Structure model of helium nucleus ${}^4_2H_e$

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Abstract. The atomic nuclei have been structured through two fundamental phenomena. The inverse electric field of the proton and the electric entity of the macroscopically neutral neutron. Specifically, the above inverse field causes the nuclear force and the nuclear antigravity one. These forces, along with the experimental constants of the spin, the magnetic moment and the mass deficit of the nucleons, are the fundamental elements that have created the deuterium, the tritium, the helium-3 and the helium-4. This last nucleus, the helium-4, is the most stable in the Nature, with which all the nuclei of the periodic table have been constructed in the core of the stars.

Keywords: Inverse electric field; topology of nucleons.

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1. Structure model of atomic nuclei

According to the unified theory[1,2] of dynamic space the atomic nuclei[3,4] have been structured through two fundamental phenomena. The inverse electric field[5] of the proton and the electric entity of the macroscopically neutral neutron.[6]

Verification of the experimental spin (also of the magnetic moment and mass deficit) of the nuclei, due to the conservation of their rotational momentum, is the first and necessary condition of their structure. The nucleons spin[7] is directed parallel to the nucleus axis and their orbits (see page 4) are vertically to this axis. Therefore, spin indicates the topology of the nucleons and the so called nuclear units in the nucleus.

The nucleus spin is the sum of its nucleons spin as well as of the magnetic moment and the mass deficit. The lower-order nuclei are the deuterium ${}^2_1H$, the tritium ${}^3_1H$, the helium ${}^3_2H_e$ and the helium ${}^4_2H_e$. This last nucleus, the helium ${}^4_2H_e$, is the most stable in the Nature, with which all the nuclei of the periodic table have been constructed in the core of the stars.

It is to be expected that the magnetic moments[8] of nucleons impose a common axis and orient themselves, interacting with each other. In addition, it is recalled that at the interaction of proton-neutron the magnetic moment of these nucleons is increased, while at the interaction of same nucleons their magnetic moment is reduced (fluctuation of nucleons magnetic moment[9]).

