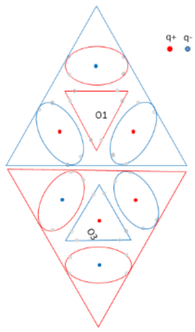


4.9.7.3 Case 2n: The energy level E_{he2n}

By taking the combination having an energy E_{L2} for the first connection, we have:

$$E_{he2n} = E_{L2} = 65.31273 \text{ MeV}$$

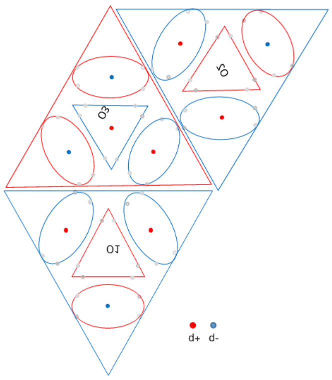
The first connection is L_{2n}. The first proton is side by side with the first neutron.



4.9.7.3.1 Case 22: The energy level E_{he22}

By taking the combination having an energy E_{L2} for the second proton, we have:

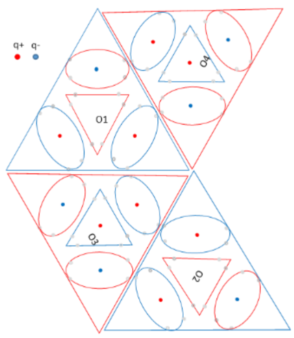
$$E_{he22} = E_{L2} + E_{L2} = 65.31273 + 65.31273 \text{ MeV} = 130.63 \text{ MeV}$$



4.9.7.3.1.1 Case 223: The energy level E_{he223}

The last neutron takes the energy level E_{L3}:

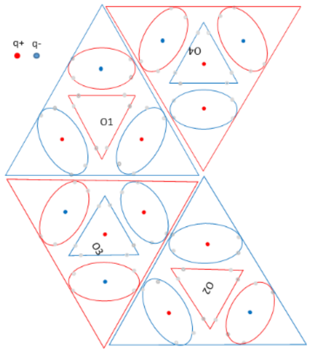
$$E_{he223} = E_{L2} + E_{L2} + E_{L3} = 65.31273 + 65.31273 + 117.4518 \text{ MeV} = 248.08 \text{ MeV}$$



4.9.7.3.1.2 Case 224: The energy level E_{he224}

The last neutron takes the energy level E_{L4}:

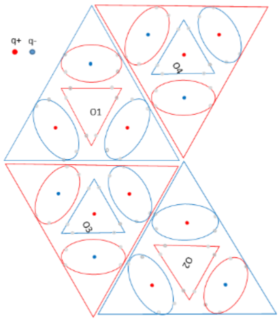
$$E_{he224} = E_{L2} + E_{L2} + E_{L4} = 65.31273 + 65.31273 + 530.1671 \text{ MeV} = 660.79 \text{ MeV}$$



4.9.7.3.1.3 Case 225: The energy level E_{he225}

The last neutron takes the energy level E_{L5}:

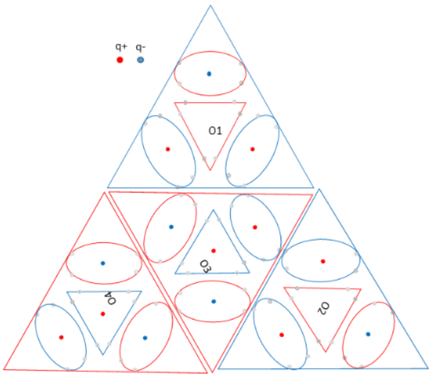
$$E_{he225} = E_{L2} + E_{L2} + E_{L5} = 65.31273 + 65.31273 + 582.3062 \text{ MeV} = 712.93 \text{ MeV}$$



4.9.7.3.1.4 Case 226: The energy level E_{he226}

The last neutron takes the energy level E_{L6}:

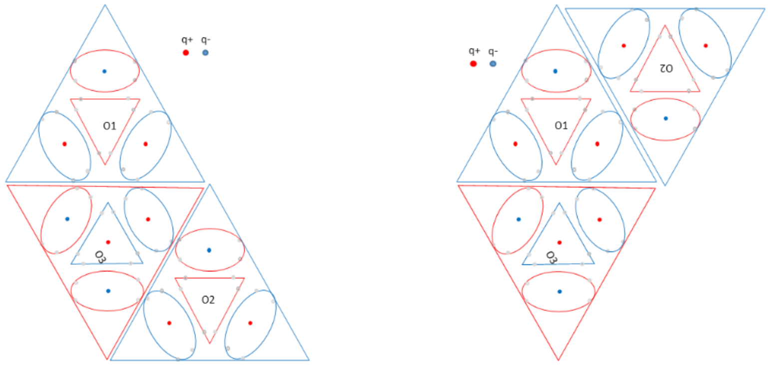
$$E_{he226} = E_{L2} + E_{L2} + E_{L6} = 65.31273 + 65.31273 + 1047.161 \text{ MeV} = 1177.79 \text{ MeV}$$



4.9.7.3.2 Case 23: The energy level E_{he23}

By taking the combination having an energy E_{L3} for the second proton, we have:

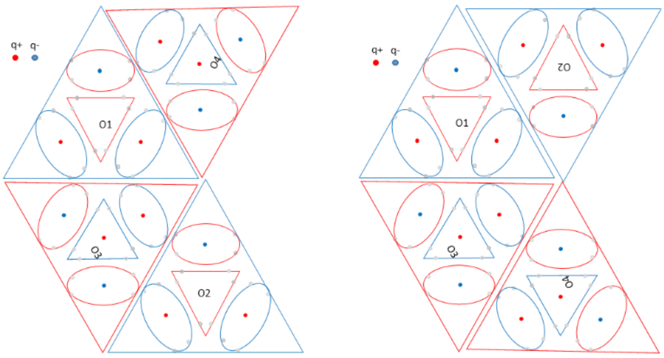
$$E_{tr23} = E_{L2} + E_{L3} = 117.4518 + 65.31273 \text{ MeV} = 182.76 \text{ MeV}$$



4.9.7.3.2.1 Case 233: The energy level E_{he233}

The last neutron takes the energy level E_{L3}:

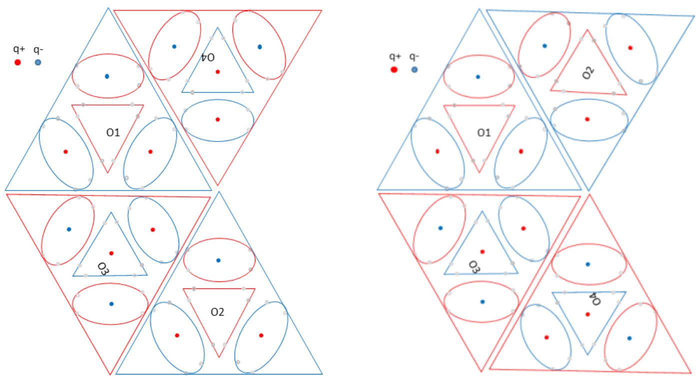
$$E_{he233} = E_{L2} + E_{L3} + E_{L3} = 65.31273 + 117.4518 + 117.4518 \text{ MeV} = 300.22 \text{ MeV}$$



4.9.7.3.2.2 Case 234: The energy level E_{he234}

The last neutron takes the energy level E_{L4}:

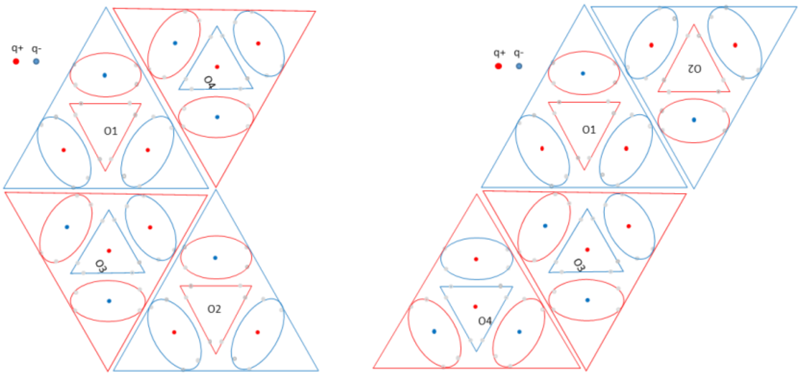
$$E_{he234} = E_{L2} + E_{L3} + E_{L4} = 65.31273 + 117.4518 + 530.1671 \text{ MeV} = 712.93 \text{ MeV}$$



4.9.7.3.2.3 Case 235: The energy level E_{he235}

The last neutron takes the energy level E_{L5}:

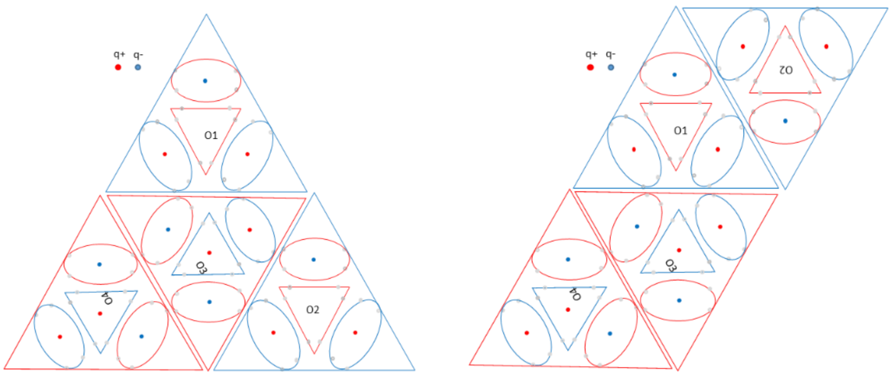
$$E_{he235} = E_{L2} + E_{L3} + E_{L5} = 65.31273 + 117.4518 + 582.3062 \text{ MeV} = 765.07 \text{ MeV}$$



4.9.7.3.2.4 Case 236: The energy level E_{he236}

The last neutron takes the energy level E_{L6}:

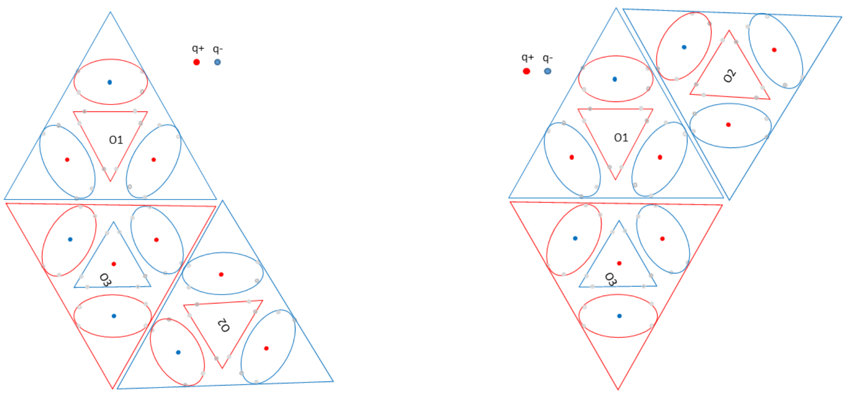
$$E_{he236} = E_{L2} + E_{L3} + E_{L6} = 65.31273 + 117.4518 + 1047.161 \text{ MeV} = 1229.93 \text{ MeV}$$



4.9.7.3.3 Case 24: The energy level E_{he24}

By taking the combination having an energy E_{L4} for the second proton, we have:

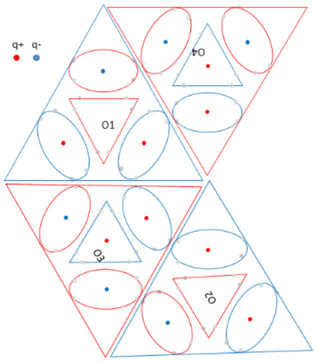
$$E_{he24} = E_{L2} + E_{L4} = 117.4518 + 530.1671 \text{ MeV} = 647.62 \text{ MeV}$$



4.9.7.3.3.1 Case 244: The energy level E_{he244}

The last neutron takes the energy level E_{L4}:

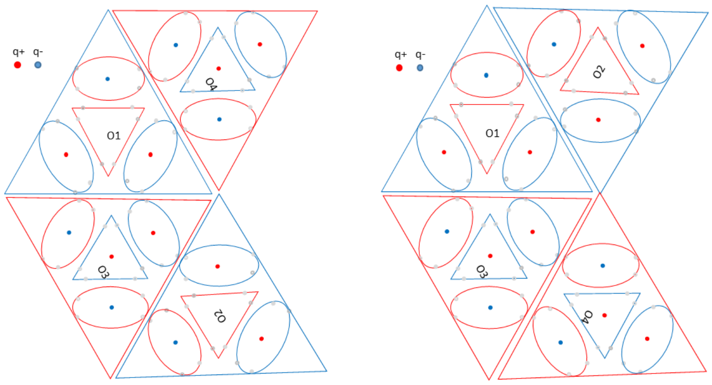
$$E_{he244} = E_{L2} + E_{L4} + E_{L4} = 65.31273 + 530.1671 + 530.1671 \text{ MeV} = 1125.65 \text{ MeV}$$



4.9.7.3.3.2 Case 245: The energy level E_{he245}

The last neutron takes the energy level E_{L5}:

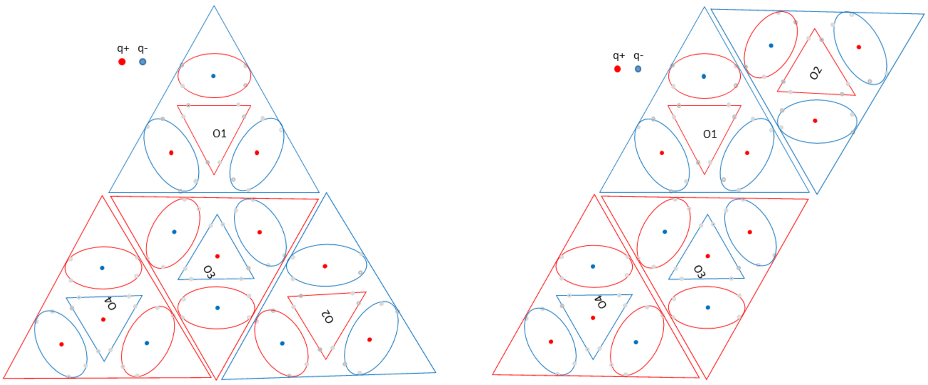
$$E_{he245} = E_{L2} + E_{L4} + E_{L5} = 65.31273 + 530.1671 + 582.3062 \text{ MeV} = 1177.79 \text{ MeV}$$



4.9.7.3.3.3 Case 246: The energy level E_{he246}

The last neutron takes the energy level E_{L6}:

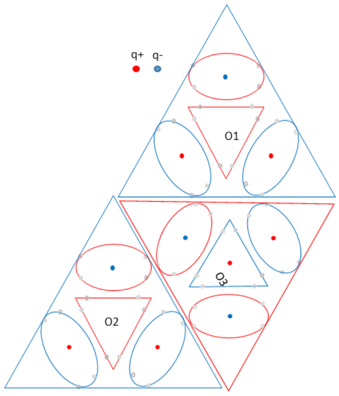
$$E_{he246} = E_{L2} + E_{L4} + E_{L6} = 65.31273 + 530.1671 + 1047.161 \text{ MeV} = 1642.64 \text{ MeV}$$



4.9.7.3.4 Case 25: The energy level E_{he25}

By taking the combination having an energy E_{L5} for the second neutron, we have:

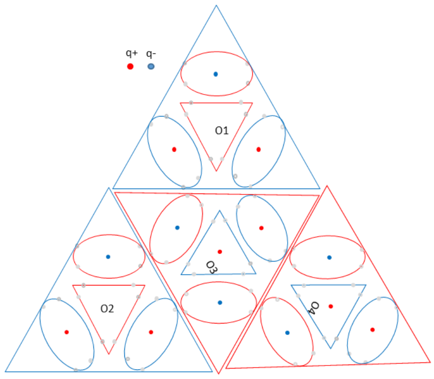
$$E_{he25} = E_{L2} + E_{L5} = 65.31273 + 582.3062 \text{ MeV} = 647.62 \text{ MeV}$$



4.9.7.3.4.1 Case 255: The energy level E_{he255}

The last neutron takes the energy level E_{L5}:

$$E_{he255} = E_{L2} + E_{L5} + E_{L5} = 65.31273 + 582.3062 + 582.3062 \text{ MeV} = 1229.93 \text{ MeV}$$

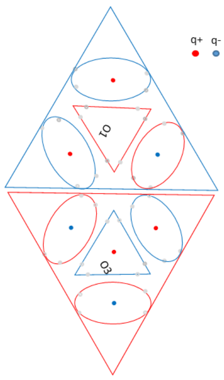


4.9.7.4 Case 3n: The energy level E_{he3n}

By taking the combination having an energy E_{L3} for the first connection, we have:

$$E_{he3n} = E_{L3} = 117.4518 \text{ MeV}$$

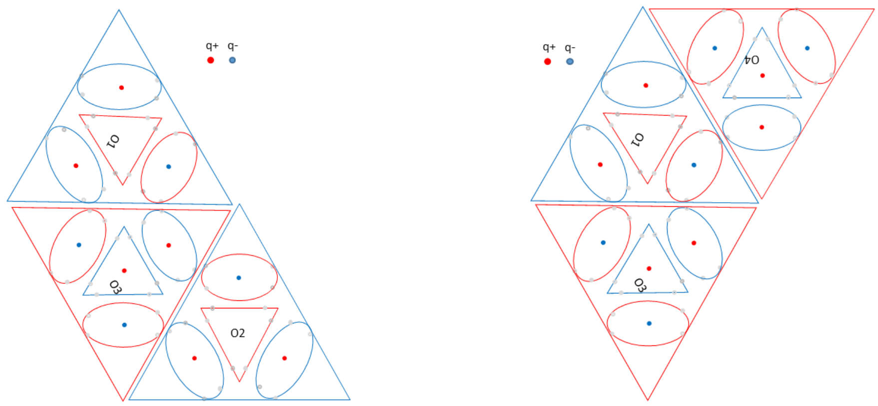
The first connection is L_{3n}. The first proton is side by side with the first neutron.



