ISSN: 2639-0108

Review Article

Advances in Theoretical & Computational Physics

On The Mechanism of the Formation of Atoms

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Submitted: 28 Sep 2021; **Accepted:** 04 Oct 2021; **Published:** 08 Oct 2021

Citation: *Rasim A. Kamliya. (2021). On The Mechanism of the Formation of Atoms. Adv Theo Comp Phy, 4(4), 278-280.*

Abstract
The mechanism of the formation of atoms from neutrons, which decay in the process of gravitational attraction, is considered. Through the mechanism of the formation of atoms, the reason is shown why the neutrons of the nucleus do not decay, and the electrons do not fall on the nucleus.

Using the deuteron as an example, it is shown what is the reason for the stability of the nucleus and why the neutron contained in the nucleus does not decay.

Introduction
The planetary model of atoms was proposed by the English scientist Ernest Rutherford in 1911. In 1913, the Danish scientist Niels Bohr formulated two postulates:

1. Electrons moving in atoms along separate stationary orbits do not emit electromagnetic waves, and the energy takes on a discrete series of values W_1, W_2, ..., W_n.
2. When an electron jumps from one orbit to another, the electron energy changes unevenly by the amount:

$$\Delta W = W_{n2} - W_{n1},$$

where: W_{n1}, W_{n2} – initial and final energy of an electron.

If $\Delta W > 0$, then the atom absorbs energy, and if $\Delta W < 0$, the atom emits a photon with a frequency $v = -\Delta W/h$.

For these two postulates, Niels Bohr received the Nobel Prize in 1922. The second postulate served as an impetus for the development of quantum mechanics. The first postulate is currently regarded with suspicion by many physicists, who understand that electrons cannot but emit energy if they revolve around the nucleus. If electrons lose energy, they must fall onto the nucleus.

Physicists agree with this position because there is no other explanation for why all electrons do not fall on the nucleus.

Free neutrons decay in 840 seconds into a proton, an electron and an antineutrino. This is called β^--decay. In the nucleus, neutrons do not decay. This fact also has no explanation.

Research results
An atom is a nucleus around which electrons are located at a certain distance from the nucleus. The latter is a collection of neutrons and protons. Neutrons and protons are collectively called nucleons. The number of nucleons determines the mass number of an atom. The number of protons in the nucleus is equal to the number of electrons, and in general the atom is an electro-neutral particle.

The nucleus consists of neutrons and protons, and electrons revolve around the nucleus, the number of electrons is equal to the number of protons in the nucleus.

Judging by the number of protons as well as electrons in their orbits around the nucleus, we can say with confidence that the electrons were formed as a result of the decay of neutrons, from which protons were obtained.

As follows from Bohr's first postulate, the centrifugal force of rotation should be equal to the force of attraction of the electron to the nucleus. The velocity under which the forces equalize can be determined from the equation

$$\frac{mv^2}{r} = \frac{e^2}{4\pi\varepsilon_0 r^2} \qquad (1)$$

where: m – the electron mass,
r – the radius of the orbit,
e – the electron charge,
ε0 – dielectric constant.

For a hydrogen atom, where $r = 5{,}29.10^{-11}$, the velocity is equal to

$$v = 2{,}19 \cdot 10^6 \qquad (2)$$

The rotation frequency is

$$f = \frac{v}{2\pi r} = 6{,}5 \cdot 10^{15} \qquad (3)$$

The result is high velocity and high rotation frequency. If the nucleus contains a large number of protons, then each electron will be attracted more strongly.

For example, for the nucleus of an Fm (Fermi) atom containing 100 protons, the force of attraction of the electron to the nucleus increases 100 times, and the speed required to compensate for the attraction increases 10 times. This is certainly a rough estimate, since the influence of all electrons must be taken into account, but it shows how much the required velocity increases to compensate for the attraction of the nucleus. That is why physicists doubt the feasibility of the results obtained. It seems that the reason why electrons are held in their orbits, and the neutrons of the nucleus of stable atoms do not decay, is different.

Atoms are formed in the process of gravitational attraction of neutrons, and during this period of time the neutrons begin to decay into a proton, an electron and an antineutrino. The released electrons do not fly far away, since they are attracted to positive protons and occupy the energetically allowed levels. The number of electrons at each level is determined by the Pauli principle. All the electrons of the atom repel each other and the levels will be spherical. The field created by the electrons will prevent the decay of neutrons, and this is also facilitated by the field created by the protons of the nucleus.

