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Bonding in the Nucleus of an Atom

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Abstract: *Since the discovery of the atom and nucleus. The bonding of the proton & neutron, proton & proton, neutron & neutron have remained a mystery. Although, scientists discovered they were being held together by nuclear forces, the scientific explanation of the attraction remained a mystery. This paper unfolds the mystery behind the attraction in the nucleus of an atom.*

I. Introduction

In 1920, J.J Thomson discovered the proton, the positive charge in the nucleus of an atom after an experiment with a discharge tube. He discovered it was positively charged. In 1932, James Chadwick discovered the neutron, the neutral charge particle of the nucleus after bombarding a thin sheet of beryllium with alpha particles. In 1964, Murray Gell–mann discovered quarks. His theory stated that the protons and the neutrons were made up of quarks. The quarks were negative and positive. He named the positive ones, up-quarks and the negative ones, down- quarks. He discovered that the protons were made of 2 up-quarks & one down quark and that the neutrons consisted of 2 down-quarks and an up-quark.

Experiments showed that the quarks are held together by strong forces and that the particles, neutrons & protons in the nucleus are held together by nuclear forces which are just residual effects of the strong forces holding the quarks.

During the course of this research it was discovered that the attraction or the bonding between protons & protons, neutrons & neutrons, protons & neutrons was due to the attraction of the positive quark in one particle to the negative quark in the other and vice-versa.

This paper explains the bonding in the nucleus of an atom.

II. The Proton

The proton was discovered by J.J. Thomson during an experiment with discharge tube. He used a discharge tube with a central cathode which had a hole in it to conduct an experiment. He showed that when a potential difference of 5000 V was applied across a discharge tube at a very low pressure of about 10^{-4}. The tube began to glow. When the potential difference was increased to 15000 V, a reddish glow was seen. This glow was due to the presence of protons (Ababio, 1990)

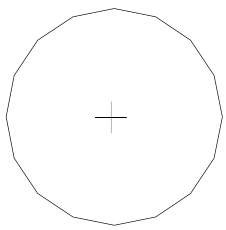

Fig. 1. The Proton

III. The Neutron

The neutron was discovered by James Chadwick after he bombarded a thin sheet of beryllium with alpha particles. The neutron had a mass equal to that of a proton but carried no charge (Ababio, 1990).

The discovery of the neutron indicated that the atomic nucleus was made up of protons and neutrons.

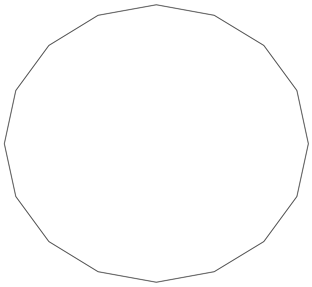

Fig. 2. The Neutron with no charge

IV. The Quark Theory

According to Dobson & Robson (1995), Murray Gell-Mann and George Zweig proposed the quark theory that stated that:

(a) The proton consists of two up-quarks and one down-quark. Up-Quark =+2/3
Down-Quark =-1/3
-1/3+2/3+2/3 =+1
+1 = Charge of Proton.

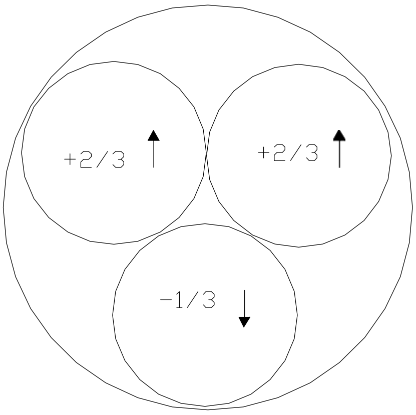

Fig.3. The Proton and its quarks.

b. The neutron consists of two down-quarks and one up-quark. Down-Quark = - 1/3
Up-Quark = +2/3
-1/3-1/3+2/3 =0
0 = Charge of Neutron.

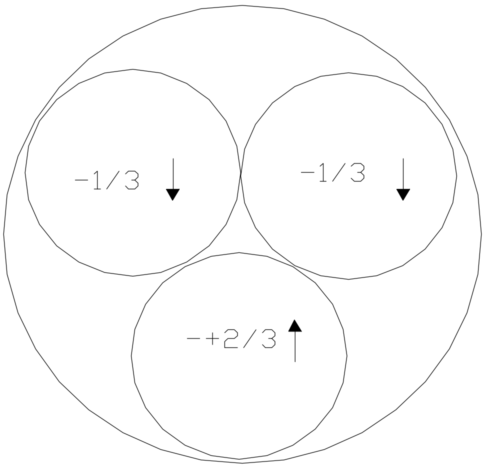

Fig.4. The Neutron with its Quarks.