4.9.7.4.1 Case 33: The energy level E_{he33}

By taking the combination having an energy E_{L3} for the second proton, we have:

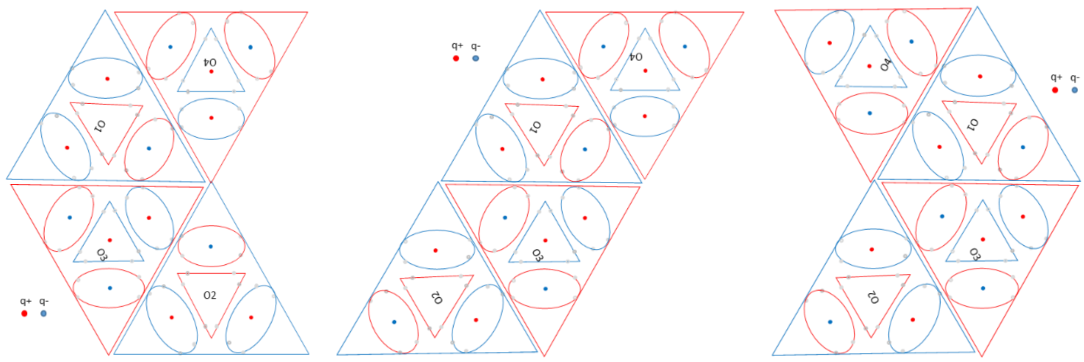
$$E_{he33} = E_{L3} + E_{L3} = 117.4518 + 117.4518 \text{ MeV} = 234.90 \text{ MeV}$$



4.9.7.4.1.1 Case 333: The energy level E_{he333}

The last neutron takes the energy level E_{L3}:

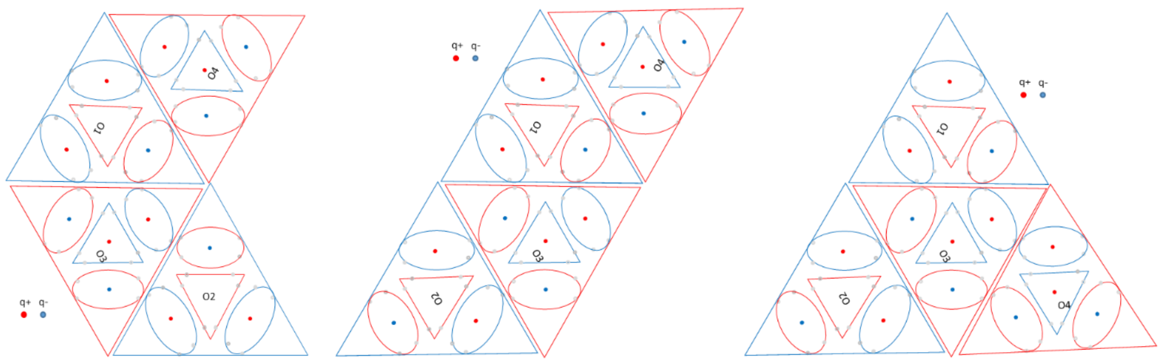
$$E_{he333} = E_{L3} + E_{L3} + E_{L3} = 117.4518 + 117.4518 + 117.4518 \text{ MeV} = 352.36 \text{ MeV}$$



4.9.7.4.1.2 Case 334: The energy level E_{he334}

The last neutron takes the energy level E_{L4}:

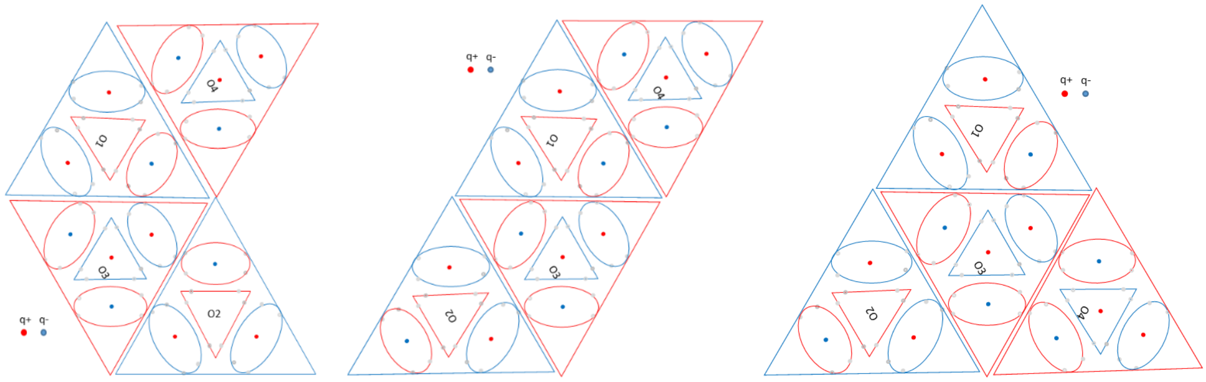
$$E_{he334} = E_{L3} + E_{L3} + E_{L4} = 117.4518 + 117.4518 + 530.1671 \text{ MeV} = 765.07 \text{ MeV}$$



4.9.7.4.1.3 Case 335: The energy level E_{he335}

The last neutron takes the energy level E_{L5}:

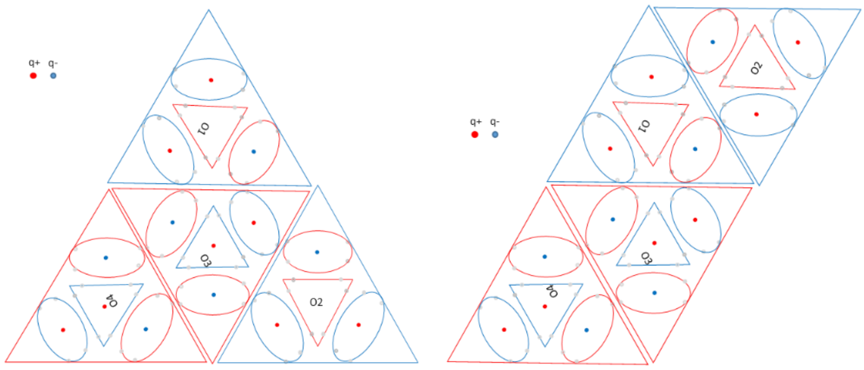
$$E_{he335} = E_{L3} + E_{L3} + E_{L5} = 117.4518 + 117.4518 + 582.3062 \text{ MeV} = 817.21 \text{ MeV}$$



4.9.7.4.1.4 Case 336: The energy level E_{he336}

The last neutron takes the energy level E_{L6}:

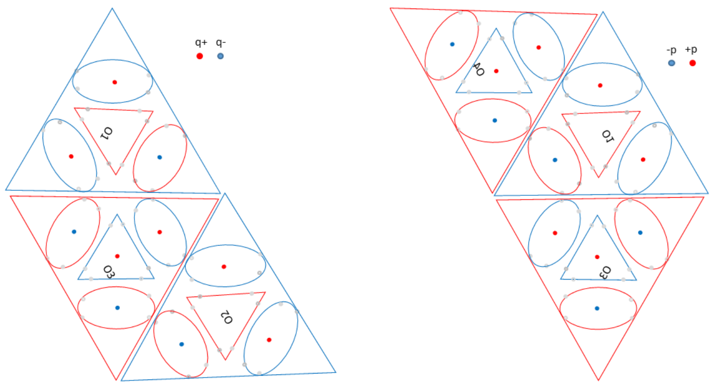
$$E_{he336} = E_{L3} + E_{L3} + E_{L6} = 117.4518 + 117.4518 + 1047.161 \text{ MeV} = 1282.06 \text{ MeV}$$



4.9.7.4.2 Case 34: The energy level E_{he34}

By taking the combination having an energy E_{L5} for the second proton, we have:

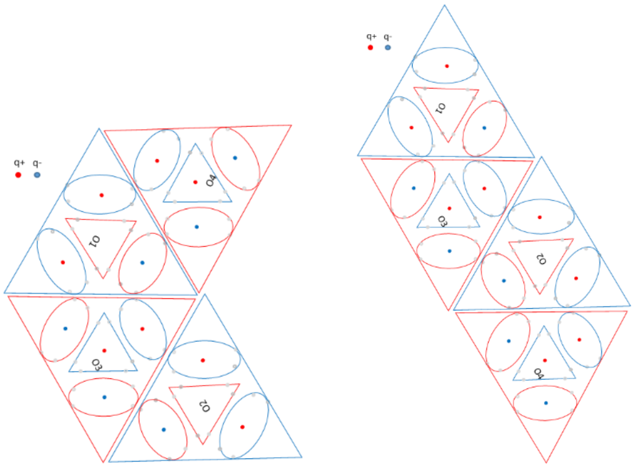
$$E_{he34} = E_{L3} + E_{L4} = 530.1671 + 117.4518 \text{ MeV} = 647.62 \text{ MeV}$$



4.9.7.4.2.1 Case 344: The energy level E_{he344}

The last neutron takes the energy level E_{L4}:

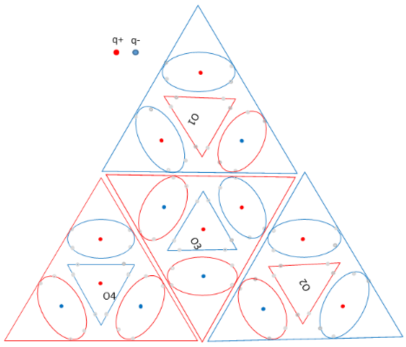
$$E_{he344} = E_{L3} + E_{L4} + E_{L4} = 117.4518 + 530.1671 + 530.1671 \text{ MeV} = 1177.79 \text{ MeV}$$



4.9.7.4.2.2 Case 345: The energy level E_{he345}

The last neutron takes the energy level E_{L5}:

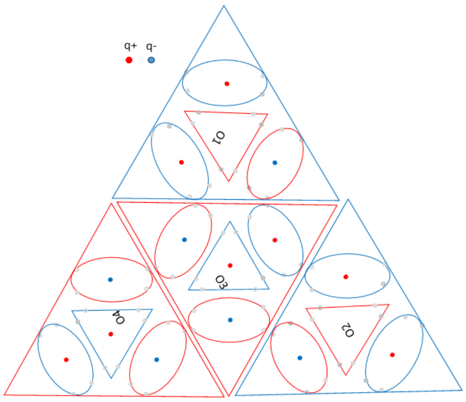
$$E_{he345} = E_{L3} + E_{L4} + E_{L5} = 117.4518 + 530.1671 + 582.3062 \text{ MeV} = 1229.93 \text{ MeV}$$



4.9.7.4.2.3 Case 346: The energy level E_{he346}

The last neutron takes the energy level E_{L6}:

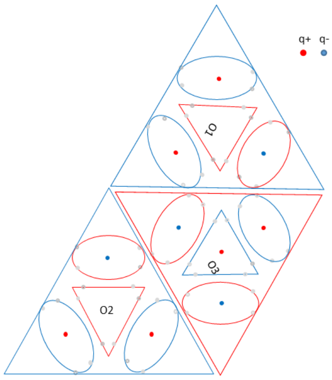
$$E_{he346} = E_{L3} + E_{L4} + E_{L6} = 117.4518 + 530.1671 + 1047.161 \text{ MeV} = 1694.78 \text{ MeV}$$

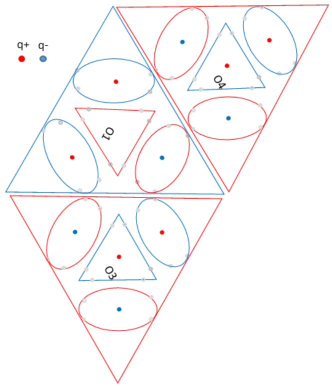


4.9.7.4.3 Case 35: The energy level E_{he35}

By taking the combination having an energy E_{L5} for the second neutron, we have:

$$E_{he35} = E_{L3} + E_{L5} = 117.4518 + 582.3062 \text{ MeV} = 699.76 \text{ MeV}$$

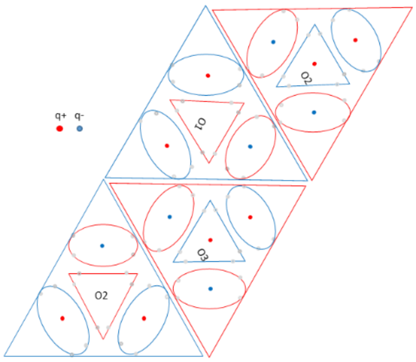


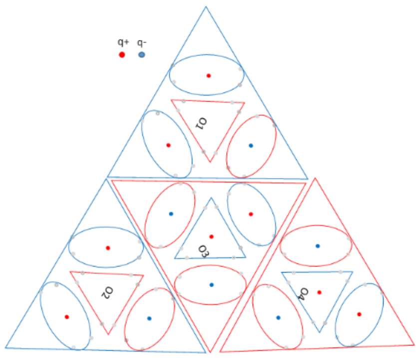


4.9.7.4.3.1 Case 355: The energy level E_{he355}

The last neutron takes the energy level E_{L5}:

$$E_{he355} = E_{L3} + E_{L5} + E_{L5} = 117.4518 + 582.3062 + 582.3062 \text{ MeV} = 1282.06 \text{ MeV}$$





4.9.7.5 Case 4n: The energy level E_{he4n}

By taking the combination having an energy E_{L4} for the first connection, we have:

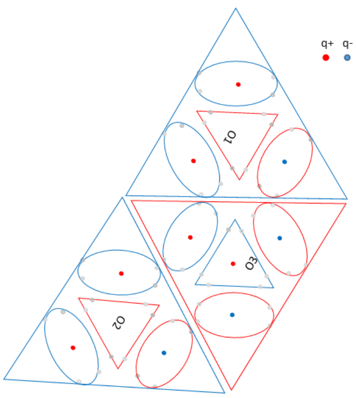
$$E_{he4n} = E_{L4} = 530.1671 \text{ MeV}$$

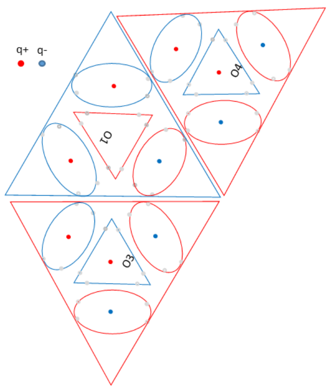
The first connection is L_{4n}. The first proton is side by side with the first neutron.

