



International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

<http://gssrr.org/index.php?journal=JournalOfBasicAndApplied>



The Role of Electron in Forming Alpha Particle

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Abstract

Alpha particle is one of three entities in the nuclear range, it is not simple in formation like the other two ones, gamma and beta. Its formation had been explained by Bethe's proton-proton cycle, and its energy is usually measured by the well known $E = mc^2$ of Einstein. Here we are going to explain its formation by the energy of the electron in neutron's system differing from explanations of both Bethe and Einstein.

Key words: hydrogen atom; deuteron; helium nucleus; electron, proton, constant U.

1. Introduction

In fact, many concepts in physics need to be reconsidered and corrected on the small and large levels in our universe. The relation between protons and neutrons forming the nucleus beginning by deuteron consisting of one proton and one neutron is the key for correcting the familiar concept of nuclear binding energy. Here, I came one day to a constant built on an electron interacting with another charged particle bearing the same or opposite charge where the distance of the electron from the other particle is inversely proportion to the energy of the electron. Applying the value of this constant on the energy of gamma ray binding the proton with the neutron in the deuteron, then the basic nuclear radius discovered by Rutherford in his well known experiment appeared referring to the role of the electron in the nuclear binding energy! I named this constant the unifying constant U because I found it could be applied on astronomical level, and published a paper about this subject. Now, in this paper, the formation of alpha 4 is explained in the light of our constant U which differs from Plank's constant in that Plank's constant had been built on the moment of the electron ($m_e v \lambda = h$) while constant U is built on the energy of the electron.

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1.1 *Bethe theory of proton- proton cycle*

In 1938 Hans Bethe and his colleagues presented what is known now as proton-proton chain of reactions that converts hydrogen into helium, according to this theory the Sun can continue shining for about 10 billion years, this process is responsible for about 98% of the Sun's energy production in its core.

In a proton- proton cycle four hydrogen nuclei (protons) combined to form one helium nucleus, 0.7 percent of the original mass is lost mainly by conversion into heat energy. First two hydrogen nuclei (^1H) combine to form a hydrogen-2 nucleus (^2H , deuterium) with the emission of a positive electron. The hydrogen-2 nucleus then rapidly captures another proton to form helium-3 nucleus (^3He) while emitting a gamma ray, two helium-3 nuclei form one helium-4 nucleus (^4He , alpha particle) with the release of two protons [1].

In fact we avoid here referring to the solar neutrino problem. The existence of neutrinos themselves still a problem in our vision!

1.2. *Converting mass into energy*

The mentioned conversion of four hydrogen atoms or their protons into one helium nucleus had been studied by F.W. Aston who showed that the four hydrogen atoms are heavier than one helium nuclei, here the door is opened automatically for the well known equation $E = mc^2$ of Einstein to play its role in explaining that the radiation energy of the Sun is rooted in converting hydrogen to helium in the very hot core of the Sun, and this was what Edington announced in 1920 in his presidential address to the British Association for the Advancement of Science [2].

1.3. *The electron's energy forms alpha particle*

With our respect to the previous efforts for explaining the formation of alpha particle, we have completely different vision about this matter.

The energy needed experimentally to separate a proton from a neutron in the deuteron, which is half alpha particle, is $2.2 \text{ Mev} = 3.52 \times 10^{-13} \text{ J}$ of gamma ray [3]. In fact this energy is that of the electron, and it is determined by its distance from the proton inside the neutron's system according to constant U where the energy of the electron is inversely proportion to its distance from the proton. It is clear that in the same time the electron with its negative charge removes the problem of repulsive force between the two protons with their same positive charge.

