

The Origin of Matter

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Abstract

I propose that the origin of matter in our Universe is the energy inherent in the quantum vacuum. According to Quantum Field Theory (QFT), infinite vacuum space is not an absolute void but rather a dynamic medium filled with fluctuating quantum fields. These energy fluctuations give rise to transient virtual particle–antiparticle pairs, which typically annihilate each other shortly after their formation, thus conserving energy and momentum. However, I hypothesize a special case wherein a neutron and an antineutron, emerging from such vacuum fluctuations, become real and stable without mutual annihilation. New neutron-antineutron pairs that were created in space were attracted to the first one. This created a spinning primeval neutron star.

The motivation for this hypothesis is the fact that it unites quantum and the matter universe. I describe a unique structure of the universe, I designate the “Pivot universe”. The matter universe started as a spinning massive primeval neutron star that exploded, when it reached a maximal acceleration limit, into two distinct part – a spinning neutron star, I designate – the Pivot, located at the center of the matter universe, and a of visible matter universe in the shape of a flat disk orbiting the Pivot. The "Pivot Universe" hypothesis aims to address cosmological puzzles that the current standard model struggles to explain.

Creation of matter in a vacuum space

The question is how short-lived virtual particles become long-lived particles that compose matter in the universe. Quantum Field Theory (QFT) teaches that from the fluctuating fields of vacuum space, various pairs of virtual particles are spontaneously and constantly created, for example: electron-positron and proton-antiproton, quark and its antiquark. However, they will annihilate each other immediately because, in this process, some properties are not conserved. For example, they have opposing electrical charges. Any point in the vacuum space contains energy that has a minimum value designated as the vacuum energy. Its behavior is codified in Heisenberg’s energy-time uncertainty principle. QFT also teaches that from the energy of the vacuum space, pairs of matter and antimatter particles are perpetually generated, e.g., an up quark and its up antiquark, a down quark and its down antiquark, an electron, and a positron, etc. These pairs pop out in the vacuum, exist for a short time, and then annihilate each other. Virtual particles with different energies can pop out. Their time of existence is dictated by Heisenberg’s time-energy uncertainty principle ($\Delta E \cdot \Delta t \geq h/4\pi$). The higher the energy (ΔE) of a virtual particle, the shorter its lifetime. For example, an up-quark and its antiup-quark, having a mass of $3.56 \cdot 10^{-30}$ kg, exist for only $2 \cdot 10^{-22}$ seconds. After their creation, the pair of virtual particles attract each other by their opposing electrical charges and annihilate each other into energy. It is important to note that this process does not violate conservation laws. This description of vacuum space filled with pairs of virtual particles is the ether of QFT.

I postulate that there is one process in which pairs of virtual particles can become real, long-lived particles. This is because the neutron and antineutron both have zero electrical charge. All other cases, such as the electron-positron and proton-antiproton, annihilate each other because they have opposing electrical charges. I suggest the following process as shown in Fig. 1:

Somewhere in the infinite vacuum space, it happened that two down quarks (d) and one up quark (u) joined together to create a neutron, shown on the left side of the figure. Simultaneously, the antimatter particles, namely two down antiquarks (\bar{d}) and one up antiquark (\bar{u}), also joined together to create an antineutron, shown on the right side of the figure. Once the neutron and the antineutron are created, the quarks cannot leave their nucleons, because quarks are never found in isolation - this phenomenon is known as quark confinement. The neutron and the antineutron cannot annihilate each other because they have the same electrical charge (0). Moreover, the neutron and the antineutron attract each other by the strong force. It is also important to note that a neutron and an antineutron have the same spin (1/2), i.e., they spin in the same direction.

In this process, several fundamental conservation laws are kept:

- 1) Conservation of Energy
- 2) Conservation of Angular Momentum
- 3) Conservation of Electric Charge
- 4) Conservation of Baryon Number (B)