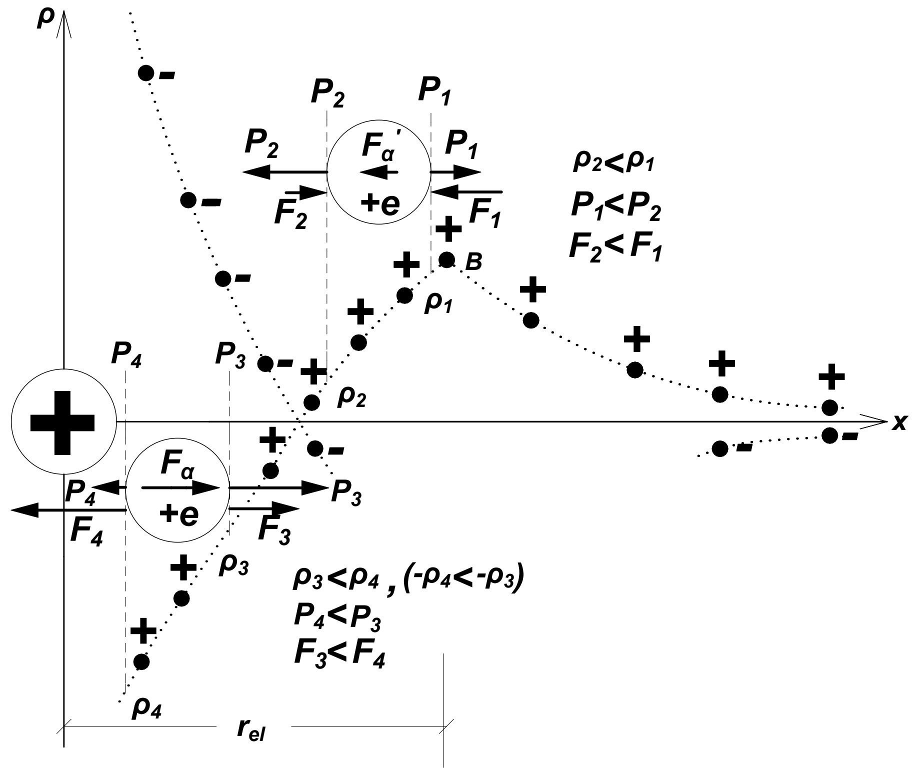

Figure 1. In the upper inverse nuclear field the antigravity force F'_a and the electric resultant[5] $F_1 - F_2$ are attractive, while in the lower field a strong repulsive antigravity force[10] F_a balances the attractive electric resultant[5] $F_4 - F_3$, i.e. the strong nuclear force

Macroscopically, the neutron is an electrically neutral particle. At the scale of nucleus where, due to the neutron's magnetic dipole moment $\mu = -1,913\mu_n$, the calculated[6] negative surface electric charge of neutron is equal to $q_n = -0,685e$, resulting the neutron to behaves as a positively charged particle. The positive potential of its inverse electric field is a cloud of positive electrical units, which reduce the negativity of the nuclear field and allow the presence of protons in the nucleus.

It is noted that two protons can not exist in the nucleus without the presence of a neutron, because the increased negativity of field causes a cleaving (beta decay β^+) of one proton. There would be no nuclei without the presence of neutrons that reduce the negativity of the protons field.

The neutrons incur at a mass deficit[11] only, while the protons contribute to its creation. The mass deficit depends solely on the negativity of the nuclear field. Therefore, the mass deficit determines also the topology of nucleons and nuclear units in the nucleus.

When a proton enters in the lower inverse nuclear field (Fig. 1), which is identical with the nucleus, the negativity of this field is increased, resulting its cohesive pressure[12] decreases further. However, this negativity in the environment of the lower field causes an attraction force on the positive cortex[15] of the proton, equilibrating its possible shrinkage and a loss of energy-mass. Therefore, the role of protons is to create the inverse electric field and of neutrons to suffer the consequences of the mass deficit.

Nevertheless, protons contribute to the increase of the nuclei mass deficit, because they increase (by their entrance in the nuclear field) the negativity of the field, thus contributing to the reduction of cohesive pressure and therefore to increase of the neutrons mass deficit.