4.9.7.5.1 Case 44: The energy level E_{he44}

By taking the combination having an energy E_{L4} for the second neutron, we have:

$$E_{he44} = E_{L4} + E_{L4} = 530.1671 + 530.1671 \text{ MeV} = 1060.33 \text{ MeV}$$

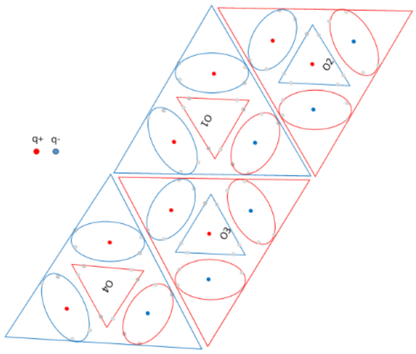




4.9.7.5.1.1 Case 444: The energy level E_{he444}

The last neutron takes the energy level E_{L4}:

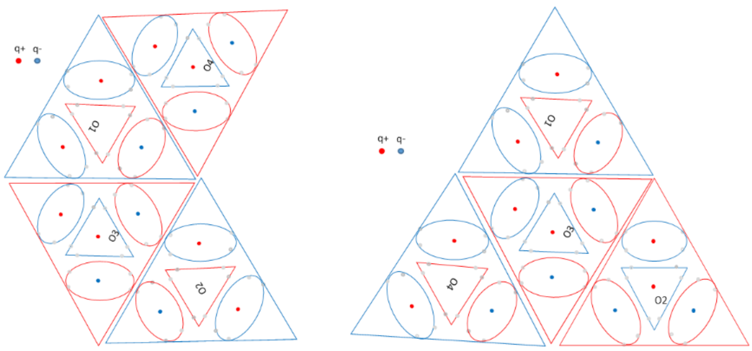
$$E_{he444} = E_{L4} + E_{L4} + E_{L4} = 530.1671 + 530.1671 + 530.1671 \text{ MeV} = 1590.50 \text{ MeV}$$



4.9.7.5.1.2 Case 445: The energy level E_{he445}

The last neutron takes the energy level E_{L5}:

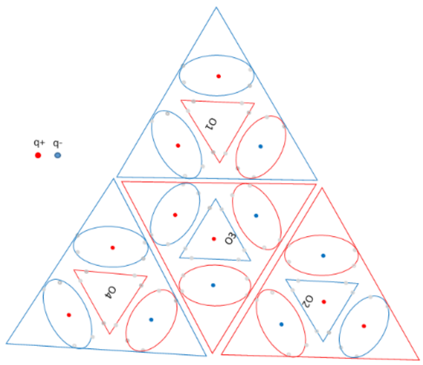
$$E_{he445} = E_{L4} + E_{L4} + E_{L5} = 530.1671 + 530.1671 + 582.3062 \text{ MeV} = 1642.64 \text{ MeV}$$



4.9.7.5.1.3 Case 446: The energy level E_{he446}

The last neutron takes the energy level E_{L6}:

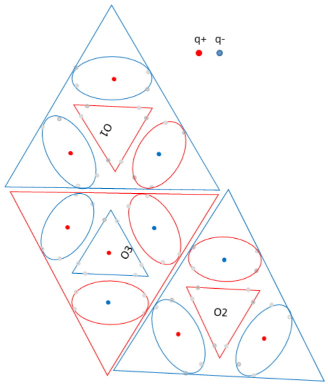
$$E_{he446} = E_{L4} + E_{L4} + E_{L6} = 530.1671 + 530.1671 + 1047.161 \text{ MeV} = 2107.50 \text{ MeV}$$

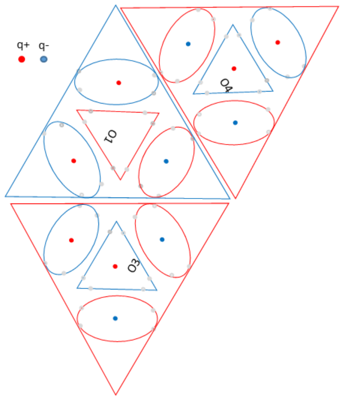


4.9.7.5.2 Case 45: The energy level E_{he44}

By taking the combination having an energy E_{L5} for the second neutron, we have:

$$E_{he45} = E_{L4} + E_{L5} = 530.1671 + 582.3062 \text{ MeV} = 1112.47 \text{ MeV}$$

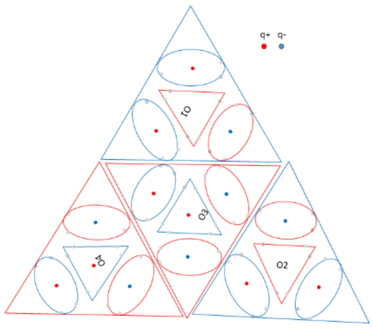


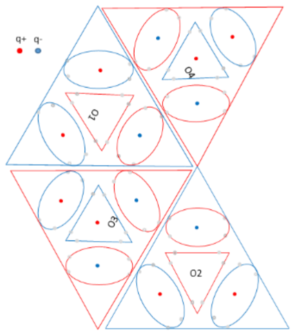


4.9.7.5.2.1 Case 455: The energy level E_{he455}

The last neutron takes the energy level E_{L5}:

$$E_{he455} = E_{L4} + E_{L5} + E_{L5} = 530.1671 + 582.3062 + 582.3062 \text{ MeV} = 1694.78 \text{ MeV}$$





4.9.7.6 Conclusion

The balance of binding energy levels is summarized in the following table:

No	Combinaison	Binding energy	Static stability	Dynamic stability	Electrical stability	Comment
1	He000	-28.297	1000	1	10	Stacking rate +
2	He001	-5.6914	100	10	10	low energy rate +
2b	He010	-5.6914	100	10	10	low energy rate +
3	He002	46.448	100	60	10	low energy rate +
4	He003	98.585	100	110	10	low energy rate +
5	He013	121.19	10	130	0	low energy rate n0
5b	He022	121.19	10	130	0	low energy rate n0
6	He023	173.33	10	180	20	low energy rate ++
7	He0330	216.04	100	230	60	Low ++++++
8	He033	225.47	10	230	50	low energy rate +++++
9	He133	248.08	1	250	20	low energy rate ++
9b	He223	248.08	1	250	20	low energy rate ++
10	He233	300.22	1	300	40	low energy rate ++++
11	He333	352.36	1	350	60	low energy rate ++++++
12	He004	511.30	100	500	-20	middle energy rate --
13	He014	533.91	10	550	-40	middle energy rate ----
14	He005	563.44	100	600	0	middle energy rate n0
15	He015	586.05	10	600	-20	middle energy rate --

No	Combinaison	Binding energy	Static stability	Dynamic stability	Electrical stability	Comment
15b	He024	586.05	10	600	-20	middle energy rate --
16	He0250	628.75	100	650	0	loop rate n0
17	He025	638.19	10	650	0	middle energy rate n0
17b	He034	638.19	10	650	0	middle energy rate n0
18	He134	660.79	1	650	-20	middle energy rate --
18b	He224	660.79	1	650	-20	middle energy rate --
19	He035	690.33	10	700	20	middle energy rate ++
20	He135	712.93	1	700	0	middle energy rate n0
20b	He225	712.93	1	700	0	middle energy rate n0
20c	He234	712.93	1	700	0	middle energy rate n0
21	He235	765.07	1	750	20	middle energy rate ++
21b	He334	765.07	1	750	20	middle energy rate ++
22	He335	817.21	1	800	40	middle energy rate ++++
23	He060	1028.29	10	1000	-40	middle energy rate ----
24	He0160	1041.47	100	1000	-40	loop rate ----
24b	He0440	1041.47	100	1000	-40	loop rate ----
25	He044	1050.90	10	1000	-40	high energy rate ----
26	He144	1073.51	1	1000	-60	high energy rate ------
27	He045	1103.04	10	1100	-20	high energy rate --
27b	He062	1103.04	10	1100	-20	high energy rate --
28	He145	1125.65	1	1100	-40	high energy rate ----
28b	He244	1125.65	1	1100	-40	high energy rate ----
29	He055	1155.18	10	1100	0	high energy rate n0
29b	He063	1155.18	10	1100	0	high energy rate n0
30	He136	1177.79	1	1100	-40	high energy rate ----
30b	He226	1177.79	1	1100	-20	high energy rate --
30c	He155	1177.79	1	1100	-20	high energy rate --
30d	He245	1177.79	1	1100	-20	high energy rate --
30e	He344	1177.79	1	1100	-20	high energy rate --
31	He236	1229.93	1	1200	0	high energy rate n0
31b	He255	1229.93	1	1200	0	high energy rate n0
31c	He345	1229.93	1	1200	0	high energy rate n0
32	He336	1282.06	1	1200	20	high energy rate ++
32b	He355	1282.06	1	1200	20	high energy rate ++
33	He064	1567.90	10	1500	-40	high energy rate ----
34	He146	1590.50	1	1500	-60	high energy rate ------
34b	He444	1590.50	1	1500	-60	high energy rate ------
35	He246	1642.64	1	1600	-40	high energy rate ----
35b	He445	1642.64	1	1600	-40	high energy rate ----
36	He346	1694.78	1	1600	-40	high energy rate ----
36b	He455	1694.78	1	1600	-20	high energy rate --
37	He446	2107.50	1	2100	-60	high energy rate ------

We see a large number of possibilities to connect these 4 nucleons. We notice the following looped configuration:

$$he0330 = \begin{bmatrix} P - N \\ N - P \end{bmatrix}$$

The 2 stacked neutron-proton bonds have the energy E_{L0}. The 2 side-by-side neutron-proton bonds have the energy E_{L3}. We have the binding energies:

$$E_{he0330} = 2*E_{L3} + 2*E_{L0} = 231.38 \text{ MeV}$$

This energy corresponds to a low level. This configuration is formed during cooling in a low temperature environment.

4.9.8 Modeling of the lithium 6 core

The lithium-6 nucleus is composed of 3 protons and 3 neutrons. What is the relative position of these 6 nucleons?

To describe the possible configurations, we start from the description of helium, for each of these cases, a proton and a neutron will be added. The number of combinations immediately becomes high. Here, only the case with the lowest binding energy will be studied.

4.9.8.1 Case 0000n: The energy level $E_{li0000n}$

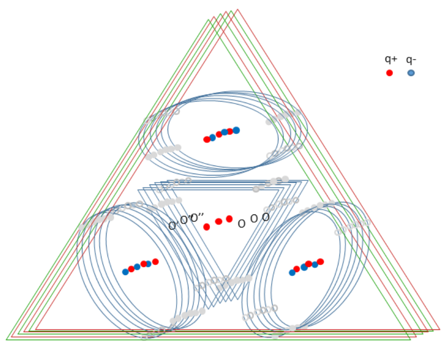
Taking the combination with the lowest energy corresponding to the first helium configuration, we have:

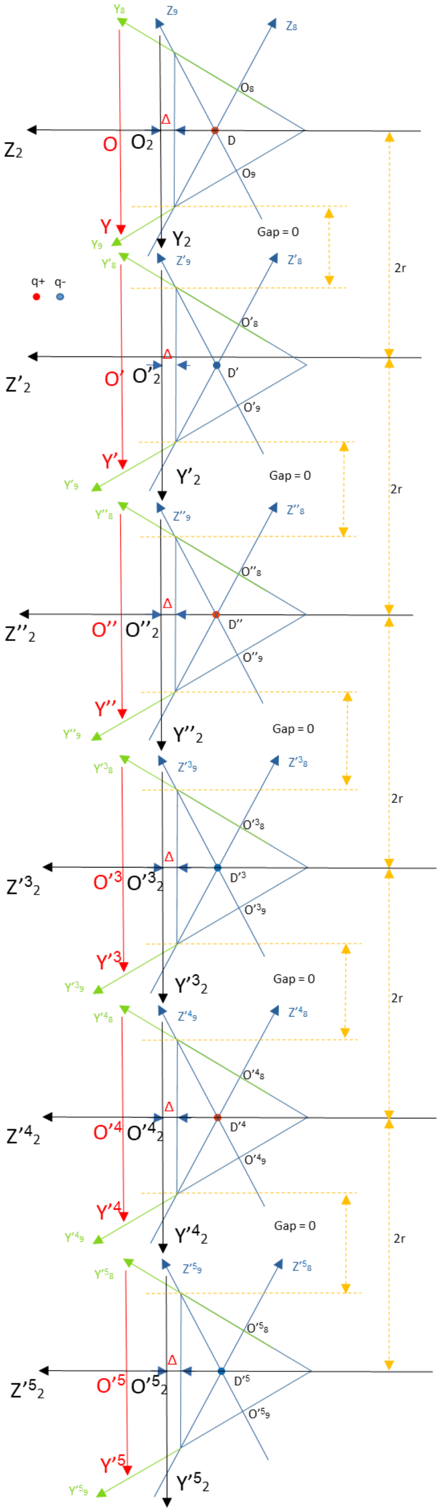
$$E_{li000n} = -21.\ 330\ 050\ 514 \text{ MeV}$$

The 6 nucleons are stacked along their axes of symmetry as follows:

- N-P-N-P-N-P

$$E_{li00000} = E_{li000n} + E_{li0n} + E_{li0n} = -31.\ 995\ 075\ 771 \text{ MeV (experimental)}$$





Binding energies can be calculated in the same way as for helium.

The coordinates of points D, D', D'', D'3, J, J', J'', J'3, A, A', A'', A'3, G, G', G'' and G'3 in the global reference frame are:

$$\overrightarrow{OD} = 2 \cdot \overrightarrow{OO_2}$$

$$D(x,y,z) = 2O_2\left(-\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = D\left(-\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = D(-r, 0, -\frac{r}{\sqrt{3}})$$

$$D'(x,y,z) = D'(-r, -2r, -\frac{r}{\sqrt{3}})$$

$$D''(x,y,z) = D''(-r, -4r, -\frac{r}{\sqrt{3}})$$

$$D'^3(x,y,z) = D'^3(-r, -6r, -\frac{r}{\sqrt{3}})$$

$$A(x,y,z) = 2O_3\left(\frac{\sqrt{3}}{2}z_0, 0, -\frac{1}{2}z_0\right) = A\left(\sqrt{3}\frac{r}{\sqrt{3}}, 0, -\frac{r}{\sqrt{3}}\right) = A(r, 0, -\frac{r}{\sqrt{3}})$$

$$A'(x,y,z) = A'(r, -2r, -\frac{r}{\sqrt{3}})$$

$$A''(x,y,z) = A''(r, -4r, -\frac{r}{\sqrt{3}})$$

$$A'^3(x,y,z) = A'^3(r, -6r, -\frac{r}{\sqrt{3}})$$

$$J(x,y,z) = 2O_1(0,0,z_0) = J\left(0,0,2\frac{r}{\sqrt{3}}\right) = J(0,0,\frac{2r}{\sqrt{3}})$$

$$J'(x,y,z) = J'(0, -2r, \frac{2r}{\sqrt{3}})$$

$$J''(x,y,z) = J''(0, -4r, \frac{2r}{\sqrt{3}})$$

$$J'^3(x,y,z) = J'^3(0, -6r, \frac{2r}{\sqrt{3}})$$

$$G(x,y,z) = G(0,0,0)$$

$$G'(x,y,z) = G'(0, -2r, 0)$$

$$G''(x,y,z) = G''(0, -4r, 0)$$

$$G'^3(x,y,z) = G'^3(0, -6r, 0)$$

Determine the potential energies between the electric charge pairs of the first neutron and the proton:

$$E = E_A^{A'} + E_D^{D'} + E_J^{J'} + E_D^{J'} + E_J^{D'} + E_G^{A'} - E_A^{D'} - E_A^{J'} - E_D^{A'} - E_J^{A'} - E_G^{D'} - E_G^{J'}$$

$$E_x^{y'} = k_e \frac{中_x \cdot 中_{y\prime}}{中_{ref}^2} \cdot \frac{e^2}{d_x^{y'}} = k_e \cdot \frac{\left(中_{ref} + \alpha_E \cdot 中_{\delta y\prime 5}\right)^2 e^2}{中_{ref}^2 \cdot d_x^{y'}}$$

The additional terms are defined as follows:

- α_E : the coefficient of proportionality of the neutral charge affecting lithium.
- $中_{\delta y'5}$: the neutral charge of lithium without static electrinettes.

$$E = \frac{k_e \cdot e^2}{4r} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right] \frac{\left(中_{ref} + \alpha_E \cdot 中_{\delta y\prime 5}\right)^2}{中_{ref}^2}$$

Here,

$E = E_{li00000} /5 = -6.399\ 015\ 154$ MeV $= -10.252\ 3741 \cdot 10^{-13}$ J.

