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Theoretical Analysis to Prove the Contradiction Between the concepts of Binding Energy and The Strong Nuclear Force

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Abstract: ***During the start of the 20th century, after Einstein presented mass-energy equivalence, many physicists started using the theory, to connect the dots in their work. One such example is the explanation of the mass defect in the nucleus and its relative binding energy, which is said to be the reason for the nucleons to stay in the nucleus. In 1932 with the discovery of neutrons by James Chadwick, a new field of interest was developed among the scientific community i.e. the force acting on the nucleons to make them stay in the nucleus. This force is nothing but the strong nuclear force. While studying these theories a contradiction in the concepts of binding energy and the strong nuclear force is observed. In this paper we are trying to address this contradiction and present a conclusion, which according to our understanding is correct.***

1. Introduction

$E=mc^2$ has become one of the fundamental equations over the past century. It's been used widely in many aspects and fields of physics. One such example of its use is the field of particle physics. The nucleus and its relative explanations have been of peculiar interest ever since its emergence. The one we are focusing on are the nucleons i.e. the protons and the neutrons.

It is observed that when the nucleons combine to form the nucleus, the mass of the nucleus is less than the summation of the individual masses of the nucleons and again when the nucleons are separated, they retain their original masses. The explanation for this that is given is the mass-energy equivalence. To further understand this a study of binding energy and the strong nuclear force has been done in the next section

2. Binding Energy and the Strong Nuclear Force

Nuclei are made up of protons and neutrons, but the mass of a nucleus is always less than the sum of the individual masses of the protons and neutrons which constitute it. The difference is a measure of the nuclear binding energy which holds the nucleus together [1]. This binding energy can be calculated from the Einstein relationship: Nuclear binding energy =Δmc2

For example, a helium atom containing four nucleons has a mass about 0.8% less than the summation of masses of four hydrogen nuclei (which contain one nucleon each). The helium nucleus has four nucleons bound together, and the binding energy which holds them together is, in effect, the missing 0.8% of mass [2].

On the other hand, The protons are all positively charged and repel each other: they nevertheless stick together, showing the existence of another force–a nuclear attraction, "the strong nuclear force" which overcomes electric repulsion at very close range [3]. A negligible amount of effect of this force is observed outside the nucleus, so it has a much steeper dependence on distance, therefore, it is a short range force.

The strong force is also responsible for pulling neutrons together, or neutrons and protons. We now know that at a distance of one fermi (10−38 centimeter) the nuclear force is 35 times as strong as the electromagnetic force and 1038 times stronger than gravity [4].

Inference which can be taken from the above two concepts is that, only one of the two is responsible for the process of bringing the protons together and thus forming the nucleus. Therefore, it won't be incorrect to state that the strong nuclear force is responsible for bringing the protons together and forming the nucleus because it is one of the fundamental forces.

3. Conclusion

After studying the concepts of binding energy and the strong nuclear force, a clear contradiction has been observed. Therefore, we conclude that the strong nuclear force being one of the fundamental force is the sole reason why the protons thus the nucleons bind together to form the nucleus and the binding energy does not have a role in forming the nucleus.

References

[1] Soheil Pourshahian. "Mass defect from nuclear physics to mass spectral analysis". In: Journal of The American Society for Mass Spectrometry 28.9 (2017), pp. 1836–1843.

[2] George P. Spenkov. "The Binding Energy of Helium, Carbon, Deuterium, and Tritium in View of Shell-Nodal Atomic Model and Dynamic Model of Elementary Parti- cles". In: ().

[3] Dr. David P. Stern. "Nuclear Energy". In: (). URL: https: //www-istp.gsfc.nasa.gov/stargaze/SnucEnerA-2.htm.

[4] Robert E. Marshak. "THE NUCLEAR FORCE". In: Scientific American 202.3 (1960), pp. 98–118. ISSN: 00368733, 19467087. URL: http://www.jstor.org/stable/24941294.