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The Neutron's Role in Nuclear Binding Energy

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Abstract: - It may be seem strange to us for the first time, but the fact is that the nuclear binding energy is that of the electron in neutron's system formed only from one proton and one electron, the magnitude of this energy is determined according to radius r ***between the electron and proton in the neutron's system which in the same time forms constant*** U ***, the value of this constant is*** $2.30x10^{-28}\,J-m$. ***The electron binds a proton to the proton in neutron by dividing its energy between the two protons where there is no repulsion between them as the electron neutralizes one of them. Therefore the nucleus called deuteron is formed, and this is the rule of forming nuclei greater than deuteron.***

Key words: **neutron, proton, electron, nuclear energy, nuclear radius, deuteron.**

I. INTRODUCTION

Although we appreciate the efforts spent for explaining the nuclear binding energy, they must be replaced by another theory solving the problem of repulsing protons in the short nuclear range. Usually it is supposed that stronger force called nuclear one overcomes their being fly apart. We are going to prove that the electron binds two protons with its energy determined by its distance from the proton in the neutron's system, where there is no repulsion between the two protons in the presence of the electron; this may shed new light on the nuclear formation beginning by the deuteron. It is well known that quantum theory does not permit the existence of the electron in the nuclear range because Planck's constant was based on the motion of the electron as momentum and not as energy which is the real measurement of motion on the small and large scales.

II. THE CONSTANT GOVERNING THE ELECTRON – PROTON SYSTEM U

This constant is as follows

$$m_e v^2 r = \frac{e^2}{4\pi\varepsilon_0} = 2.30x10^{-28}\,J-m \qquad [1]$$

Where r is the distance between the electron m_e and other particle bearing the opposite or same charge but its mass doesn't appear here, it could be the mass of a proton in a neutron or a positron in gamma . From this constant we can determine the atomic radius or the nuclear radius once we have the energy of one of them. From here we can have exactly the atomic radius or the basic nuclear radius and this proves that the difference between electromagnetic and nuclear energy *is not in kind* but only in degree, and this degree is nothing but the distance r between the electron and proton in constant U.

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$$m_e v^2 r = \frac{e^2}{4\pi\varepsilon_0} = 2.30x10^{-28}\,J-m$$

[1]

Let us see how we can have the radius of hydrogen atom in the ground state from constant U before obtaining the basic nuclear radius from the same constant. The energy of the electron in the ground state of hydrogen atom is $13.6ev = \frac{1}{2}m_e v^2 = 2.17x10^{-18}\,J$ and $m_e v^2 = 4.300^{-18}\,J$, then

$$\frac{2.30\,x10^{-28}\,J-m}{4.300\,x10^{-18}\,J} = 5.34\,x10^{-11}\,m.$$

As it is clear this exactly is the radius of hydrogen atom at ground state.

III. THE NUCLEAR BINDING ENERGY IS THAT OF THE ELECTRON

The electron extends its role of binding from atomic and molecular levels to nuclear level through the neutron's system which is one of the forms of constant U . The nucleus of the deuterium or deuteron gives us the key for understanding what the nuclear binding energy is, and it is that of the electron in the neutron dividing its energy between its proton and another proton, where again there is no repulsion between the two protons in the presence of the opposite charge of the electron. Our vision of the electron as the source of nuclear binding energy will be shown now to be valid when dividing the value of constant U by the energy that separated the neutron from the proton in deuteron after the electron's energy being divided between the two protons in this nucleus. The energy that separated the neutron from the proton in many experiments here was 2.2 MeV = $3.52x10^{-13}\,J$, then we have the basic nuclear radius as follows

$$\frac{2.30\,x10^{-28}\,J-m}{3.52\,x10^{-13}/2} = 1.30\,x10^{-15}\,m.$$

IV. NUCLEI HEAVIER THAN DEUTERON

When one neutron joins the deuteron we have the radioactive alpha 3, but when another proton joins it we have the stable alpha 4 or ^4H_e , the nucleus of helium , where two electrons in two neutrons bind four protons ,

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the ratio here is the same as one electron in one neutron binds two protons in the previous example . Here the radius of the nucleus remains the same because the share of every proton from the energy of the electron is the same. Why ^4H_e is the nucleus from which heavy nuclei are built and it is emitted from them as a solid nuclear entity? The answer is that it is unusually stable nucleus, where its 2 neutrons and 2protons are arranged into complete shells, while its isotopes are radioactive and short live ones, for example helium5 has the shortest lived isotope $(7.6x10^{-22}\,second)$, and helium 6 decays by emitting a beta particle and has half-life of ,8 second etc.[6] , and as passed helium3 is radioactive. Here the mechanism of nuclear binding energy is explained, where the role of neutrons is clear and reasonable and accurate avoiding the problem of protons crowding with their same repulsive charges in the very tiny nuclear size where – as it is believed now- unknown nuclear force stronger than electromagnetic one keeps them from flying out of the nuclear range, but the role of neutrons here is not clear at all. We can understand in this light also why neutrons outside nuclear range are unstable and have a mean lifetime of about 14 minutes or less. This is not the case inside nucleus where the energy of the electron is shared by another proton in deuteron. It is clear that no nucleus over that of hydrogen can exist without neutrons, and the number of neutrons equals or surpasses that of many protons to strengthen their binding energy. No doubt it seems strange that the electron is the source of nuclear binding energy while the existence of the electron itself in the nuclear range is forbidden according to de Broglie formula $\lambda = \frac{h}{mc}$ [7] , as the wave length of the electron according to it exceeds greatly the nuclear range, this is one of the shortcomings of quantum theory, and it is well known that quantum theory was built on momentum (Planck's constant) while our new constant U here is built on energy which is the correct measure of motion in the universe on small and large levels.

V. CONCLUSION

Now, we have a solid theory about the nuclear binding energy where the electron in the neutron's system binds its proton - after neutralizing it- with another proton dividing its energy between them. The energy of the electron comes from interacting with the proton at a distance r according to constant $U = m_e v^2 r = 2.30x10^{-28}\,J-m$ where there is no restrictions from special relativity or quantum mechanics as v^2 can exceeds naturally the speed of light c when the distance r is less than the nuclear diameter , and the electron has its natural place in the nuclear range as an active particle in the neutron's system.

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