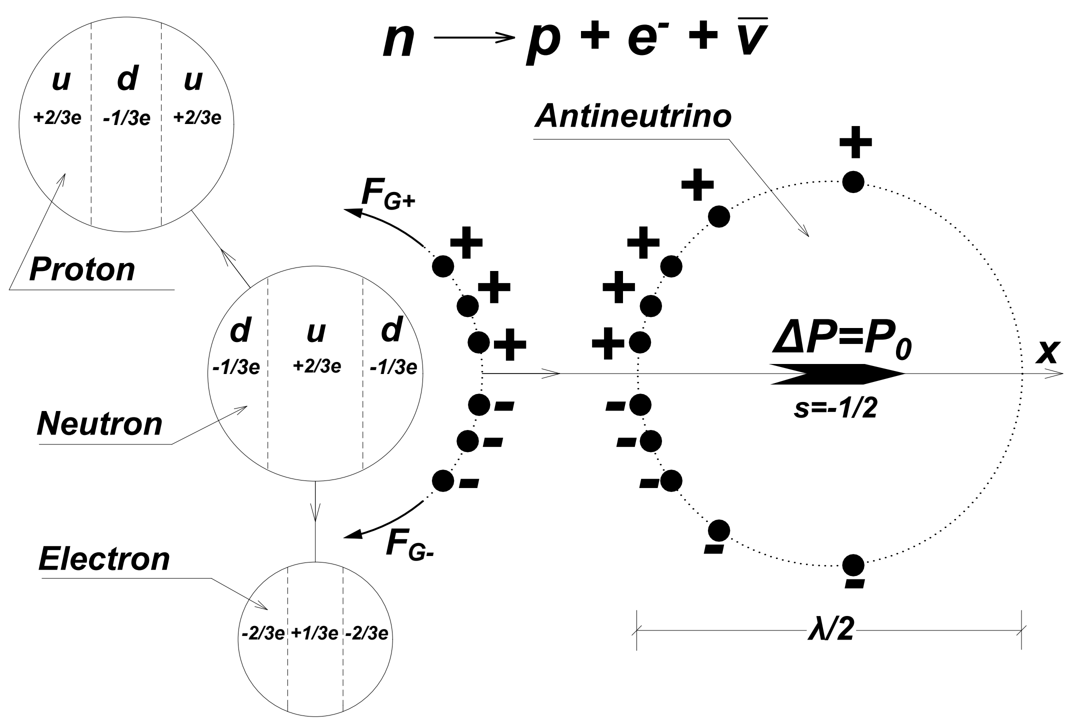

Figure 2. The beta decay β^- creates the grouping units[13] of antineutrinos[14] (of one spindle) at the contact limits of the neutron quarks,[7] formed (as schematically is designed) by the induction forces[13] F_{G+} and F_{G-}

Additionally, the proton entering the nucleus can be cleaved (beta decay β^+) at the strong negative potential of field, which though reduced by entering of the neutron in the nucleus. Oppositely, a greater reduction in the negativity of nuclear field may cause a neutron cleaving (beta decay β^-, Fig. 2) and a reduction in mass deficit due to increased cohesive pressure. Specifically, at the beta decay β^- and β^+ the locations of these phenomena in the nucleus are determined.

As we said, at the nucleus scale the neutron behaves as a positively charged particle and repels the closest proton, which is now moving on a helical orbit emitting gamma radiation and is finally immobilized, due to the balance between the attractive nuclear force and to the strong repulsive antigravity[10] one‡ (Fig. 1 and indicatively see Fig. 5). This radiant energy of the proton transmitted by the neutron is measured as mass deficit Δm and is equal to half of the kinetic energy of the neutron. Therefore, neutrons are those that move into the nuclei (with the remaining half of their kinetic energy) on circular orbits around immobilized protons which have spin only. If protons were rotating they would cause orbital magnetism, which has never been observed, beyond magnetic dipole moment of nucleons spin. In addition, no regression of proton has occurred, because it would cause alternating magnetism, which has not been observed.

It is noted that attraction is exerted by the proton's electric field only, causing the neutron to sink deeper into its lower inverse field. After all, there are nuclei, whose neutrons are rotated around columns of strong electric fields, in addition of those that around the protons are rotated.

1.1. Structure model of deuterium nucleus ${}^2_1H$

The deuterium nucleus (Fig. 3)

$$ {}^2_1H = p + n \tag{1} $$

is derived from hydrogen nucleus ${}^1_1H$ by addition of one neutron and has an experimental spin

$$ s = \frac{1}{2} + \frac{1}{2} = 1 \Rightarrow s = 1 \tag{2} $$

and an experimental magnetic dipole moment

$$ \mu = (2,792 + a)\mu_n - (1,913 + a + 0,022)\mu_n = 0,857\mu_n \Rightarrow \mu = 0,857\mu_n, \tag{3} $$

where

$$ \mu' = a\mu_n \tag{4} $$

is the increase magnetic moment of proton and

$$ \mu'' = (a + 0,022)\mu_n \tag{5} $$

is the increase magnetic moment of neutron (fluctuation of nucleons magnetic moment[9]).

The experimental mass deficit of deuterium nucleus

$$ \Delta m = 2,2MeV \tag{6} $$

is identical to that of neutron, which is stable now.

The electric radius of deuterium nucleus is[5]

$$ r_{el} \approx 10^{-14}m, \tag{7} $$

while $r_{el}/2$ is the allowed orbit radius of neutron.