It is known [1], that electrons of the K and L levels can be captured by the nucleus. In this case, the field around the nucleus decreases and the decay of one of the neutrons of the nucleus becomes possible.

For clarity consider the deuterium nucleus, which contains one neutron and one proton. We know the structure and mutual arrangement of quarks from [2] (Fig. 1). Let us assume that the neutron has undergone -decay, as a result of which an electron leaves e-quark.

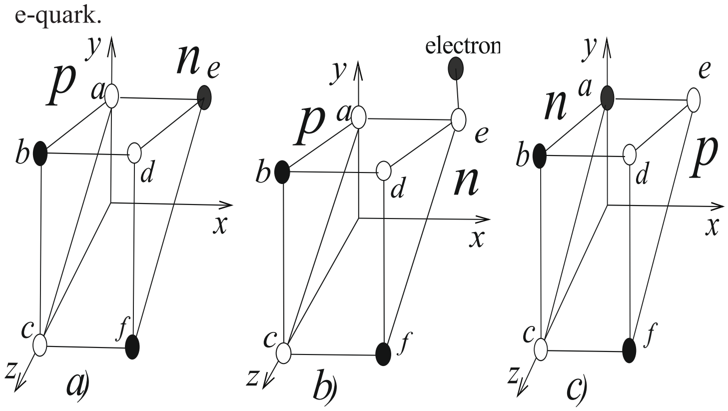

Figure 1: Deuterium nucleus structure

When the electron leaves the neutron (Fig. 1b), a positive charge (u-quark) remains in place of the e-quark (d-quark). The a-quark and e-quark create a strong electric field that will return the electron to its place (Fig. 1a). The capture of an electron by a-quark is also possible, which will lead to the transformation of a proton into a neutron (Fig. 1c). Due to the field that forms the nucleus, the electron cannot reach the first Bohr orbit, and the other nearby levels are not allowed energetically. Thus, deuterium is a stable element.

For atoms with a large mass number, neutrons can be located in different places on the surface of the nucleus. It should be noted that the packing of nucleons in the nucleus can turn out to be different in the process of formation. This can explain the existence of different isomers. If the field around the nucleus is small, then some neutron can decay. The released electron goes to its nearest free level. This increases the field created by the nucleus, and at the same time increases the field created by the electrons.

The electrons around the nucleus repel each other. Therefore, there can be no bunches of electrons in certain places. The field created around the nucleus will be relatively uniform. The two electrons of the hydrogen layer are located at two diametrically opposite points. If the field around the nucleus is sufficient to prevent the decay of neutrons, the process of the formation of the atom is completed.

If the number of nucleons in the nucleus corresponds to a stable atom, and there are few electrons around the nucleus, then over time the required number of neutrons will decay, and there will be a sufficient number of electrons in the orbits. The time during which a stable atom will form is unknown. It seems to depend on the mass number of the atom. The fact is that a neutron in a free state decays in 840 seconds, while in a nucleus the decay time of a neutron changes. We do not know how the neutron decay time depends on the magnitude of the electric field that acts on the neutron, but this is the subject of other studies.

Electrons occupy energetically allowed levels, which vary discretely. Discretization in the binding energy of an electron with a nucleus takes place regardless of whether the electron rotates around the nucleus or not. If electrons revolved around the nucleus, then it becomes unclear where the electron takes energy from, temporarily captured by the nucleus and returning to orbit to spin around the nucleus with velocity 2.106. In addition, a rotating electron, emitting energy, will lose kinetic energy.

The properties of the nucleus and the atom as a whole are influenced by how the nucleons are packed in the nucleus. When atoms are formed from neutrons, the mutual arrangement of these neutrons is random, and when they approach each other, depending on which neutrons decay, different variants of nucleon packing can be obtained, which affects the properties of atoms. There are cases when atoms of radioactive substances with the same mass number and the same number of electrons have different half-lives.

Conclusions

1. The decay of neutrons of the nucleus is prevented by the electric field around the nucleus, created by the nucleus itself and electrons.
2. Electrons are kept in orbits due to the fact that the possible binding energy of an electron with a nucleus changes discretely.

References

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