Sung (2015) explained that there are light quarks which includes up, down and strange quarks. The up and down quarks have the lowest masses and they are stable and the most common quarks in the universe, because they are in the atom nucleus. Quarks combine to form composite particles called hadrons such as baryons and mesons. Sung (2015) further explained that Protons and neutrons are stable examples of baryons.

Carithers & Grannis (1995) explained that the quarks hypothesis depicted that the up (u), down (d) and strange (s) quarks account for the hadrons. The quarks have an intrinsic spin of ½ unit. He further explained that the u quark has a charge of 2/3 while the d and s quarks have charges of -1/3 in units (where the electron charge is -1).

V. Other old major developments relating to discovery to quark

In the 1970's, other developments established the fact that quarks was real. Experiments led to the discovery of charm (c) quark, top (t) quark and bottom (b) quark. The c and t quarks had electric charge of +2/3 while the b quark has a charge of -1/3 (Carithers & Grannis, 1995).

VI. Nuclear Force

Niel Bohr discovered that the particles in the nucleus were held together by nuclear forces. The same nuclear force holds proton & neutron and proton & proton (Dobson & Roberts, 1995).

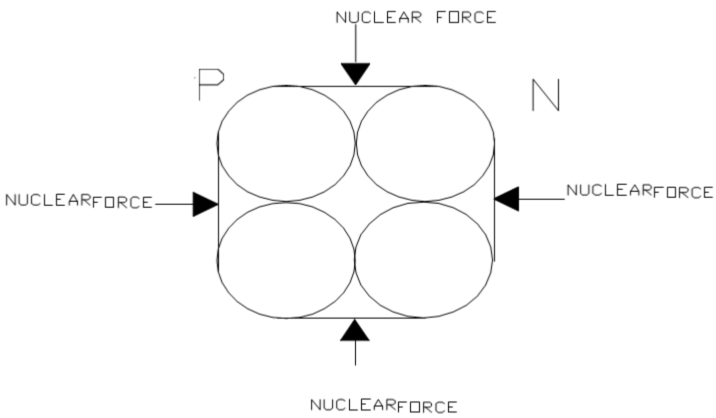

Fig.5 Diagram showing the nuclear forces binding the protons and the neutrons together.

VII. The New Hypothesis

The New Hypothesis states that:

a. The up-quarks of the proton attracts the down-quark of another proton to form a nuclear bond and vice-versa

b. The down-quark of the neutron attracts the up-quark of a proton to form a nuclear bond and vice-versa

c. The up-quark of the neutron attracts the down quark of a proton to form a nuclear bond.

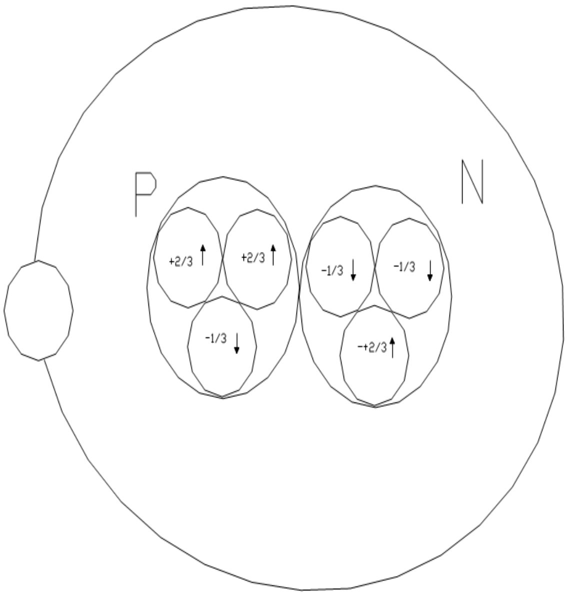

Fig.6 Diagram showing the bonding in the nucleus of deuterium, an hydrogen isotope.

VIII. Conclusion

The research shows that the attraction in the bonding is due to the attraction between the quark of one nuclei particle and the quark of another.

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