‡ In the lower[5] inverse nuclear field, where the relative electric densities are $-\rho_4 < -\rho_3$ (or $\rho_3 < \rho_4$) and for $\rho = \rho_3$, $\rho = \rho_4$ the respective cohesive pressures[12] P_3 and P_4 are $P_3 = P_0(\rho_0 - \rho_3)/\rho_0$, $P_4 = P_0(\rho_0 - \rho_4)/\rho_0$, so $P_4 < P_3$ and $\Delta P = P_3 - P_4$. So, the buoyancy conditions creates a repulsive antigravity force[10] $F_a = V\Delta P/\Delta x$ in the lower inverse nuclear field (Fig. 1), that balances the attractive electric resultant[5] $F_4 - F_3$ (nuclear force).

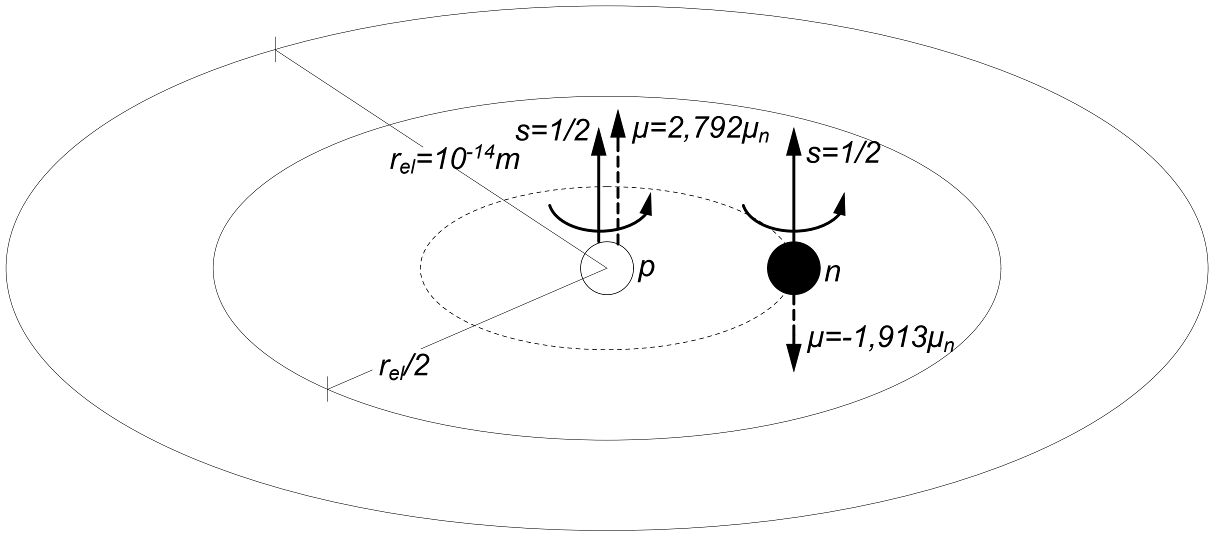

Figure 3. Structure model of deuterium nucleus $^{2}_{1}H = p + n$, with experimental spin $s = 1/2 + 1/2 = 1$ and with experimental magnetic moment $\mu = (2,792 + a)\mu_n - (1,913 + a + 0,022)\mu_n = 0,857\mu_n$, where $\mu' = a\mu_n$ and $\mu'' = (a + 0,022)\mu_n$ the increase magnetic moment[9] of proton (p) and neutron (n) respectively, $r_{el} \approx 10^{-14}$m the electric radius[5] (Fig. 1) of nucleus and $r_{el}/2$ the allowed orbit radius of neutron. The small mass deficit of deuterium $\Delta m = 2,2$MeV is identical to that of neutron, namely neutron is not so deeply in the nuclear field