We deduce the value of α_E:

$$\frac{E \cdot 中_{ref}^2 \cdot 4r}{k_e \cdot e^2 \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]} = \left(中_{ref} + \alpha_E \cdot 中_{\delta y\prime 5}\right)^2$$

$$\alpha_E \cdot 中_{\delta y\prime 5} = \sqrt{\frac{E \cdot 中_{ref}^2 \cdot 4r}{k_e \cdot e^2 \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]}} - \left(中_{ref}\right)$$

We have:

$$中_{\delta y\prime 5} = 18\left(中_F + 中_F + 中_H\right) + 18\left(中_H + 中_H + 中_F\right) = 4469.464818 \cdot 10^{-31}\, kg$$

$$中_{ref} = 9.1 \cdot 10^{-31}$$

$$\alpha_E 中_{\delta y\prime 5} = \sqrt{\frac{10.2523741 \cdot 10^{-13} \cdot 82.81 \cdot 10^{-62} \cdot 4 \cdot 0.36373 \cdot 10^{-15}}{8.987552 \cdot 1.602177^2 \cdot 10^{-29} \cdot \left[6 - 2\sqrt{2} - \sqrt{3}\right]}} - 9.1 \cdot 10^{-31}$$

$$\alpha_E 中_{\delta y\prime 5} = \sqrt{\frac{37.193377188 \cdot 10^{-61}}{1.0}} - 9.1 \cdot 10^{-31}$$

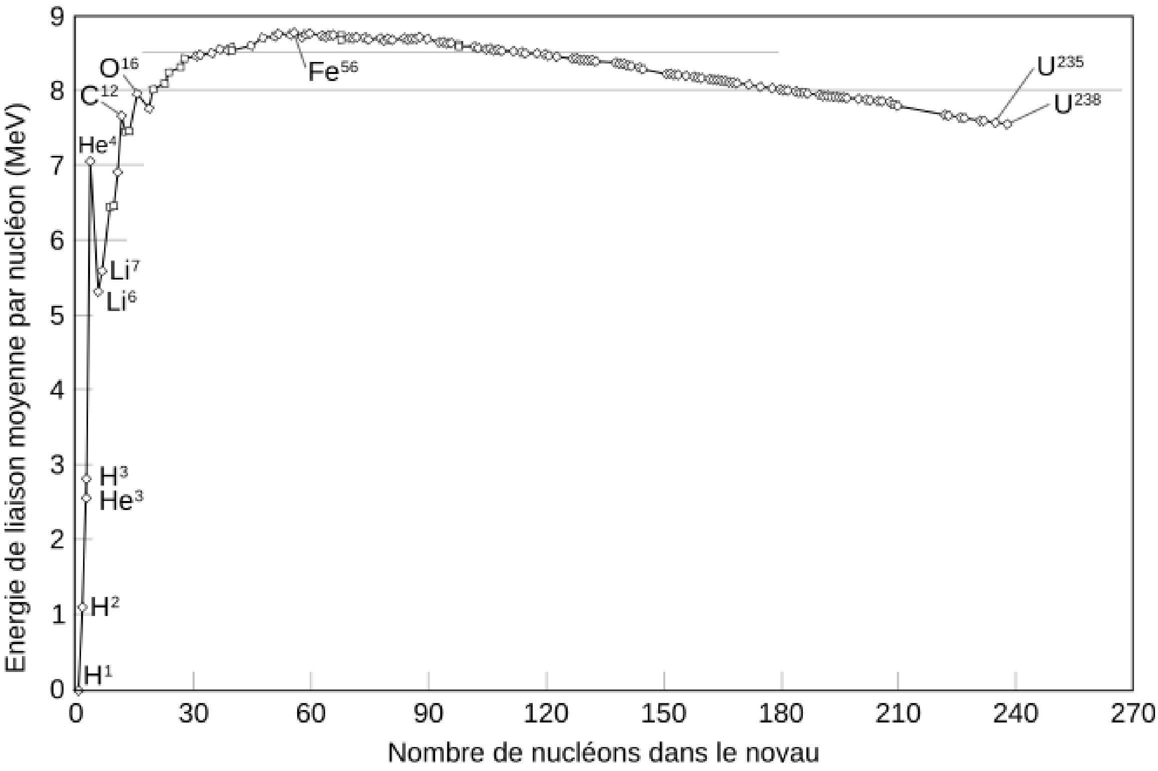
$$\alpha_E 中_{\delta E} = 19.285\ 584\ 562 \cdot 10^{-31} - 9.1 \cdot 10^{-31}$$

$$\alpha_E \cdot 4469.464818 \cdot 10^{-31} = 10.185\ 584\ 562\ 037 \cdot 10^{-31}$$

$$\alpha_C = 0.002\ 278\ 927$$

4.9.9 Interpretation of the Aston curve

The Aston curve is a curve representing the binding energy per nucleon of atomic nuclei, as a function of their mass number.



The geometric configuration of quarks within protons and neutrons makes it easy to explain this curve.

If atomic nuclei contain only negative energy bonds (axial or radial), this curve would be strictly increasing. Indeed, the volume density of energy increases initially, then quickly saturates as construction progresses.

The hook between He^4 and Li^6 is explained by a volume increase greater than the energy variation.

The lowering of the curve after Fe^{56} is explained by the appearance of positive energy bonds (dynamic radials). The sum of the binding energies increases less quickly when the number of nucleons increases. This lowers the average.

4.9.10 Modeling nuclear fusions

This paragraph describes the conditions for nucleon fusion and the energies involved. The following legend will be used:

- Proton: 
- Neutron: 

4.9.10.1 The necessary conditions for fusion between a proton and a neutron

For a fusion between 1 proton and 1 neutron to take place, it is imperative to respect the following conditions:

1. If fusion occurs through an axial bond, then the energy is negative. This bond is based on the 3 pairs of electrinettes separated by a constant distance. The absolute value of this bond is the weakest. The condition is that the axes of these 2 nucleons are on the same line.
2. If fusion occurs by radial bonding, then the 4 contacting pairs of electrinettes from the O1 nucleon must be in synchronization with the 4 contacting pairs of electrinettes from the O2 nucleon. The O1 and O2 nucleons must be positioned facing each other.
3. The two nucleons must come together until they make contact. In the case of an axial bond, the approach can be done automatically. In the case of a radial bond, pressure is necessary to compensate for the electric force generated by two electric charges of the same sign, except in case 3 of deuterium.

4.9.10.2 The necessary conditions for fusion between 2 protons

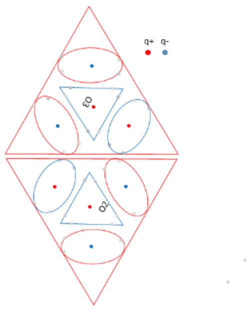
For a fusion between two protons to take place, the following conditions must be met:

1. Fusion can only be achieved by a radial bond.
2. The two protons must come together until they make contact. Pressure is needed to compensate for the force generated by two electrical charges of the same sign.

4.9.10.3 The necessary conditions for fusion between 2 neutrons

For a fusion between two neutrons to take place, the following conditions must be met:

1. Fusion can only be achieved by a radial bond.
2. The two neutrons must come together until they make contact. Pressure is needed to compensate for the force generated by two electrical charges of the same sign. There is one exception:



In this specific case, the expulsion force is less than the attraction force. Pressure is not necessary to make contact.

4.9.10.4 The necessary conditions for fusion between two atomic nuclei

Here, atomic nuclei have at least two nucleons. Generally, the first two nucleons are proton-neutron. For fusion between two atomic nuclei to take place, the following conditions must be met:

1. If the bond is axial, then the bond section must be in agreement with the 2 nuclei. There is therefore a positive number of L_0 bonds.
2. If the bond is radial, then the bond cut must have a sufficient number of negative energy LL_0 double bonds.
3. The bonding nucleons must be in the correct position facing each other.
4. In the case of radial bonding, there is a second possibility. The bond energy is positive. These are bonds between the bonded electrinettes. They are dynamic. Whereas the axial bond and the radial bond with negative energy are static.
5. In the latter case, the connected electrinettes must be synchronized with respect to the contact points.
6. The problem of binding energy: In the case of positive energy, the result of fusion remains motionless. In the case of negative energy, the emitted binding energy is converted into kinetic energy. According to the law of conservation of angular momentum, the final angular momentum must be equal to the initial angular momentum. In the case of zero initial momentum, the final momentum must be zero. This leads to the separation of the two nuclei in two opposite directions. This is why it is preferable to choose a fusion that produces at least two particles that facilitate the conservation of angular momentum.

In practice, the first two conditions are not as simple as they seem. Indeed, the nuclei to be fused carry an overall positive electric charge. Therefore, at a distance greater than the radius r of the charginettes, the nuclei repel each other. Therefore, sufficient pressure is required to bring them together.

The problem is that the electric force is proportional to the volumetric energy density. So, increasing the pressure will lead to an increase in the energy density. Which leads to an increase in the repulsive force. So, there is a kind of natural regulation of the fusion rate.

By the same reasoning, increasing temperature has the same effect as increasing pressure.

The last synchronization condition is the most difficult. Indeed, although nucleons are built over time, they are not all in phase. It takes a very large number of nucleons to obtain a small number of synchronizable nucleons.

If we take the diameter of the electron, at best (because some estimate that it tends towards 0), at the following value:

$$d_e = 10^{-22} \text{ m}$$

The circumference of a charginette is:

$$l_c = \pi*2*r = \pi*2*0.36373 = 2.285382992*10^{-15} \text{ m.}$$

The number of positions on the trajectory of a charginette:

$$N_p = l_c / d_e = 2.285 * 10^7.$$

On average, it takes $N_p + 1$ nuclei to have 2 synchronizable nuclei. It therefore takes N_p different encounters to cross a synchronizable nucleus.

The third condition is less severe than the second. But it still takes time for them to fall face to face naturally, even under pressure. Indeed, the rotation of the charginettes becomes neutral at a distance above their radius. Self-positioning is not possible.

In the general case of a negative energy bond, the new bond releases energy. This is potential energy. This energy does not remain in space within the energy field. It will be converted into kinetic energy in the new atomic nucleus.

In the general case of a positive-energy fusion, the energies of the new bonds must be provided. This is potential energy. This energy remains in space within the energy field.

4.9.10.5 The necessary conditions for fusion between 1 atomic nucleus and 1 neutron

Here, the atomic nucleus has at least 2 nucleons. Generally, the first 2 nucleons are proton-neutron. For a fusion between 1 atomic nucleus and a neutron to take place, it is imperative to respect the following conditions:

1. If the bond is axial, then the neutron must find 1 proton in the nucleus to position itself on its axis. This assumes that the nucleus has at least one proton with a free axial position.
2. If the binding is radial, then the neutron alone can only have a dynamic binding, therefore with positive energy.

Uranium has an isotrope of 235 with 143 neutrons and 92 protons. The number of neutrons is almost twice the number of protons. Therefore, there are a certain number of neutrons with their dynamic bonds. Since these dynamic bonds are less stable compared to static bonds, radioactivity is explained.

4.9.10.6 Example of fusion between Deuterium and Tritium

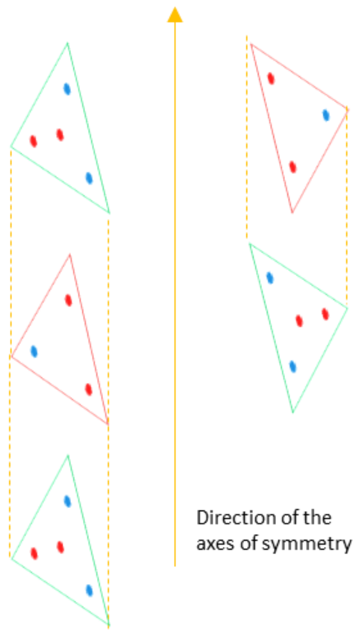
In the fusion of a deuterium and a tritium giving a helium 4 nucleus and a neutron, the equation is as follows:

$$D + T = H_{e4} + n_0$$

4.9.10.6.1 Progress of the merger

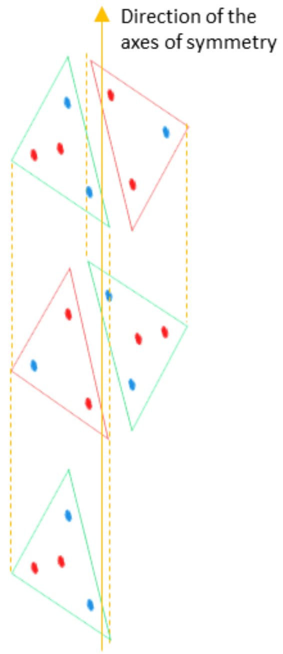
In the case of the laboratory, the entry and exit cases are as follows:

1. Step 1: Deuterium E_{de0} and tritium E_{tr00} are positioned in parallel by thermal agitation at high temperature or by high pressure.

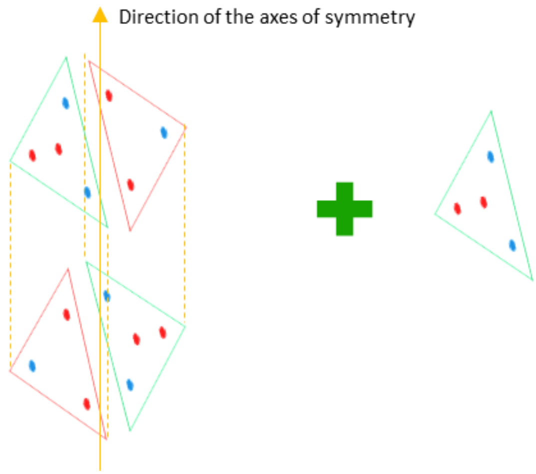


2. Step 2: Deuterium E_{de0} combines with tritium E_{tr00} under the effect of high pressure and thermal agitation which compensate for the electrical force.

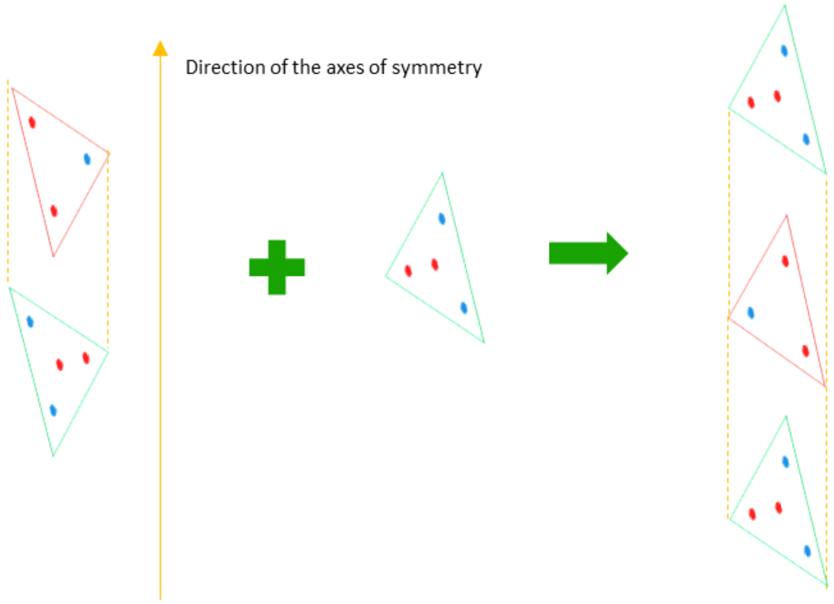
3. Step 3: The most compact combination to achieve is the radial bonding of deuterium and tritium into helium 5: $E_{he000LL0}$.



4. Step 4: Conservation of momentum makes helium 5 unstable and releases the neutron from the E_{L0} energy level.



5. Step 5: Since tritium is expensive, we must take advantage of the released neutron to obtain tritium.



This final step 5 requires that more deuterium be added at the input. The initial tritium acts as a catalyst. Then, self-fusion generates tritium.

Noticed:

This final step 5 produces a single particle. Momentum conservation can make collinear collisions unstable if the deuterium and neutron were moving in two opposite directions. Rebounding is possible and likely.

Fusion between two deuterium without using tritium is also possible. The probability is lower than the tritium + deuterium case for the same reason as above, which results in a single particle.

4.9.10.6.2 Energy put into play

The initial deuterium has an E_{de0} configuration. This deuterium combines with a tritium of configuration E_{tr00} to give a helium 5. The mass balance is as follows:

$$\Delta M_1 = M_{he5} - M_{de} - M_{tr}$$

$$\Delta M_1 = 5.01222u - 2.014102u - 3.016049u = -0.017931u = -16.702\ 619\ MeV$$

Helium 5 becomes helium 4 by losing a neutron. The mass balance is as follows:

$$\Delta M_2 = M_{he4} + M_n - M_{he5}$$

$$\Delta M_2 = 4.002603u + 1.008666u - 5.01222u = -0.000\ 951u = -0.885\ 851\ MeV$$

The energy balance is:

$$E = \Delta M_1 - \Delta M_2 = -16.702\ 619\ MeV + 0.885\ 851\ MeV = -15.816\ 769\ MeV$$

4.9.10.6.3 Conditions favoring fusion

Solution:

For fusion between deuterium and tritium to take place, two operations must be carried out: moving the electron away from each of them and bringing the two nuclei together.

The first operation can be achieved by raising the temperature, while the second can be achieved by raising the pressure. The problem is that it is difficult to achieve very high temperature and very high pressure at the same time. The only known case of this achievement is the H bomb. The disadvantage of this method is that it does not allow the fusion energy to be delivered in a controlled manner.

It is therefore necessary to find another way to quickly release a large amount of energy. The most powerful energy source (the H-bomb, for example) known to date is of nuclear origin. According to the present model, this energy comes from electron-positron bonding. This leads to the use of two very high voltage electrodes (a method close to the H-bomb mode), to release a very large amount of energy by neutralizing the electrical charges. If the amount of energy is sufficient, the two conditions of high temperature and high pressure will be achieved during the electrical discharge which generally lasts a very short time (1 to 10 ms).

This short-term, highly localized fusion benefits from electromagnetic favor. The current model indicates that the electric force is proportional to the volumetric energy density. But the rapidity of the energy increase makes this proportionality inoperative for a short time at the beginning of this increase. This is an inherent delay of electromagnetism, like magnetic remanence. This allows the atomic nuclei to be brought together with a repulsive force corresponding to the old energy density. This favors fusion.

On the other hand, the Tokamak mechanism does not benefit from this advantage. Indeed, the plasma in a Tokamak is obtained by gradual heating. This gradually increases the electrical force while decreasing the probability of fusion of the nuclei.

With the H-bomb mode, the maximum fusion rate during an electric discharge is calculated taking into account the following characteristics:

1. Deuterium and tritium each have 5 facets: two axial, 3 radial
2. For each core, the probability of obtaining a fused facet is: $\frac{3}{5}$. In fact, only the 3 radial facets are fused.

3. For each fused facet, the probability of falling on the correct facet of the other nucleus is: $\frac{1}{5}$ in the case of the single facet (2 electrinettes of the same sign) or: $\frac{1}{5}$ in the case of the double facet (2 electrinettes of different signs).
4. The overall probability is: $\tau = \frac{3}{5}\cdot\left(\frac{1}{3}\cdot\frac{1}{5}+\frac{1}{3}\cdot\frac{1}{5}+\frac{1}{3}\cdot\frac{1}{5}\right) = \frac{3}{5}\cdot\left(\frac{3}{15}\right) = \frac{3}{25}$
5. If the time of a fusion is less than the duration of a discharge and the duration of magnetic remanence, this rate can be greater than one tenth.

