Neutron Decay and Neutrino Problem

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Abstract

In contemporary physics, it is assumed that the decay of neutrons is a proof of electron neutrino existence. The article has shown that in this case a mass defect of a proton may have a different cause, i.e., a negative mass of a positron. The hypothesis of an electron neutrino is not necessary.

Keywords: mass, neutron, elementary particles, positron, electron, decay, neutrino, proton, particle physics, leptons, barions, photon, energy conservation law.

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Introduction

For more than 100 years, it has been known that the result of neutron **n** decay is a proton (**p^+**) and an electron (**e^-**): $n = p^+ + e^-$. The problem is that the sum of proton and electron masses is not equal to the mass of a neutron. It violates the energy conservation law. In 1930 Wolfgang Pauli resolved the conundrum by introducing a new particle, i.e., a neutrino [1]. The electron antineutrino (**$\bar{\upsilon}_e$**) takes away excess energy: $n = p^+ + e^- + \bar{\upsilon}_e$.

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The opposite reaction is used to prove the existence of the neutrino:

$$p^+ + \bar{\upsilon}_e = n + e^+,$$

where: e^+ is a positron.

There is a small possibility of the interaction of a single neutrino with a proton. For this reason, in 1956 the scientists Clyde Cowan and Frederick Reines used huge neutrino flux from a nuclear reactor [2]. The interpretation of this experiment follows. The neutron interacts with cadmium and gives off a gamma ray when it absorbs the neutron. The neutrino interacts with a proton of hydrogen and produces a positron. After the neutrino interaction event, the two gamma rays from the positron annihilation would be detected several microseconds later. The appearance of a positron is considered to be a proof of an electron antineutrino ($\bar{\boldsymbol{\upsilon}}_e$) existence.

Analysis of neutron decay

It is well known that particles emerge in particle-antiparticle pairs [3]. There is no reason to believe that an electron is generated alone in the neutron decay. Therefore an electron-positron pair arises inside the neutron. The electron is pushed out, but the positron creates a proton with the rest of the neutron:

$$n \rightarrow n + e^+ + e^- \rightarrow (n + e^+) + e^- \rightarrow p^+ + e^- .$$

The proton mass is: $m_p = m_n + m_{e+} - m_{e-} + \Delta m$,

where: $m_n = 939.565\ 4133$ MeV/c^2 – mass of neutron;

$m_p = 938.272\ 0813$ MeV/c^2 – mass of proton;

$m_{e+} = -0.510\ 998\ 9461$ MeV/c^2 – mass of positron is negative [4];

$m_{e-} = 0.510\ 998\ 9461$ MeV/c^2 – mass of electron;

Therefore the mass defect of the neutron is $\Delta m = 0.271\ 334\ 108$ MeV/c^2. It covers the energy of the initial momentum of the proton and the electron but is insufficient for creating a new particle.

The opposite reaction is impossible. The energy of $\boldsymbol{\Delta m}$ is too tiny for the creation a neutron from a proton. The Cowan-Reines neutrino experiment can be explained as shown below. The fast neutron hits the electron of hydrogen and absorbs in cadmium. The electron penetrates in the proton of hydrogen and finally annihilates with a positron inside a proton. As a result, the proton converts to a neutron and emits two photons:

$e^- + p^+ \rightarrow n + (e^- + e^+) \rightarrow n + 2\,\gamma$.

The transformation of a free proton to a neutron is energetically impossible, since a free neutron has a greater mass than a free proton. But a high-energy collision of a proton with an electron can result in a neutron.

Conclusions

There is no need to use an electron neutrino to explain neutron decay.

The appearance of a positron cannot be regarded as the evidence of neutrino existence.

The proton is a composite particle containing a positron. That is why the proton has a lepton number, too.

The question of electron neutrino existence remains open. To find an answer to this question an analysis of all beta decay experiments is necessary. In the case of neutron decay the neutrino is unnecessary.

References

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