Let us present constant U [4] as follows

$$m_e v^2 r = \frac{e^2}{4\pi\epsilon_0} = 2.30 \times 10^{-28} \text{ J} - m \quad (1)$$

In the state of helium-2 (deuteron) the electron divides equally its mentioned energy between its proton in neutron system and the other proton, otherwise we will not have here from constant U, the basic nuclear radius,

but we have it exactly, where

$$\frac{2.30 \times 10^{-28} J \cdot m}{\frac{3.52 \times 10^{-13} J}{2}} = 1.30 \times 10^{-15} m \quad (2)$$

Therefore each proton is fused in helium2 or deuteron by $1.1 \text{ Mev} = 1.76 \times 10^{-13} J$

Now, how alpha particle which is two deuterons or two protons and two neutrons is kept as a solid entity inside the nuclear range apart from the matter of the Sun's radiation energy that we have completely different theory about it [5].

When a proton joins the deuteron we have then helium nuclei-3 or alpha-3 which is the only stable isotope of any element with more protons than neutrons [6], the electron here distributes its $2.2 \text{ Mev} = 3.52 \times 10^{-13} J$ energy among three protons where the share of each proton is an energy less than $1.1 \text{ Mev} = 1.76 \times 10^{-13} J$ meaning $1.17 \times 10^{-13} J$. Now, when another neutron joins alpha-3 it will do what the other neutron had done distributing its $3.52 \times 10^{-13} J$ among three protons: its one in its neutron system and the other two protons, then the share of every proton in the new state is

$$1.17 \times 10^{-13} J \times 2 = 2.34 \times 10^{-13} J = 1.46 \text{ Mev}$$

This amount of energy being more than the previous 1.1 Mev for the proton in deuteron, no doubt gives alpha-4 its solidity to the degree of being named alpha particle, and Rutherford used it as a projectile in the experiment revealing the structure of the nucleus giving the first measure of the basic nuclear radius which appeared previously in the smallest nucleus helium2 when we used constant U to prove that the electron in neutron system divides its energy between two protons to form helium2.

2. A comparison between our explanation and Bethe's about alpha formation

Our explanation is based on experimental fact beginning by the energy of gamma used in separating the proton from neutron in deuteron which is half alpha particle, and this led us across constant U to the basic nuclear radius determined experimentally by the well known experiment of Rutherford which became more accurate with more experiments. This showed us the importance of constant U in revealing the nature of the neutron as a system with its definite value and not as a neutral charged particle with mass slightly greater in the nuclear range than that of the proton. On this familiar and not correct picture of the neutron both proton – proton chain of Bethe, and $E = mc^2$ of Einstein dealt with the formation of alpha particle without no numerical experimental ground. At least it is not reasonable that the binding energy of one neutron and one proton in deuteron is experimentally 2.2 Mev while according to $E = mc^2$ the binding energy of two protons and two neutrons, in alpha particle, is 28.3 Mev [7] !

Explaining the Sun's radiation according to Bethe's proton –proton chain and Einstein's mass defect theory is based on a very hot oven in the core of the Sun transferring hydrogen into helium, but we showed in another paper that the Sun is very condensed and cold because it behaves as one huge hydrogen atom. In fact, we here

used Bose-Einstein condensation theory which has been verified experimentally to prove this image of the Sun. Then what is the source of Sun's radiation to the Earth ? It comes from the interaction between energetic coronal electrons in the last layer in the Sun's structure and the gaseous envelope of the Earth formed mostly from nitrogen and oxygen. When the earth faces the Sun during its daily motion around its axis, the free energetic coronal electrons from the Sun cause the terrestrial atoms to glow creating what is known as the day light on the Earth [8].

3. Conclusion

In constant U the energy of the electron $m_e v^2$ inversely proportion to its distance r from another charged particle, let it be the proton with its positive charge. This exactly is the neutron system case. When another proton joins this system, the electron divides its energy equally between its proton and the other proton, the value of r then is exactly that of the nuclear basic radius $1.30 \times 10^{-15}m$ where we have the smallest nucleus called helium-2 or deuteron. When another proton joins the system, the electron distributes its energy among three protons, including its one, creating helium-3. Now, when another neutron joins the system its electron distributes its energy among the three protons as the previous one did, thus each proton in the two neutron systems is fused to the other two protons with electron's energy exceeding that fused the two protons in helium-2 and accordingly helium-3. For this reason helium-4 or alpha particle has its greatest rigidity.

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