This calculation takes into account the following hypothesis:

Under high pressure, the two nuclei have time to readjust to fuse when the two faces are good thanks to the force of attraction.

This is not true if the pressure is low. Indeed, if the electrinettes are not sufficiently opposite, the nuclei will bounce off each other.

To increase the probability of fusion, it is possible to consider influencing the orientation of the nuclei by using their electric moment and their magnetic moment.

It is not possible to rely on a condition combining high temperature, high pressure, and the continuity of the first two quantities. Indeed, a container that can withstand 100 million degrees and 10,000 bars is difficult to achieve. In addition, a stabilized environment reduces the melting rate. Therefore, a system that discharges cyclically must be used, much like a 4-stroke cylinder in a gasoline engine. The container is cooled by a cooling system. Thus, the average temperature of the container is much lower than the melting temperature.

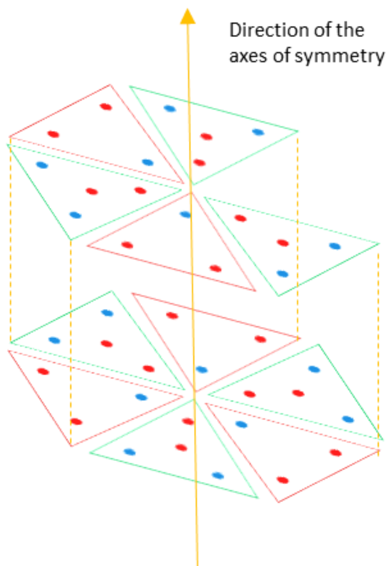
4.9.10.7 Another example between a proton and a boron nucleus

The fusion of a proton and a boron nucleus:

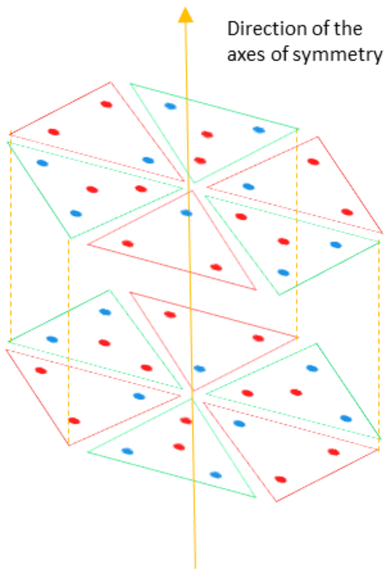
- ${}^{1}_{1}P + {}^{11}_{5}B = {}^{12}_{6}C = {}^{4}_{2}He + {}^{4}_{2}He + {}^{4}_{2}He + 8.7MeV$

4.9.10.7.1 Progress of the merger

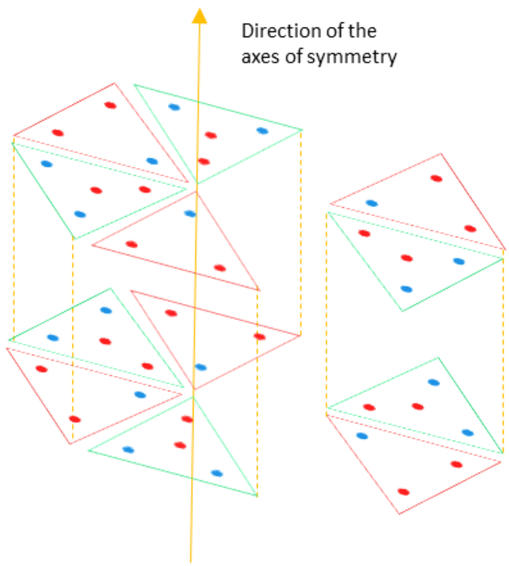
The structure of the Boron nucleus can be represented by the following diagram:



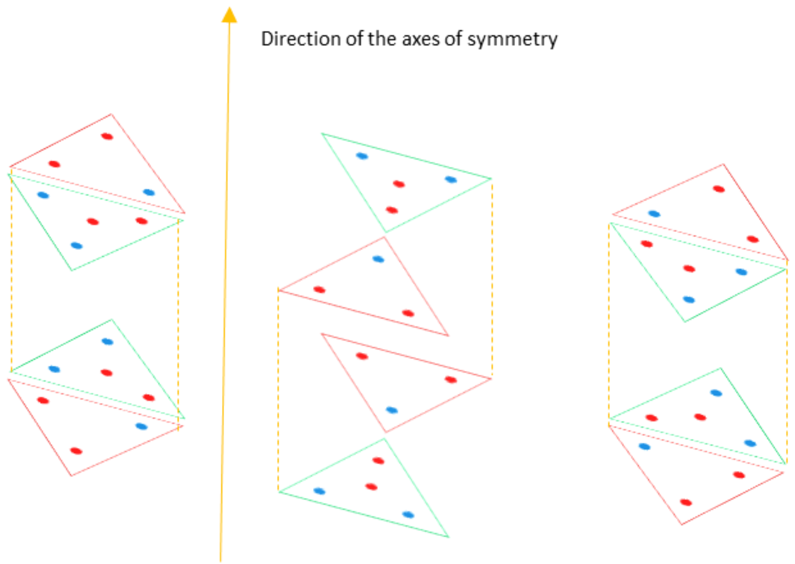
The fusion of the Boron nucleus with a proton gives a carbon nucleus whose structure is as follows:



The kinetic energy from fusion first separates the carbon into 1 helium and 1 beryllium:



Kinetic energy continues to separate the beryllium into 2 helium:



4.9.10.7.2 Energy put into play

The mass of Boron 11 is:

$$\Delta M_1 = 11{,}0093054u = 10255,\ 102\ 232\ 528\ MeV$$

The sum of the mass of the proton and Boron:

$$\Delta M_2 = M_P + M_B$$

$$\Delta M_2 = 1{,}007\ 276\ u + 11{,}0093054u = 11193.\ 374\ 532\ 528\ MeV$$

The sum of the 3 heliums:

$$\Delta M_3 = 3M_{he4}$$

$$\Delta M_3 = 3*\ 4{,}002\ 602\ u = 11185.\ 199\ 577\ MeV$$

The energy balance is:

$$E = \Delta M_2 - \Delta M_3 = 11193.374\ 532\ 528\ MeV - 11185.199\ 577\ MeV = 8.175\ MeV$$

4.9.10.7.3 Conditions favoring fusion

Solution:

The boron nucleus has 5 positive charges. The repulsive force is much greater than that of a tritium nucleus.

The pressure to be implemented is greater than for deuterium and tritium.

The advantage of this fusion is that no neutrons are released. The energy released is in kinetic form.

The most direct way to recover this energy is to use the principle of the piston engine.

4.9.10.8 Conclusions

This model can explain why a star has such a long lifetime:

The lifespan of a star is approximately 10 billion years, depending on its fuel reserves. This longevity is also due to the self-regulation of fusions, which takes time to achieve.

Constraint:

This model reveals an important aspect. Indeed, projects to build fusion power plants must take into account this constraint of self-regulation of fusions. Otherwise, failures will be encountered.

Verification with experimental results:

Current achievements of nuclear fusions show that the efficiency of the inertial mode (H-bomb mode) is 1.53; while the Tokamak mode is 0.64; which is consistent with the description of the conditions favoring fusion.

Areas for improving the fusion rate:

Since nuclei are electrically charged, it is possible to influence their orientation using an electromagnetic field. If, for example, the symmetry axes of the nuclei were all parallel, then this would increase the fusion rate.

4.9.11 Fission modeling

This paragraph describes the conditions of nucleon fission and the energies involved.

4.9.11.1 Conditions for nucleon fission

The structure of an atomic nucleus composed of a large number of nucleons may not be very stable. This happens when there are dynamic bonds.

A neutron can penetrate the atom due to its relative neutrality. If this neutron has an energy greater than the fission barrier of 5.7 MeV, the nucleus of the atom can break into several smaller nuclei. Fission releases higher energy neutrons, which triggers a chain reaction.

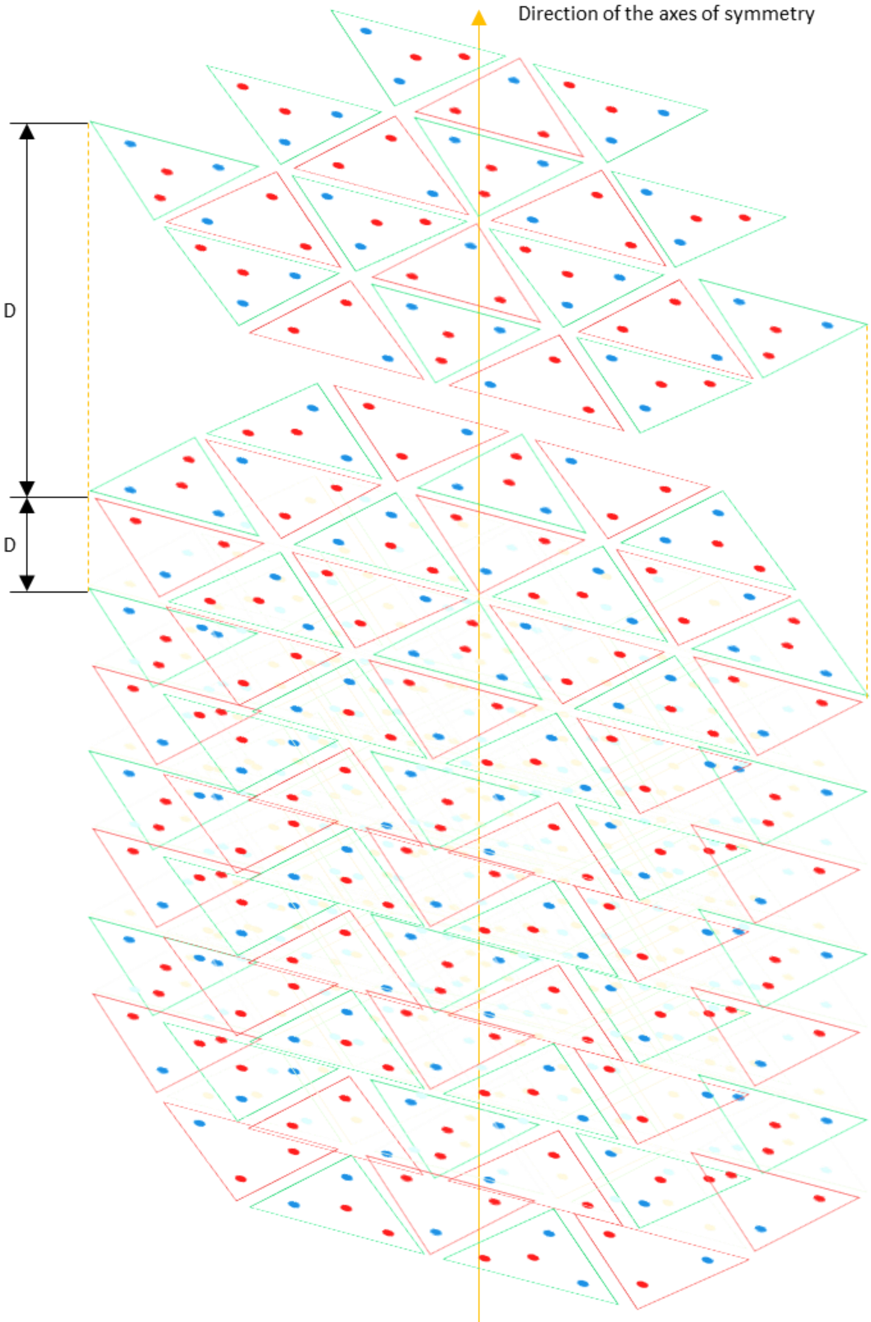
4.9.11.2 Example of fission and energy involved

The fission of uranium U_{92}^{235} can be described by the following equation:

$$U_{92}^{235} + n_0^1 = K_{r36}^{92} + B_{a56}^{141} + 3\, n_0^1 + E_\Delta$$

4.9.11.2.1 Ideal geometric structure

The ideal structure of an atomic nucleus is a homogeneous lattice with protons and neutrons alternating in all 3 dimensions. For example: 92 protons + 96 neutrons = U_{92}^{188}, an isotope of uranium.



The uranium 188 thus obtained is very stable.

4.9.11.2.2 Placement of remaining neutrons

After placing the 92 protons + 96 neutrons according to the ideal structure of an atomic nucleus, there remains: 235 - 92 protons - 96 neutrons = 47 neutrons.

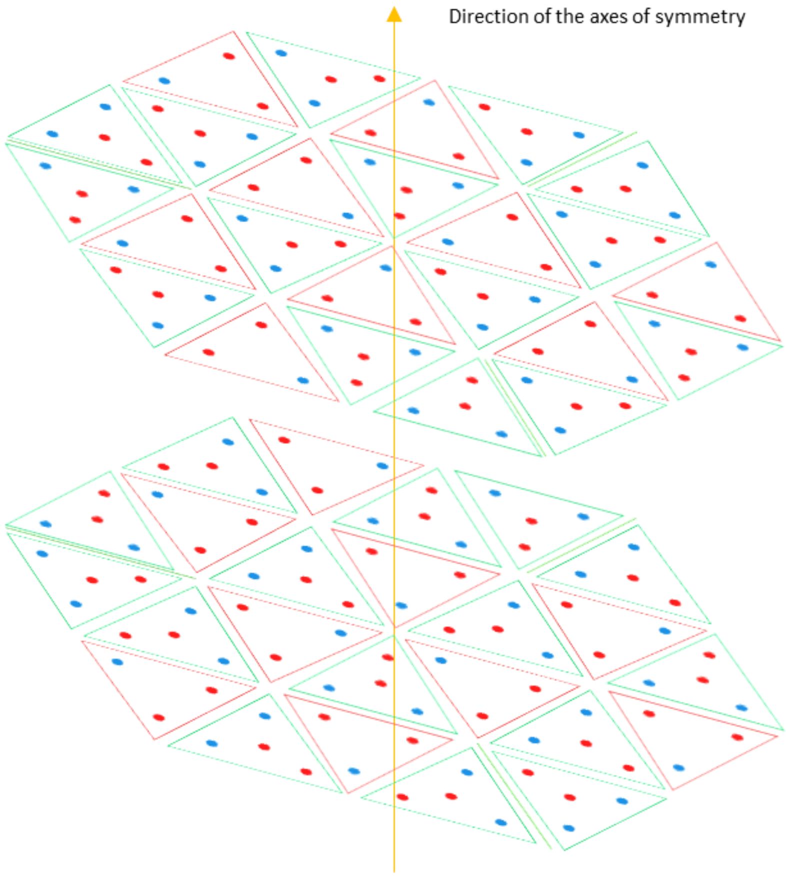
There are 12 proton spaces left at the bottom of the nucleon + 8 proton spaces at the top of the nucleon. This leaves 27 neutrons to be placed. But there are no more spaces to establish an axial bond. It is not possible to establish negative energy radial bonds because the neutrons are alone. The only possibility left is to establish positive energy radial bonds. Each stage has 12 possible spaces. 7 stages give 84 possible spaces, not including the last stage. All that remains is to place the remaining 27 neutrons.

4.9.11.2.3 Fragile geometric structure

The structure of an atomic nucleus has a large, almost infinite number of possibilities. Among them, we must find those that are fragile.

One possibility is that some protons are replaced by neutrons. This configuration breaks the axial bond, which weakens axial stability.

With a 10-stage nucleus, 5 more neutrons are needed per stage, so 5 fewer protons. This gives 15 neutrons + 9 protons per stage, except for the last 2 stages which have 10 protons + 12 (or 11) neutrons. The following diagram shows 2 consecutive stages:



Each stage has 3 positive-energy radial bonds, illustrated by the 3 green lines. These 3 bonds constitute 3 fragile points of the stage. The neutrons replacing protons also constitute the inter-stage fragile points.

There are a very large (almost infinite) number of possibilities for replacing protons with neutrons in the atomic nucleus. These replacements constitute the fission points during fission. A fission can occur through one or more fission points.

The energy released during fission is equal to the sum of the broken bond energies. It is equal to the sum of the positive energy radial energies minus the negative energy radial bond energies.

4.9.12 Modeling of β radioactivity

This paragraph describes the conditions of β+, β- radioactivity and the energies involved. In the following, the origin of the Up chrominette is the environment which contains an ocean of neutral particles including Up and Down chrominettes.

What happens if this chrominette is not synchronized with the atomic nucleus? In this case, when the quark in place is replaced, the proton or neutron will decay. Thus, it will release quarks synchronized with the other nucleons of this atom.