1.2. Structure model of tritium nucleus $^{3}_{1}H$

The tritium nucleus (Fig. 4)

$$^{3}_{1}H = p + n + n \tag{8}$$

is derived from deuterium nucleus by addition of one neutron (with opposite magnetic moment) between the proton and the initial neutron and has an experimental spin

$$s = \frac{1}{2} - \frac{1}{2} + \frac{1}{2} = \frac{1}{2} \Rightarrow s = \frac{1}{2} \tag{9}$$

and an experimental magnetic dipole moment

$$\mu = (2,792{+}0,186{-}c)\mu_n{+}(1,913{+}b)\mu_n{-}(1,913{+}b{-}c)\mu_n = 2,978\mu_n, \tag{10}$$

where

$$\mu' = (0,186 - c)\mu_n \tag{11}$$

is the increase magnetic moment of proton,

$$\mu'' = b\mu_n \tag{12}$$

is the increase magnetic moment of the nearest neutron and

$$\mu''' = (b - c)\mu_n \tag{13}$$

is the increase magnetic moment of the distant neutron.

The experimental mass deficit of tritium nucleus is

$$\Delta m = (4,24 + d) + (4,24 - d) = 8,48MeV \Rightarrow \Delta m = 8,48MeV, \tag{14}$$

where

$$\Delta m' = (4,24 + d)MeV \tag{15}$$

is the mass deficit of the nearest neutron and

$$\Delta m'' = (4,24 - d)MeV \tag{16}$$

is the mass deficit of the distant neutron.

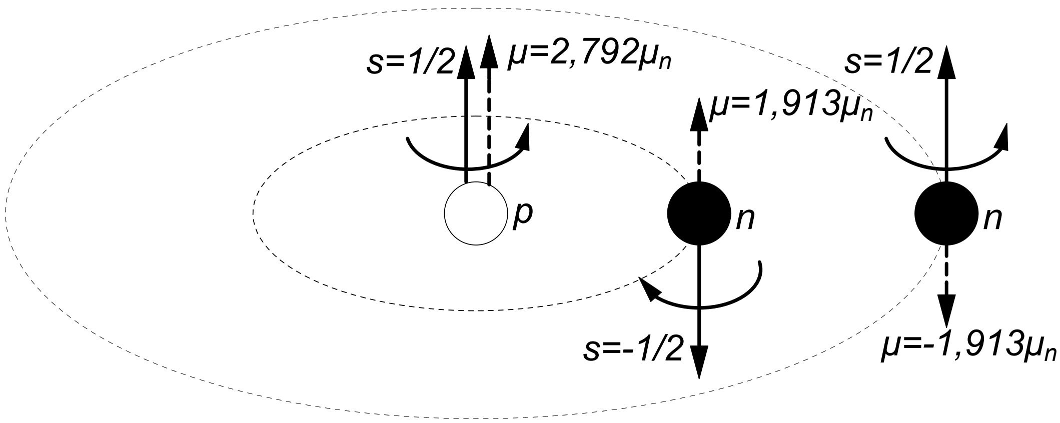

Figure 4. Structure model of tritium nucleus ${}^3_1H = p + n + n$, with experimental spin[7] $s = 1/2 - 1/2 + 1/2 = 1/2$ and with experimental magnetic moment $\mu = (2,792 + 0,186 - c)\mu_n + (1,913 + b)\mu_n - (1,913 + b - c)\mu_n = 2,978\mu_n$, where $\mu' = (0,186 - c)\mu_n$ is the increase magnetic moment[8] of proton, $\mu'' = b\mu_n$ is of the nearest neutron and $\mu''' = (b - c)\mu_n$ is of the distant neutron. The mass deficit of tritium is $\Delta m = (4,24 + d) + (4,24 - d) = 8,48$MeV, where $\Delta m' = (4,24 + d)$MeV is the mass deficit of the nearest neutron and $\Delta m'' = (4,24 - d)$MeV of the distant neutron

As the second neutron enters the deuterium nucleus, between the proton and the neutron, the negativity of the field decreases, leaving the initial neutron at a more distant orbit and reducing its mass deficit that this neutron to become unstable. So, tritium is an unstable nucleus.