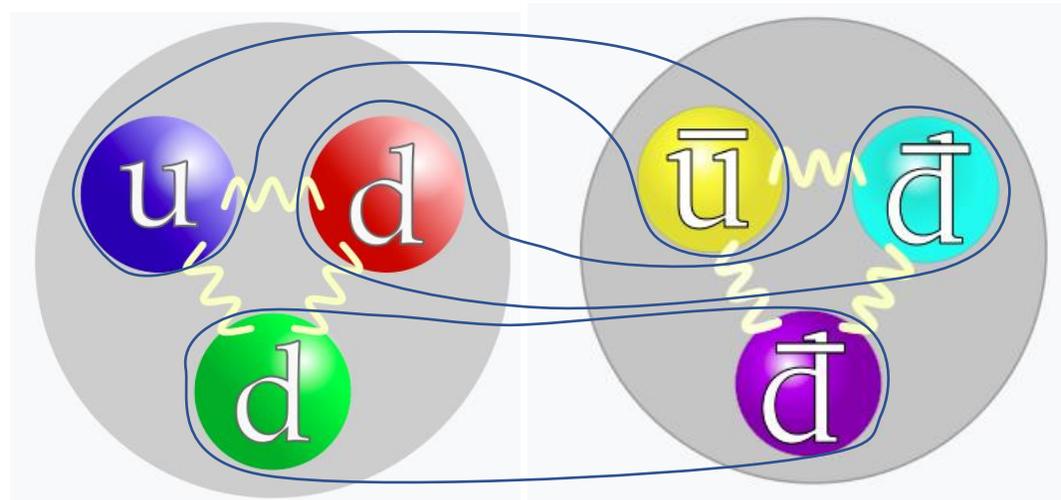


Fig.1 – The creation of a neutron and an antineutron

This event was the beginning of the creation of a primeval nucleus. The vacuum space is a source of quarks that compose the neutrons and antineutrons; thus, the process went on. Additional neutrons and antineutrons that were created in the vacuum space were attracted by the strong force to the first pair. The primeval neutron star rotated in the same direction as the first pair. The neutrons and antineutrons were packed in the primeval nucleus at the maximum density possible: $7.8 \cdot 10^{17} \text{ kg/m}^3$.

To sum up, the primeval neutron contained matter particles (neutrons) and antimatter particles (antineutrons), which did not annihilate each other. The primeval neutron star grew, and when it reached a physical limit, it exploded (See the explanation of the explosion below). It is observed that after the explosion, only neutrons remained. The question is, where did the antineutrons go? The following description of the primeval nucleus answers the arguably greatest conundrums in physics, namely, the question of why our universe contains only matter particles.

I make a speculative assumption. This assumption is based on the hypothetical process in which an antineutron, in a nucleus, transforms into a neutron known as neutron-antineutron transition ($n \leftrightarrow \bar{n}$). Thus, it is possible that all the antineutrons will be transformed to neutrons, and thus the primeval nucleus contained only neutrons, before it exploded. Unfortunately, I cannot elaborate on this issue because it is an active area of experimental and theoretical research.

Why did the primeval nucleus stop growing?

The question is what stopped the growth of the spinning primordial neutron star? I postulate that the growth of the nucleus stopped when it reached the maximum acceleration possible in the Universe. The radius of the primeval nucleus grew until the gravity on its surface reached the maximum acceleration possible in the Universe, and then it exploded in a huge explosion. Recent experiments were conducted to find this acceleration. Potzel, [1] e.g., did such an experiment. He calculated that the maximal acceleration possible in the Universe is $a_{\max} > 1.5 \cdot 10^{21} \cdot m / \text{sec}^2$. It is to be noted that Fridman calculated another result $a_{\max} = 1 \cdot 10^{19} \cdot m / \text{sec}^2$. I emphasize that this issue of maximum acceleration is in ongoing research. Note: In my calculations of the maximum size that the primeval neutron reached, I use an estimation of $a_{\max} = 1.58 \cdot 10^{20} \cdot m / \text{sec}^2$

How did the spinning primeval neutron evolve into the Pivot structure?

The explosion shattered the primeval nucleus. It caused the nucleons of the nucleus to be flung off tangentially in the equatorial plane of the primeval nucleus and the same direction as the primeval nucleus's spin. The final result was as follows: A significant part of the primeval nucleus became the Pivot. The other nucleons that flung off tangentially from the primeval nucleus arranged around the Pivot in a ring-shaped visible Universe. The Pivot universe resembles cosmological structure observed in the universe e.g., the Sombrero galaxy. From the GR point of view, the Pivot is described as a rotating black hole. A black hole has an event horizon; therefore, the visible Universe must reside outside this event horizon. The force that holds the visible Universe in orbit around the Pivot is its gravity. GR also teaches that the spinning Pivot drags the entire space around it. Particles created in the explosion are dragged by space; thus, no additional energy is needed for their motion. (Exactly as a boat is dragged by a river).

This description solves two mandatory conundrums in cosmology:

- 1) The dark matter resides in the Pivot. The Pivot cannot be observed by an observer located outside its event horizon.
- 2) There is no need for dark energy as the motion of celestial bodies is caused by the dragged space.

Free neutrons that flung off the primeval neutron outside the nucleus into space vacuum are not stable. Within ~15 minutes after the explosion, the free neutrons decayed into protons, electrons, and antineutrinos. It is also possible that big chunks of neutrons remained together to become the center of celestial systems.

There are additional basic issues of the Pivot universe model that I do not relate here. To delve into the structure of the Pivot Universe, see: [2] -The structure of the Pivot Universe

Open questions

The description in this paper is qualitative. There are several open questions, such as:

- 1) What is the probability of neutron-antineutron pair creation in vacuum space?
- 2) How long did it take the primeval nucleus to explode?
- 3) Is it possible that the same procedure has been occurring in other places in infinite space?
Or in other words, is it possible that additional matter Universes exist?

References

1. Potzel (2014) "Clock hypothesis of relativity theory, maximal acceleration, and Mossbauer spectroscopy". <https://arxiv.org/abs/1403.2412>
2. https://www.academia.edu/45575390/The_structure_of_the_Pivot_Universe