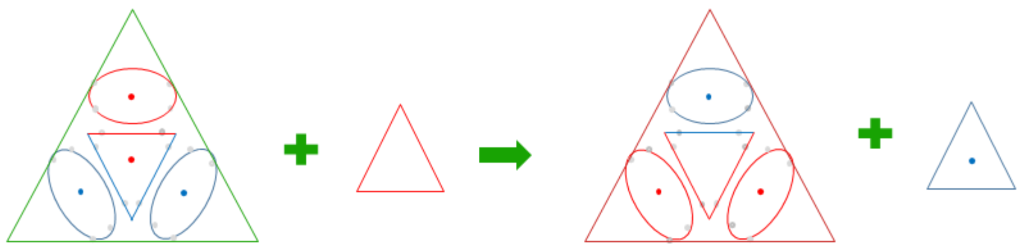
4.9.12.1 β- radioactivity

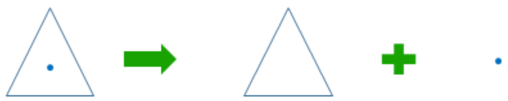
The standard model considers that a neutron becomes a proton with the help of the weak electro force:

Neutron + energy ==>> proton + electron + antineutrino

The present model considers that an up chrominette enters the core of the neutron by replacing one of the two down quarks of the neutron. In passing, the positron of the core is captured by this up chrominette.

Neutron + chrominette U ==>> proton + chrominette D + electron





The detached down quark releases the electron within it to become a D quark.

The condition is that this U chrominette comes from the same atomic nucleus. This is the condition for synchronization between the charginettes.

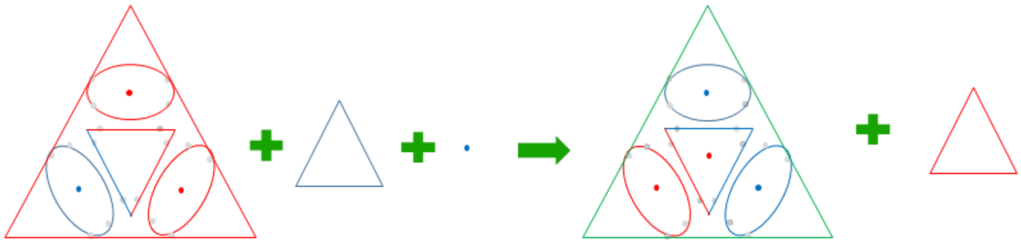
4.9.12.2 β+ radioactivity

The standard model considers that a proton becomes a neutron with the help of the weak electro force:

Proton + energy ==>> neutron + positron + neutrino

The present model considers that an energetic down quark, after capturing an electron (a Down quark), penetrates into the core of the proton by replacing one of the 2 up quarks of the proton.

Proton + chrominette D + electron ==>> neutron + chrominette U



The detached Up quark releases the positron within it which is captured by the core during the replacement of the Up quark by the Down quark.

The condition is that this D chrominette comes from the same atomic nucleus. This is the condition for synchronization between the charginettes.

4.10 Modeling of large nucleon-based structures

Examining the structure of the proton and that of the neutron allows us to deduce the existence of their symmetrical structures, schematized as follows:

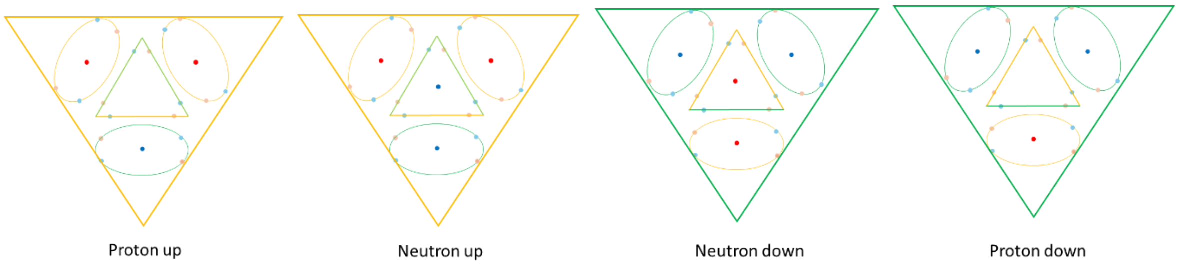


Figure 44 - Symmetrical nucleons

The present model predicts the existence of the down proton, the symmetrical particle of the proton which is an up proton. Similarly, it predicts the existence of the up neutron, the symmetrical particle of the neutron which is a down neutron.

For the same reasons as the up proton, the down proton is stable. However, the stability of the up neutron is less certain. The reason for not observing these two symmetrical nucleons in nature is not known to date.

4.10.1 Neutron-based structure modeling

It is possible to build structures with only up and down neutrons. It should be noted that the symmetrical neutron is not the antineutron. In the neutralization sense, the antineutron is the neutron itself, but with free electric charges (= single = without the opposite charge to form a charginette) of opposite signs. This comes from the definition of the antiquark. An antiquark of a Q quark is the Q quark itself, but with an electric charge of the opposite sign.

4.10.1.1 Neutronette

The simplest compound is one neutron up + one neutron down.

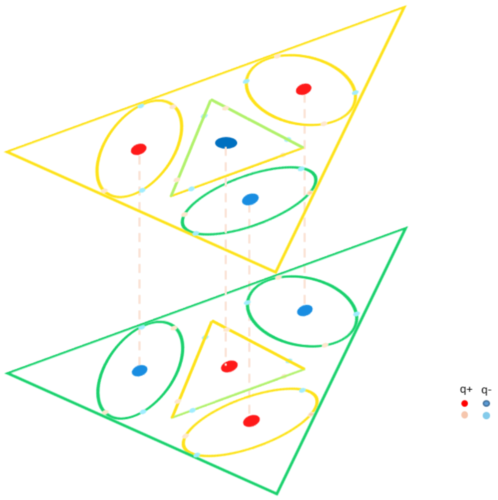


Figure 45 - Structure of a neutronette

The 2 electrons and 2 positrons of the up neutron are face to face with the 2 positrons and 2 electrons of the down neutron. The axes of symmetry of the 2 neutrons are in the same direction and coincident. This structure is even more stable than deuterium. It will be called a neutronette.

4.10.1.2 Triple neutron

The following compound is one neutron up + 2 neutrons down or one neutron down + 2 neutrons up.

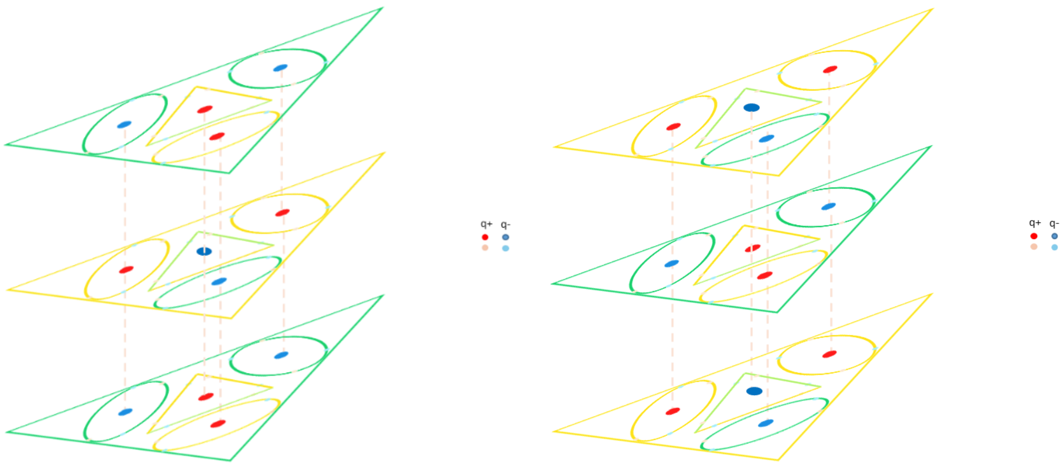


Figure 46 - Triple neutron

The axes of symmetry of the three neutrons are in the same direction and coincident. This structure is even more stable than tritium. It will be called a triple neutron.

4.10.1.3 Double Neutronette

Two neutrons can be placed in parallel and become the following structure:

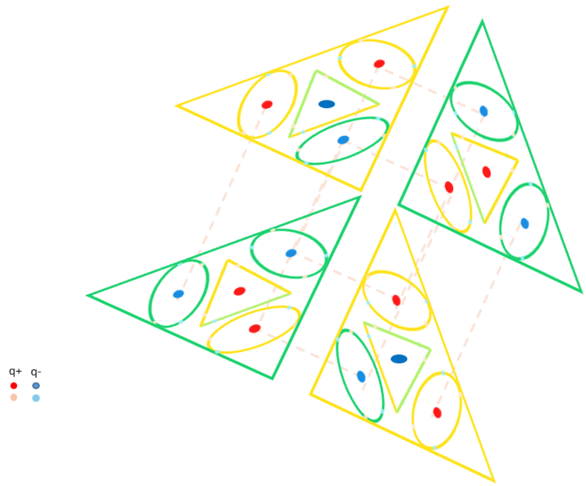


Figure 47 - Double neutronette

The axes of symmetry of the two neutrons are in two opposite directions. This structure is even more stable than helium. It will be called a double neutronette.

4.10.1.4 Complex neutron-based structure

It is possible to generalize the structure of the double neutronette into a complex structure:

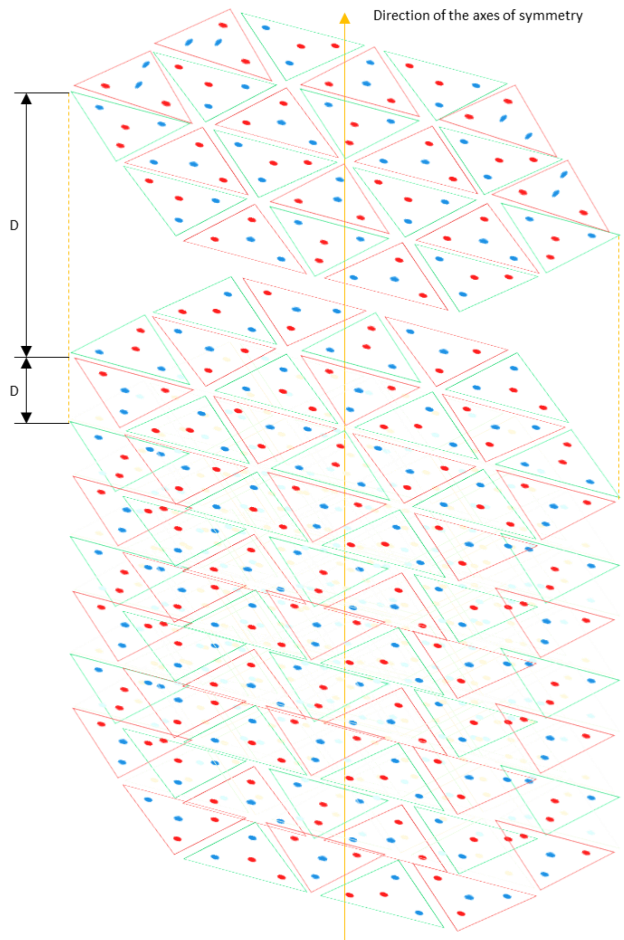


Figure 48 - Large Neutronette-Based Structure

The neutron axes of symmetry are all parallel. But their directions oppose each other to form neutronettes. This structure can extend indefinitely. It is very stable because all inter-neutron bonds are static and have negative energy. It will be called a neutronette-based structure.

A neutronette-based structure has the following properties:

- The density is very high, at least 100,000 times more than ordinary matter.
- The rigidity is very high, at least 100,000 times more than diamond.
- The melting temperature is very high, at least 250 million degrees.
- It should reflect light a bit like a mirror.
- It is electrically insulating.
- It is thermally insulating.
- Etc.

The applications of this material would be extraordinary. For example:

- Extremely strong armor, for tanks, warships, etc.
- Submarine hull resistant to very high pressure,
- Aircraft engine resistant to very high temperatures,
- Spaceship hull resistant to very high temperatures,
- Corrosion-resistant ship hull,
- Nuclear radiation resistant protective wall,
- etc.

4.10.2 Modeling of proton-based structures

It is possible to build structures with only up and down protons.

4.10.2.1 Protonette

The simplest compound is one proton up + one proton down.

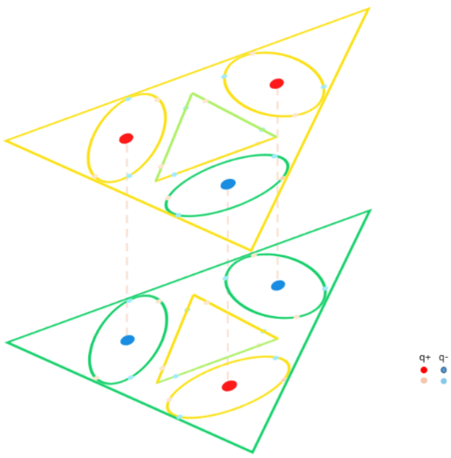


Figure 49 - Structure of a protonette

The electron and two positrons of the up proton are face to face with the positron and two electrons of the down proton. The axes of symmetry of the two protons are in the same direction and coincident. This structure is even more stable than deuterium. It will be called a protonette.

4.10.2.2 Triple Proton

The following compound is one proton up + 2 protons down or one proton down + 2 protons up.

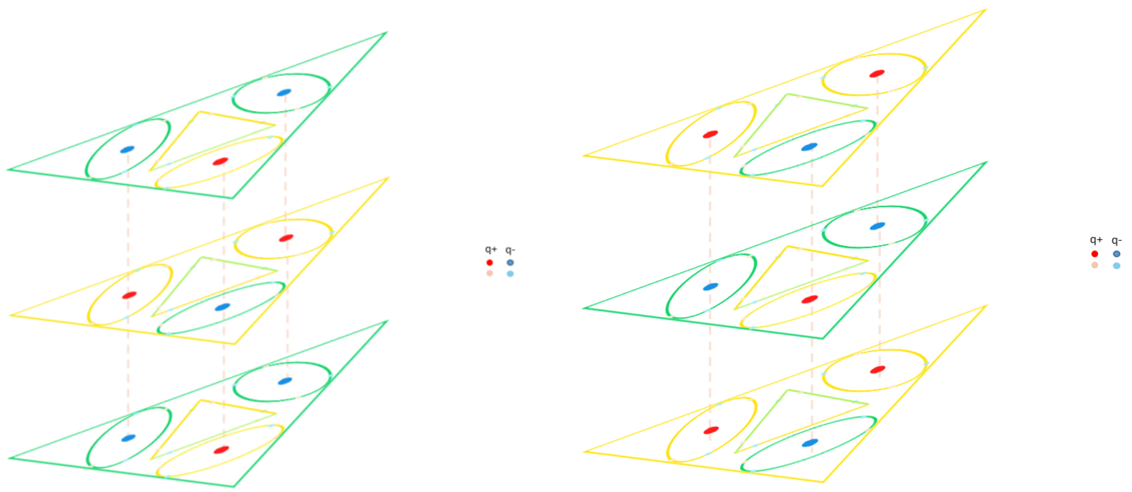


Figure 50 - Triple Proton

The axes of symmetry of the three protons are in the same direction and coincident. This structure is even more stable than tritium. It will be called a triple proton.

4.10.2.3 Double Protonette

Two protonettes can be put in parallel and become the following structure:

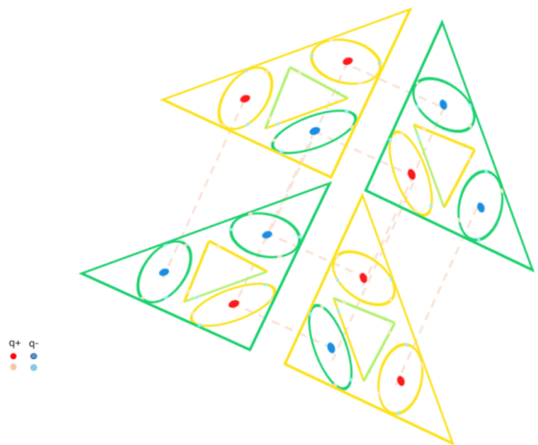


Figure 51 - Protonette double

The axes of symmetry of the two protonettes are in two opposite directions. This structure is even more stable than helium. It will be called a double protonette.

4.10.2.4 Complex proton-based structure

It is possible to generalize the structure of the double protonette into a complex structure:

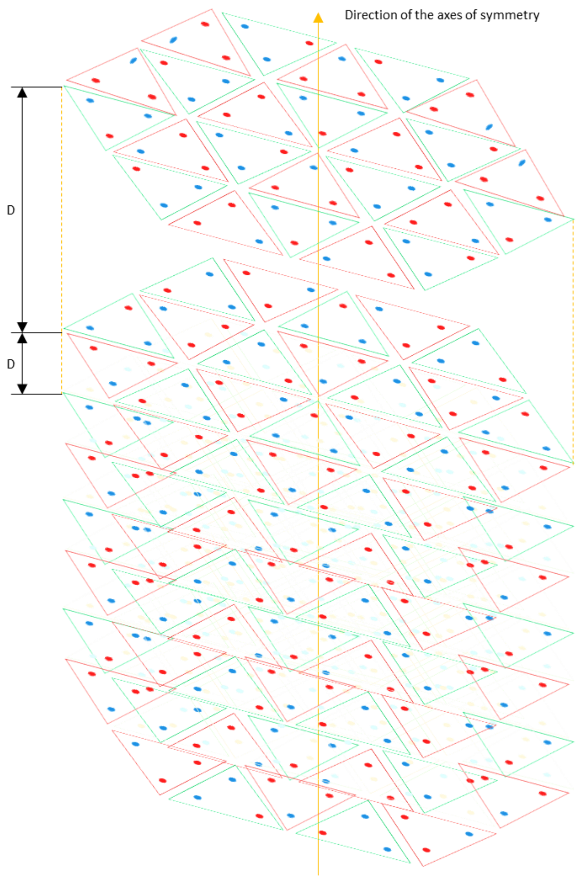


Figure 52 - Large Protonette-Based Structure

The proton axes of symmetry are all parallel. But their directions oppose each other to form protonettes. This structure can extend indefinitely. It is very stable because all interproton bonds are static and have negative energy. It will be called a proton-based structure.