1.3. Structure model of helium nucleus ${}^3_2H_e$

The helium nucleus ${}^3_2H_e$ has the same mass number (A = 3) with the tritium, whose the unstable neutron cleaves (beta decay β^-, Fig. 2)

$$n = p + e^- + \bar{\nu} \tag{17}$$

and the resulting proton accelerated in the inverse field and finally balanced, due to the strong repulsive antigravity[10] force,§ radiating all its kinetic energy.

§ In the lower[5] inverse nuclear field, where the relative electric densities are $-\rho_4 < -\rho_3$ (or $\rho_3 < \rho_4$) and for $\rho = \rho_3$, $\rho = \rho_4$ the respective cohesive pressures[11] P_3 and P_4 are $P_3 = P_0(\rho_0 - \rho_3)/\rho_0$, $P_4 = P_0(\rho_0 - \rho_4)/\rho_0$, so $P_4 < P_3$ and $\Delta P = P_3 - P_4$. So, the buoyancy conditions creates a repulsive antigravity force[10] $F_a = V\Delta P/\Delta x$ in the lower inverse nuclear field (Fig. 1), that balances the attractive electric resultant[5] $F_4 - F_3$ (nuclear force).

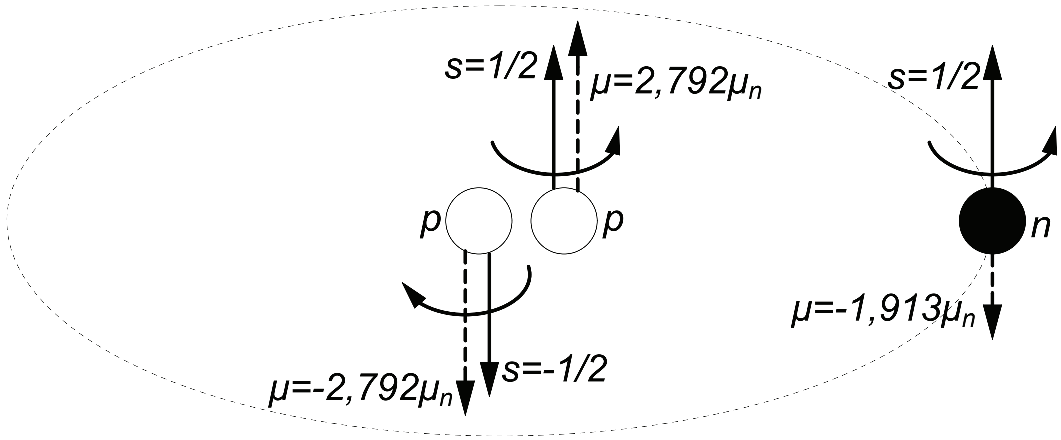

Figure 5. Structure model of helium nucleus ${}^3_2H_e = p + p + n$, with experimental spin $s = -1/2 + 1/2 + 1/2 = 1/2$ and with experimental magnetic moment $\mu = (-2,792+2,792)\mu_n - (1,913+0,214)\mu_n = -2,127\mu_n$. The mass deficit of helium ${}^3_2H_e$ ($\Delta m = 7,69$MeV) is for the neutron only

So, the helium nucleus ${}^3_2H_e$ (Fig. 5)

$$ {}^3_2H_e = p + p + n \tag{18}$$

has an experimental spin

$$ s = -\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{1}{2} \Rightarrow s = \frac{1}{2} \tag{19}$$

and an experimental magnetic dipole moment

$$ \mu = (-2,792 + 2,792)\mu_n - (1,913 + 0,214)\mu_n = -2,127\mu_n, \tag{20}$$

where

$$ \mu' = (-2,792 + 2,792)\mu_n = 0 \Rightarrow \mu' = 0 \tag{21}$$

is the sum magnetic moments of the two protons and

$$ \mu'' = (1,913 + 0214)\mu_n \tag{22}$$

is the increase magnetic moment of neutron.

The increased mass deficit of helium nucleus ${}^3_2H_e$ is

$$ \Delta m = 7,69MeV, \tag{23}$$

that is identical to the neutron.

1.4. Structure model of helium nucleus ${}^4_2H_e$

The two protons of the helium nucleus ${}^4_2H_e$ are very near due to the balance between the two strong forces, i.e. the nuclear force and the antigravity one. They have opposite spins and magnetic moments, causing a strong negative field that would instantly cleave them (beta decay β^+). However, the presence of the two neutrons in the inverse electric field reduces its negativity and avoids this decay, creating the helium nucleus ${}^4_2H_e$ as the most stable nucleus in the Nature.

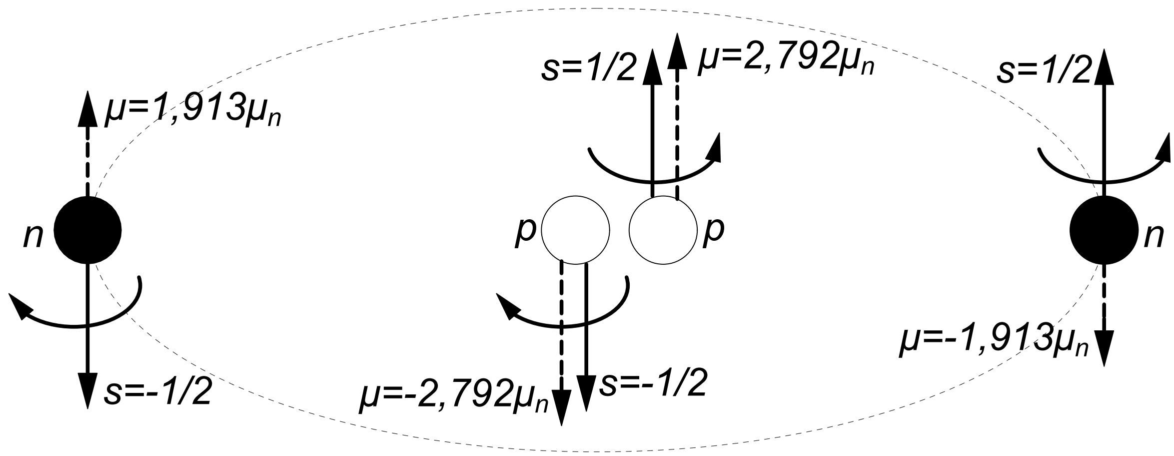

Figure 6. Structure model of helium nucleus $^4_2H_e = n + p + p + n$, with experimental spin[7] $s = -1/2 - 1/2 + 1/2 + 1/2 = 0$ and with experimental magnetic moment $\mu = (1,913 + f)\mu_n - (2,792 + g)\mu_n + (2,792 + g)\mu_n - (1,913 + f)\mu_n = 0$. The mass deficit $\Delta m = (14,11 + 14,11)MeV = 28,22$MeV is for the two neutrons only

So, the helium nucleus $^4_2H_e$ (Fig. 6)

$$^4_2H_e = n + p + p + n \tag{24}$$

has an experimental spin

$$s = -\frac{1}{2} - \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 0 \Rightarrow s = 0 \tag{25}$$

and an experimental magnetic dipole moment

$$\mu = (1,913+f)\mu_n - (2,792+g)\mu_n + (2,792+g)\mu_n - (1,913+f)\mu_n = 0, \tag{26}$$

so

$$\mu = 0. \tag{27}$$

The large mass deficit $\Delta m = 14,11$MeV of each neutron is due to the very strong negativity of the inverse field. Therefore, the mass deficit of the helium nucleus $^4_2H_e$ is

$$\Delta m = (14,11 + 14,11)MeV = 28,22MeV \Rightarrow \Delta m = 28,22MeV. \tag{28}$$

It is noteworthy that, by the helium $^4_2H_e$, the last lower-order nucleus (^2_1H, ^3_1H, $^3_2H_e$, $^4_2H_e$), all the upper-order nuclei are constructed.

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