A proton-based structure has the following properties:

- The density is very high, at least 100,000 times more than ordinary matter.
- The rigidity is very high, at least 100,000 times more than diamond.
- The melting temperature is very high, at least 250 million degrees.
- It should reflect light a bit like a mirror.
- It is thermally insulating.
- It is electrically insulating.
- It conducts photons in the direction of their axis of symmetry. The photon can even be the gamma ray γ.
- Etc.

The applications of this material would be extraordinary. For example:

- Extremely strong armor, for tanks, warships, etc.
- Submarine hull resistant to very high pressure,
- Aircraft engine resistant to very high temperatures,
- Spaceship hull resistant to very high temperatures,
- Corrosion-resistant ship hull,
- Nuclear radiation resistant protective wall,

- etc.

4.10.3 Modeling of proton-neutron structures

It is possible to build structures with only protons up and neutrons down.

This is the case with atomic nuclei on Earth, and perhaps even in the universe.

But if this structure is too large, the accumulation of positive electric charge is so great that any new nucleon with a positive electric charge will be repelled. This prevents large structures from forming. This explains why in nature there are no large structures formed of nucleons (protons up and neutrons down).

4.10.4 Modeling of structures based on proton-neutron symmetry

It is possible to construct structures with only down protons and up neutrons. These are symmetrical structures compared to structures based on protons and neutrons. The absence of these structures in nature could mean their instability.

4.10.4.1 Deuteriumelle

The simplest compound is one proton down + one neutron up.

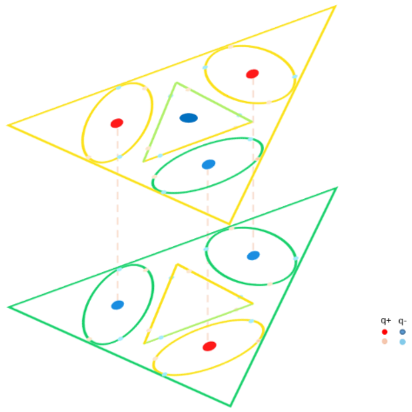


Figure 53 - Structure of a deuteriumelle

The 2 electrons and the positron of the down proton are face to face with the 2 positrons and one of the electrons of the up neutron. The axes of symmetry of the 2 nucleons are in the same direction and coincident. The stability of this structure is uncertain. It will be called deuteriumelle.

4.10.4.2 Tritiumelle

The following compound is one neutron up + 2 protons down or one proton down + 2 neutrons up.

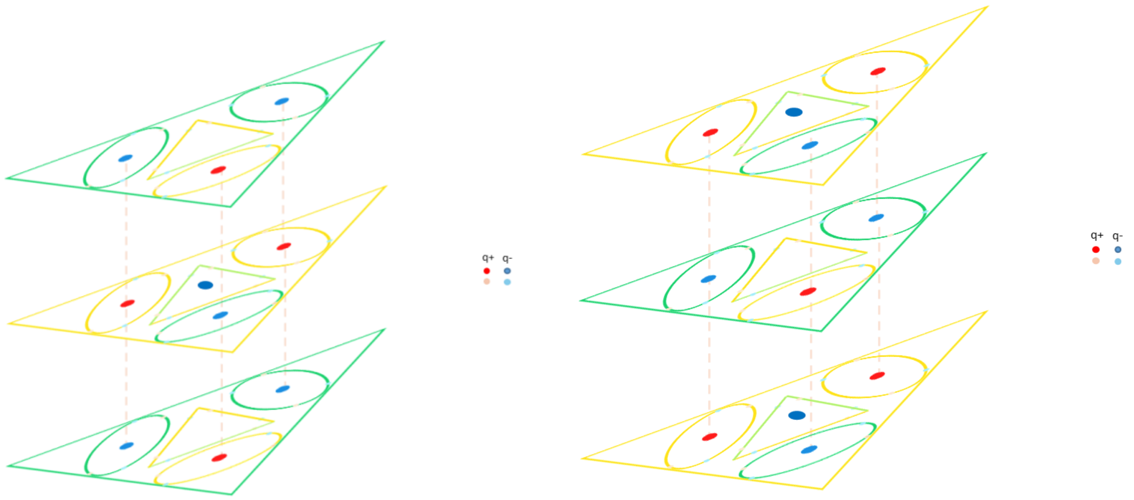


Figure 54 - Tritiumelle

The axes of symmetry of the three nucleons are in the same direction and coincident. The stability of this structure is uncertain. It will be named tritiumelle.

4.10.4.3 Heliumelle

Two deuteriumelles can be placed in parallel and become the following structure:

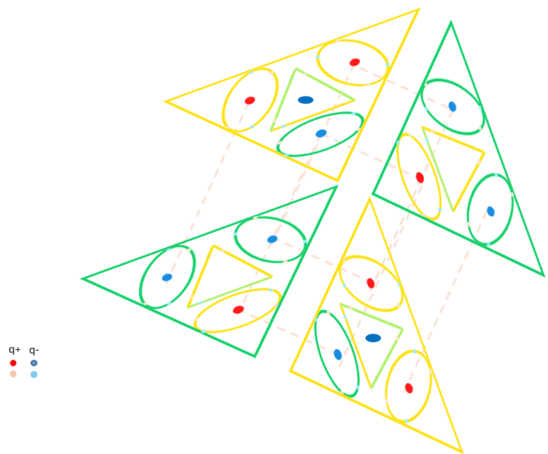


Figure 55 - Heliumelle

The axes of symmetry of the two deuteriumelles are in two opposite directions. The stability of this structure is uncertain. It will be called heliumelle.

4.10.4.4 Complex structure based on heliumelle

It is possible to generalize the structure of heliumelle into a complex structure:

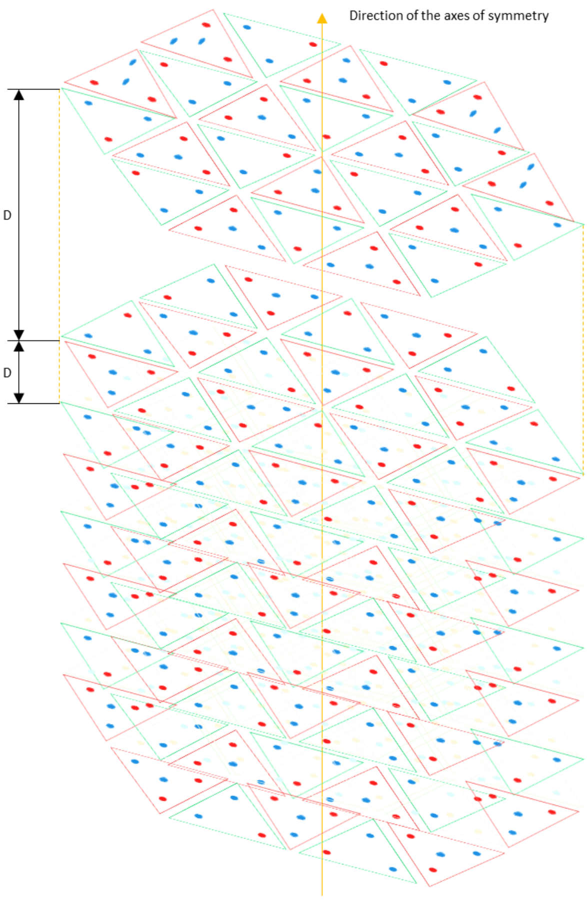


Figure 56 - Large structure based on heliumelle

The axes of symmetry of deuteriumelle are all parallel. But their directions oppose each other to form heliumelle. This structure can expand a little, but within a certain limit. It is very stable because all the inter-nucleon bonds are static with negative energy. It will be called a heliumelle structure. But if this structure is too large, the accumulation of negative electric charge is so great that any new nucleon with a negative electric charge will be repelled. This prevents large structures from forming.

4.10.5 Modeling of structures based on deuterium and its symmetry

It is possible to construct structures with alternating deuteriums and deuteriumelles per row.

4.10.5.1 Alternancelle

The next compound is a deuterium + a deuteriumelle.

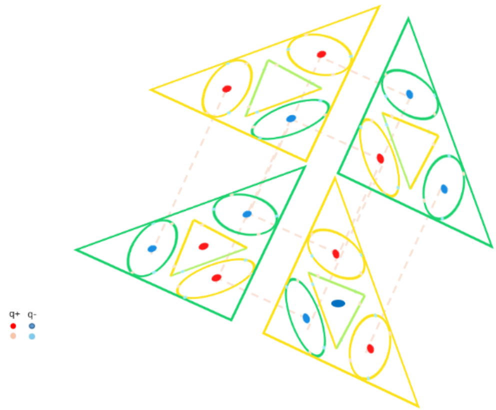


Figure 57 - Alternancelle

This structure is almost identical to that of helium. The difference is that one of the deuteriums is replaced by a deuteriumelle. It will be called an alternancelle. The most important property of an alternancelle compared to helium is its electrical neutrality.

The stability of this structure is uncertain. The only uncertainty is the stability of the up neutron's electron. If it escaped, the remaining structure would become electrically positive, but would remain stable.

4.10.5.2 Complex structure based on Alternancelle

It is possible to generalize the structure of the alternancelle, both in the direction of the nucleon symmetry axes, and in the perpendicular directions. In addition, the electrical neutrality of the alternancelle allows for macroscopic structures.

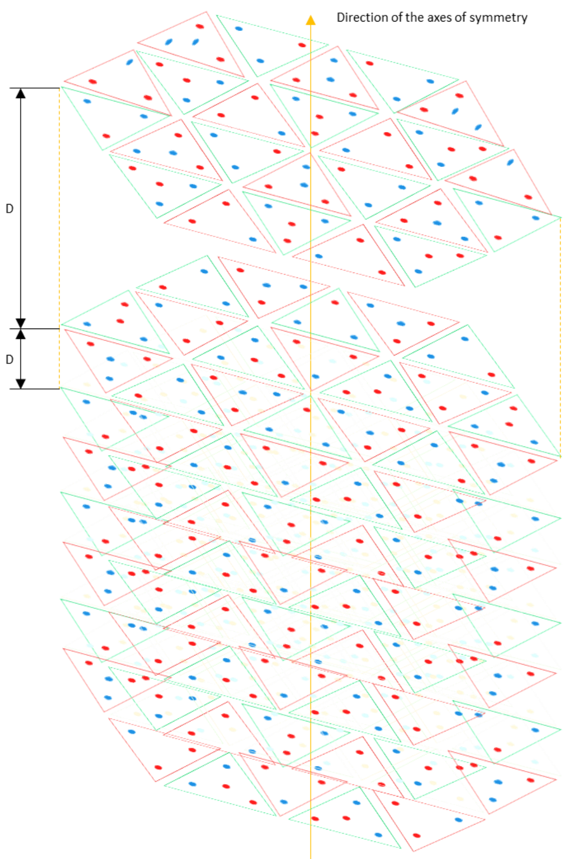


Figure 58 - Alternancelle-based solid

Apart from the two faces at the ends of the solid in the direction of symmetry, the electrons of the up neutrons are stable. Indeed, the two exits of the electron of the up neutron are blocked by two down protons, and even reinforced by other up neutrons.

Such a solid has the following properties:

- The density is very high, at least 100,000 times more than ordinary matter.
- The rigidity is very high, at least 100,000 times more than diamond.
- The melting temperature is very high, at least 250 million degrees.
- It should reflect light a bit like a mirror.
- It is thermally insulating.
- It is electrically insulating in the direction perpendicular to their axis of symmetry.
- It is electrically conductive in the direction of their axis of symmetry. It is even supra conductive.
- Etc.

The applications of this material would be extraordinary. For example:

- Extremely strong armor, for tanks, warships, etc.
- Submarine hull resistant to very high pressure,
- Aircraft engine resistant to very high temperatures,
- Spaceship hull resistant to very high temperatures,
- Corrosion-resistant ship hull,
- Nuclear radiation resistant protective wall,
- High intensity magnetic field generator.
- etc.

5 Predictions

Some predictions are immediately following this modeling. The most striking ones are listed here.

5.1 Two particles are enough to build the universe

Apart from the photon and the electro, all particles are composed of these first two.

5.2 Potential energy is located in the environment

The existence of potential energy is no longer in doubt. For example, between the Moon and the Earth, when the distance between them d decreases, the potential energy E_p is converted into kinetic energy. The speed of the Moon v increases. When the distance d increases, the speed v decreases. And the potential energy E_p increases. But where is E_p located? It is neither in the Moon nor in the Earth. It is in the surrounding medium.

5.3 Conservation of materials is a strict law

The present model predicts that a photon remains a photon, an electric charge remains an electric charge. There is no conversion between a photon and an electric charge. A photon never disappears. An electric charge never disappears.

Therefore, the conservation of energies is also absolute.

As a result, there are no destructive neutralizations between matter and antimatter. Besides, antimatter does not exist. They are only electrinettes of opposite signs.

5.4 A quark has an integer elementary electric charge e^+ or e^-

Knowing the structure of the proton and the neutron, it is easy to predict that each quark has its own elementary electric charge. There is no need to split the charges to obtain a sum of 0 for the electric charge of the neutron. Since the core of these particles is a fourth quark that can host an electrinette.

5.5 Inert mass is direction depending

The inertial mass of a particle is not the same in all directions. It varies in the direction of movement depending on its speed. But it is constant in the perpendicular direction. This constant is equal to the neutral charge of the particle.

5.6 The photon has an inert mass and a gravitational mass.

Unlike the standard model which considers that the photon has zero mass (inert or gravitational), the present model considers that the photon has an infinite linear inert mass and a perpendicular inert mass equal to its neutral charge.

The reason is simple. The speed of the photon is not modifiable. Everything happens as if the photon has an infinite mass.

Observations show that the photon is deflected by massive objects. Which indicates that the perpendicular inert mass is not infinite. And that the photon is sensitive to gravitation.

5.7 Photon can exit black holes

Since the photon has an infinite linear inert mass and a perpendicular inert mass equal to its neutral charge, it can perfectly exit a black hole by following its symmetry axis.

Indeed, the large mass of the black hole cannot modify the speed of the photon. It can modify the direction of the photon. But when rotation axis of the black hole is also its symmetry axis, deviation forces annihilate each other. Therefore, the photon will continue its movement until it exits the black hole.

The gigantic jets of black holes observed in astronomy confirm this prediction [12].

5.8 The speed of the photon can be greater than c

Since the photon is propelled by a substance sensitive to gravity, the measured speeds of the photons in the local referential R_{li} are all equal to c. But in an absolute referential Ra, the local referential each have their speed $v_{ri} > 0$. Which gives a resulting speed of the photon in the absolute referential R_a:

$$\overrightarrow{v_a} = \overrightarrow{v_{ri}} + \vec{c}$$

If the direction $\overrightarrow{v_{ri}}$ and the direction $\vec{c}$ are in the same one, $v_a > c$.

If the direction $\overrightarrow{v_{ri}}$ and the direction $\vec{c}$ are in the opposites one, $v_a < c$.

In space, when a photon passes through several regions with different speeds in an absolute referential, the trajectory of this photon is not a straight line. It is zigzag.

5.9 Accelerated expansion of the universe does not need dark energy

The present model predicts that the acceleration of the expansion of the universe [7] is simply due to photons.

In fact, free photons move faster than composite particles. So, these photons located in the outer parts of the universe attract by the gravity force the materials located in the internal parts of the universe. And with time, the expansion accelerates.

5.10 There are oceans of neutral particles orbiting massive centers

The present model predicts that oceans of neutral particles exist in the universe. The density of these particle oceans depends on the masses of the centers at which these particles gravitate.

Observational results in astronomy prove this prediction [11].

5.11 The wave aspect of particles does not belong to these particles

The present model predicts that wave aspect of particles belongs to the environment composed of energy field and neutral particles.

In the case of photon, while moving, the charginettes in the environment can temporarily capture this photon. One of the 2 electrinettes having captured the photon will make an arc movement, then release the photon. This produces a wave depending on photon's energy.

In presence of several photons, the charginettes having captured photons interact with each other. The trajectory of each photon will thus be modified by neighboring charginette, energized by another photon. If energized electrinettes of the charginettes are of opposite signs, the two photons will approach a little. Otherwise, the two photons will move away a little. The final result is called interference.

In case of an électrinette e^+, it attracts the electrinette e^- of a charginette in the environment. Which forces the e^+ electrinette of the charginette to orient itself in opposite direction.

In presence of several electrinettes of the same sign, they will interact at some distance through intermediate charginettes. The same phenomenon as wave interference occurs. We have the impression that electrinettes have wave properties.

5.12 The fusion of nuclear nuclei requires conditions

The current model predicts that nuclear fusion can only occur under sufficiently high pressure and temperature. This phenomenon results from the self-regulation of the electric force proportional to the surrounding energy density. In addition, it takes some time for two nuclei to come face to face.

5.13 There is a solid 100,000 times stronger than diamond

The current model predicts that it is possible to create a solid made up solely of nucleons and their symmetries. This solid is much denser, stronger, and more insulating than solids made up of atoms.

5.14 There is a super conductor of photons, including gamma ray

The current model predicts that it is possible to create a solid made entirely of nucleons and their symmetries. This solid is much denser, stronger, and more insulating than solids made of atoms. And this solid conducts photons in the direction of the nucleon's axes of symmetry. Even the gamma ray γ can travel through it. The attenuation of photons is much lower than that of optical fibers.

5.15 There is an electrical supra conductor at any temperature

The current model predicts that it is possible to create a solid consisting solely of nucleons and their symmetries. This solid is much denser, stronger, and more insulating than solids made of atoms. And what's more, this solid offers supra conductivity along the nucleon's axes of symmetry. And this supra conductivity is insensitive to temperature changes up to 250 million degrees.

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6 Abbreviations

The following abbreviations are used in this manuscript:

Alternancelle	New word to name the particle composed of 1 deuterium and 1 deuteriumelle.
Charginette	word that has just been created for the need of naming a newly introduced particle: a couple formed of electron and positron
Chrominette	word that has just been created for the need of naming a newly introduced particle: a compound particle
Deuteriumelle	New word for symmetrical deuterium.
Electrinette	New word to designate an electron or a positron.
Heliumelle	New word for symmetrical helium.
Neutronette	New word for a newly introduced particle: a compound of neutron up and neutron down.
Nucleonette	word that has just been created for the need of naming a newly introduced particle: a compound particle

PC	Personal Computer
Photonette	word that has just been created for the need of naming a newly introduced particle: a photon couple
Protonette	New word for a newly introduced particle: a compound of proton up and proton down.
SM	Standard Model
Tritiumelle	New word for symmetrical tritium.
XM	XijieDong Model
☯	Yin and yang symbol whose hexadecimal Unicode is 0x262f. It represents a charginette in XM.
Δ	Greek character uppercase delta. It represents a chrominette in XM.
䘷	Ideogram designating an object whose hexadecimal Unicode is 0x4637. It represents a nucleonette in XM.
㆗	Ideogram designating the neutral whose hexadecimal Unicode is 0x3197. It represents a neutral charge in XM.
⼝	Ideogram for a mouth whose hexadecimal Unicode is 0x2f1d. It represents a pure electric charge in XM.
㥅	Ideogram for an ancient object whose hexadecimal Unicode is 0x3945. It represents the energy field in XM.
重	Ideogram denoting the mass of an object whose hexadecimal Unicode is 0x5658. It represents the gravitational field in XM.
㕧	Ideogram designating an electrical object whose hexadecimal Unicode is 0x3567. It represents the electric field in XM.
㑅	Ideogram for a magnetic object whose hexadecimal Unicode is 0x3445. It represents the magnetic field in XM.
⼭	Ideogram for a mountain whose hexadecimal Unicode is 0x2f2d. It represents the potential field in XM.

7 Appendix A: Using Matlab Simulink

7.1 Appendix A.1: Characteristics of the charginettes

The relationship between the radius r, the rotational speed v and the mass ㆗ is a surface that can be plotted using Matlab.

The details are given in the file generated by Matlab version R2019a:

charginette_surface_r_v_zh_kn_10_12_noPot_En.m

The OX axis represents mass. Unit is 10^{-31} kg. The plotting variable is:

xx = [0.08:0.08:8.0]; (default range)

%xx = [0.001:0.001:0.10]; (reserve range)

%xx = other desired ranges

To obtain proper visibility, the range of values to be displayed must be properly sized. Remove the "%" in front of xx to be used and add "%" in front of the current range.

The OY axis represents the speed. Unit is 10^2 meter/second. The plotting variable is:

yy = [0.1:0.1:10]; (default range)

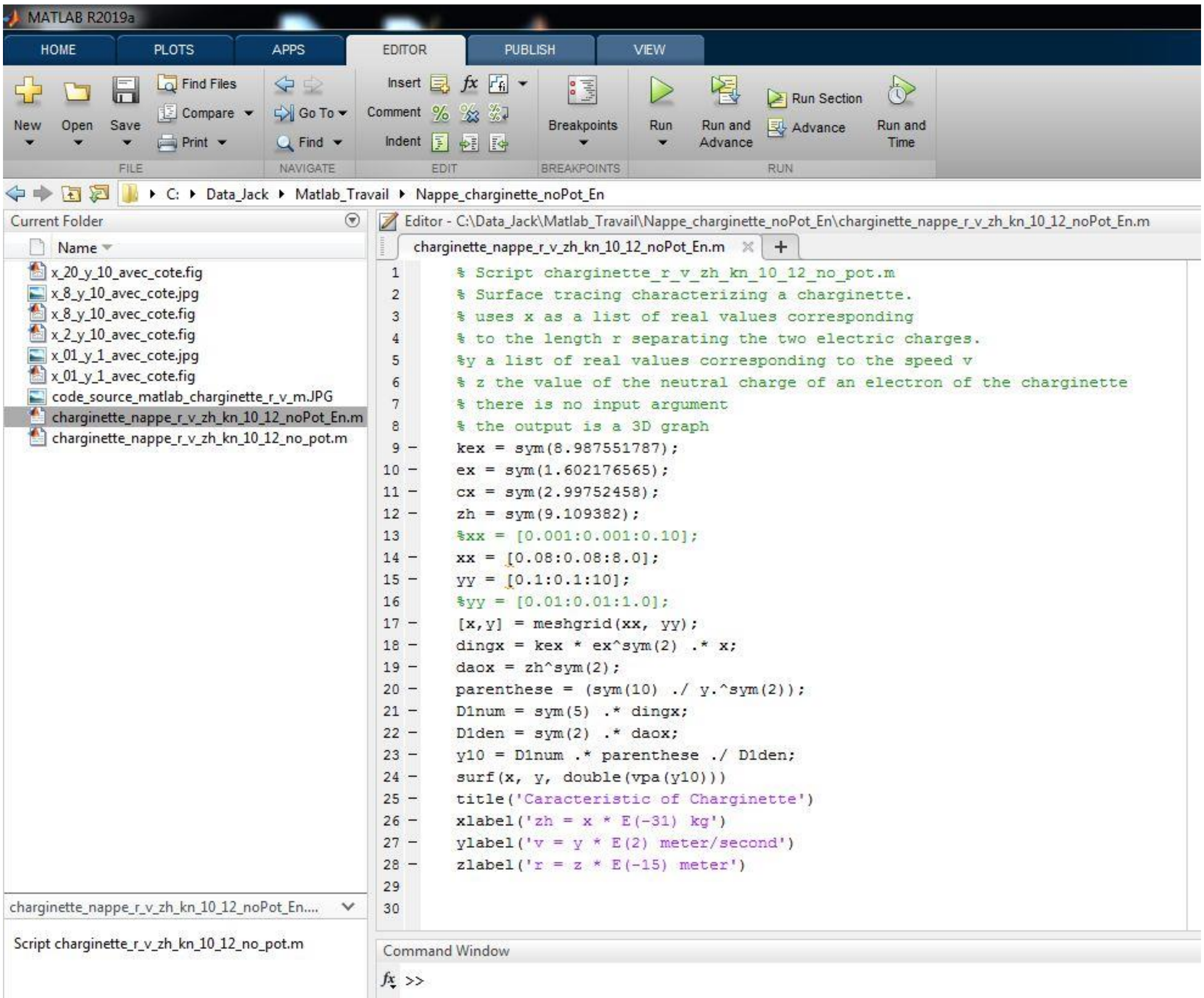
%yy = [0.01:0.01:1.0]; (reserve range)

%yy = other desired ranges

To obtain proper visibility, the range of values to be displayed must be properly sized. Remove the "%" in front of yy to be used and add "%" in front of the current range.

The OZ axis represents the radius r. Unit is 10^{-15} meter.

The following screenshot shows the Matlab source code for the charginette:



7.2 Appendix A.2: The system of differential equations of a chrominette

The system of differential equations governing the behavior of the charginettes within a chrominette is composed of the following 2 equations:

Equation 23 - Chrominette differential equation 1

Equation 24 - Chrominette differential equation 2

Matlab's Simulink software tool is well suited for the numerical resolution of this system of differential equations.

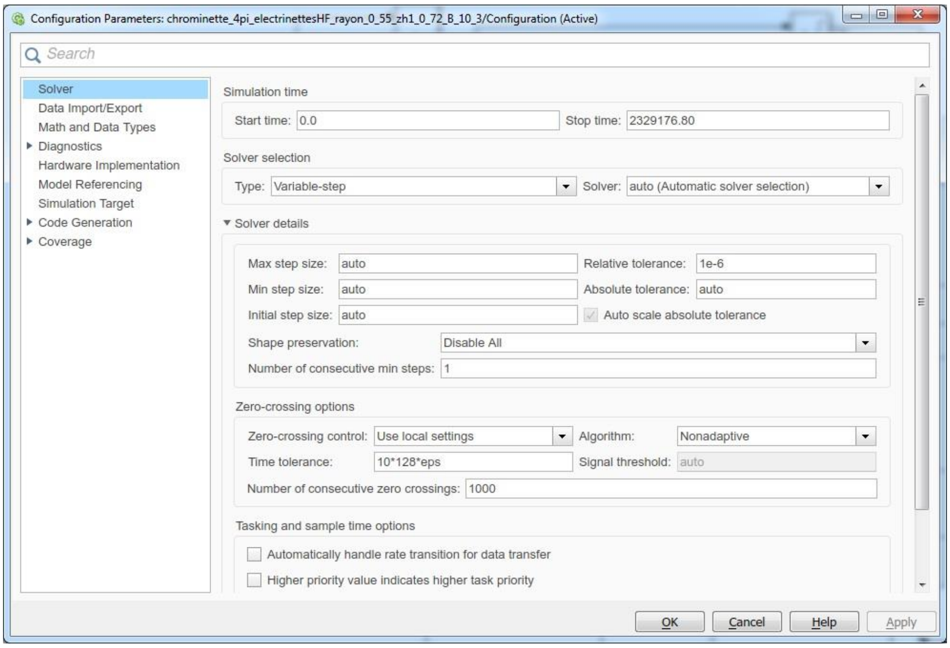
Details are given in the file generated by Matlab Simulink version R2019a:

chrominette_4pi_electrinetteHF_r_055_zhf_072_B_10_3_kn_21.slx

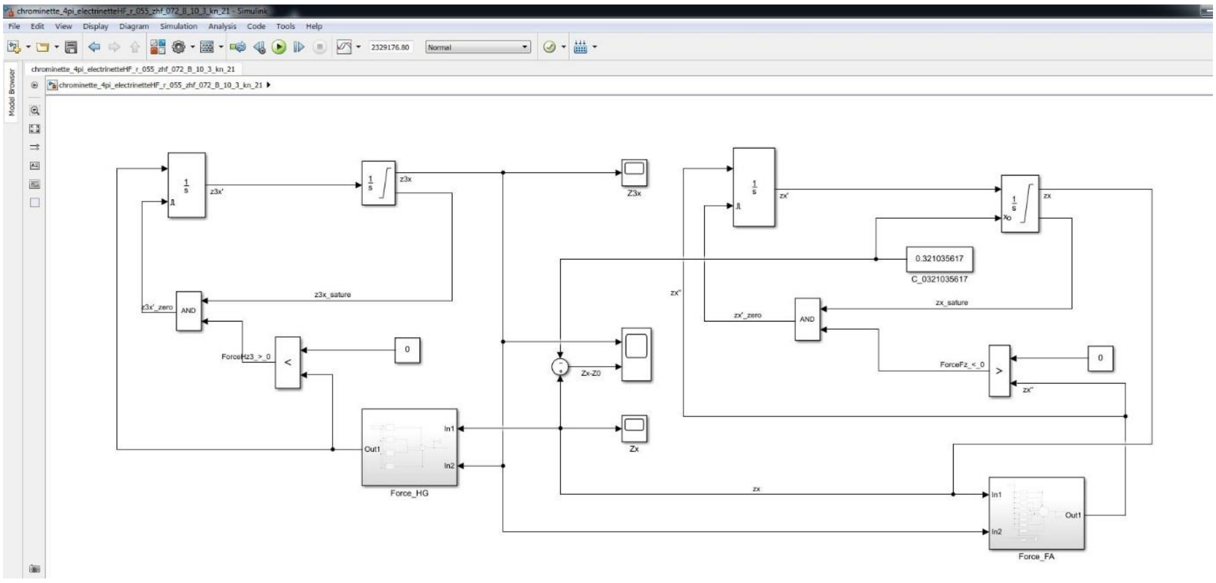
Where:

1. chrominette : means that it is a chrominette.
2. 4pi : means that the simulation is done over 2 periods of 2π.
3. electrinetteHF : means that the equations relate to the H-electrinette and the F-electrinette.
4. r_055 : means that the radius r_x of the charginettes is 0.55605.
5. zhf_072 : means that the neutral charge 中 $_{F0}$ of the electrinette F is $0.72*10^{-31}$ kg.
6. B_10_3 : means that the value of the constant β is: $10^{-3}*10^{-15}$ m.
7. kn_21 : means that the attenuation coefficient is: $10^{-100D/r} + 10^{-21}$.

The simulation parameters are given by the following screenshot:



The following screenshot shows the first view of the chrominette Simulink schematic:



7.3 Appendix A.3: The system of differential equations of a nucleonette

The system of differential equations governing the behavior of charginettes within a nucleonette is composed of the following 4 equations:

Equation 25 - Nucleonette differential equation 1

Equation 26 - Nucleonette differential equation 2

Equation 27 - Nucleonette differential equation 3

Equation 28 - Nucleonette differential equation 4

Matlab's Simulink software tool is well suited to the numerical resolution of this system of differential equations.

Details are given in the file generated by Matlab Simulink version R2019a:

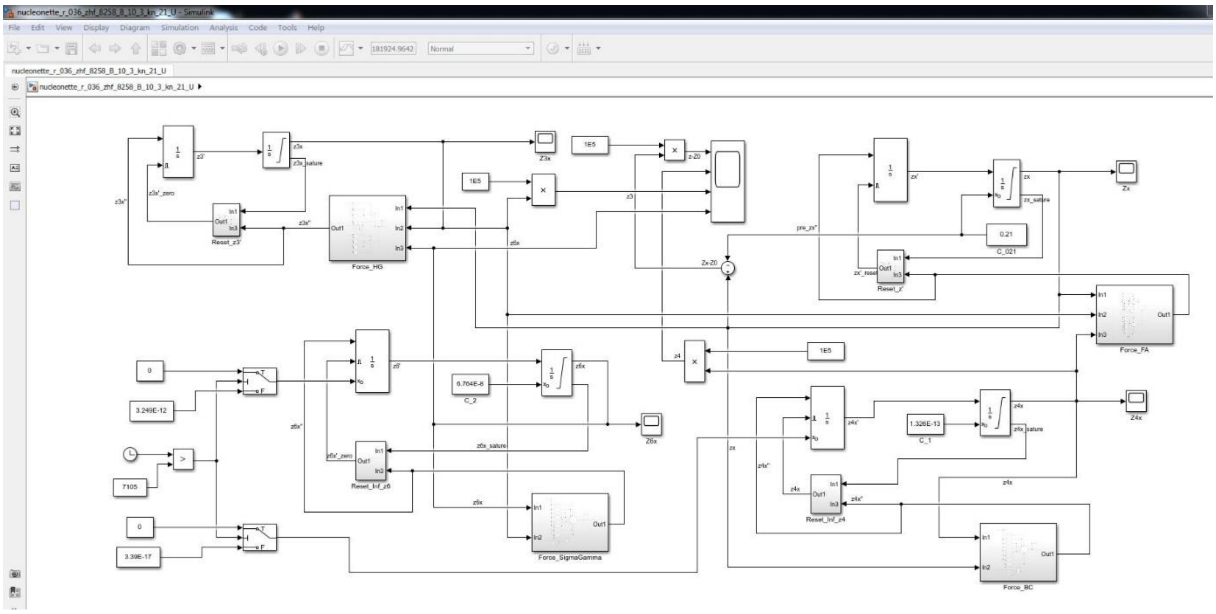
nucleonette_r_036_zhf_8258_B_10_3_kn_21_U.slx

Where:

1. nucleonette : means it is a nucleonette.
2. r_036 : means that the radius r_x of the charginettes is 0.3605.
3. zhf_8258 : means that the neutral charge 中 $_{F0}$ of the electrinette F is $8.258*10^{-31}$ kg.
4. B_10_3 : means that the value of the constant β is: $10^{-3}*10^{-15}$ m.
5. kn_21 : means that the attenuation coefficient is: $10^{-100D/r} + 10^{-21}$.
6. U : means the file version is U.

The simulation parameters are the same as for the chrominette.

The following screenshot shows the first view of the Simulink diagram of the nucleonette:



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