

## The origin of matter.

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### Abstract

I claim that the source of matter in our Universe is the energy of the infinite vacuum space. The vacuum space, according to Quantum Field Theory, is not a total void but is rather endowed with fluctuating fields of energy. From these fields of energy, virtual particles of matter and antimatter are perpetually popping out and shortly after that annihilating each other. There is one case when real particles - a neutron and antineutron are created from the virtual particles without annihilating each other- this is the source of matter.

### General

In my paper

[https://www.academia.edu/51230191/Is\\_there\\_an\\_explanation\\_for\\_Hubble\\_s\\_constant\\_crisis](https://www.academia.edu/51230191/Is_there_an_explanation_for_Hubble_s_constant_crisis)

I describe a structure of the universe that is composed of a spinning central neutron star I designate the Pivot and a flat disk of a visible Universe that orbits this Pivot. This structure can resolve cosmological observations such as, why has the Hubble constant two separate definite values, how come the universe includes huge voids, and is there aether? Etc.,

There are some profound questions regarding the Pivot structure. What is the origin of the Pivot? How was the visible Universe created? Or **how did it all begin?** In a nutshell, I speculate that there was a primordial spinning neutron star that was built up gradually, over a long time -TBD, from the infinite vacuum space energy. It grew until it reached a physical limit and then it exploded. The spinning primordial neutron star exploded into two distinct parts. The first is the Pivot that retained the bigger part of the primordial neutron star and the second is the visible Universe that flung off tangentially from the primordial spinning neutron star, and eventually arranged as a thin disk that is orbiting the Pivot.

I concur with Newton's hypothesis that the vacuum space (or aether as was known at his time) is absolute, eternal, infinite, and permeates everywhere. Newton did not define what is the aether. However, the aether hypothesis was discarded at the beginning of the 20<sup>th</sup> century after an experiment done by Michelson & Morley. But the aether was replaced in modern physics by the vacuum space. Vacuum space, according to Quantum Field Theory (QFT), is not a total void but is rather endowed with fluctuating fields of energy. Any point in this vacuum space contains energy that has a minimum value designated 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, electron, and 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 ( $\Delta E$ ) 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 and by their opposing electrical charges annihilate each other into energy. It is important to note that this process does not violate conservation laws.

## Creation of matter

***The question is how do the virtual particles become real long-lived particles that compose matter in the universe, such as neutrons, protons, and electrons?***

I claim that there is one case in which virtual particles can become real long-lived particles. This is the neutron because neutron and antineutron both have zero electrical charges. All other cases including electron-positron and proton-antiproton will annihilate each other because they have opposing electrical charges.

I postulate 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. At the same time, the antimatter particles, namely two down antiquarks ( $\bar{d}$ ) and one up antiquark ( $\bar{u}$ ), also joined together to create an antineutron - the right side of the figure. Once the neutron and the antineutron are created the quarks cannot leave their nucleons, in other words, 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. (Note: A similar process applies also to proton and antiproton creation. But it differs from the neutron antineutron process, because proton and antiproton annihilate each other in a short time because they have an opposing electrical charge.)

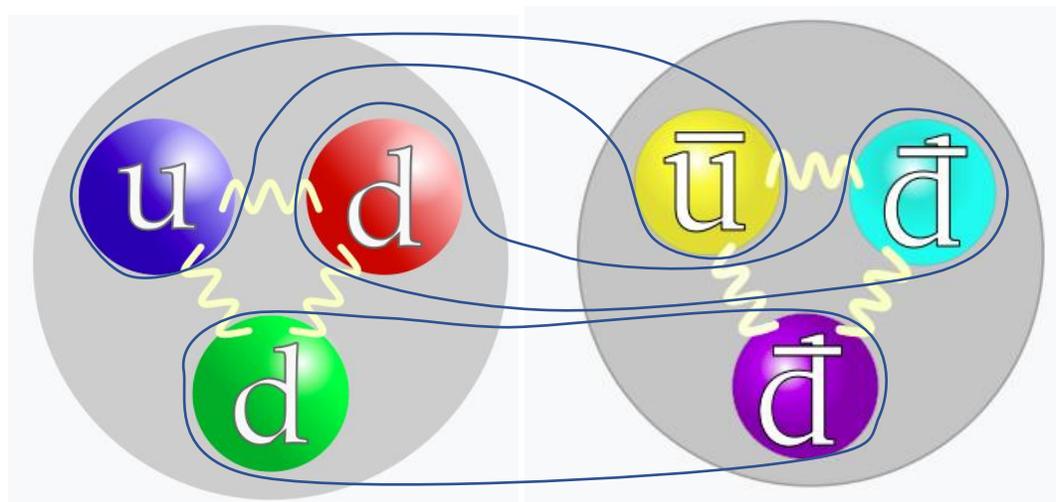


Fig.1 – The creation of a neutron and an antineutron

This event was the beginning of the creation of a primeval nucleus. The vacuum space is an infinite 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. In the nucleus, unlike in free space, the neutrons and antineutrons are stable, and therefore, they did not decay into protons and antiprotons. The neutrons and antineutrons were packed in the primeval nucleus to the maximum density possible in the Universe (=density of neutron –  $7.8 \cdot 10^{17} \text{kg/m}^3$ ). I would like to note, without elaboration, that there is the phenomenon of neutron-

antineutron transformation in the nucleus. The question that arises now is what stopped the growth of the primeval nucleus? The answer is given in the next paragraph. The above description is given from the quantum physics point of view. However, the primeval nucleus can also be described by general relativity. As the primeval nucleus grew, its mass was big enough to become a rotating Kerr black hole. GR teaches that a rotating black hole dragged vacuum space around it. An additional note is about gravity- During the epoch of the primeval Universe, only the primeval nucleus existed in the infinite vacuum space. Thus, the only force holding the nucleus together was the nucleons themselves. Quantum physics teaches that there is an attractive force between nucleons that are located at a sub-atomic distance. This force is designated the strong force. My claim is that this strong force between nucleons is the origin of gravity between celestial bodies that were created later, after the explosion of the primordial neutron star. At cosmological distances, the strong force (= gravity) decreases to extremely small values, but, as the number of nucleons in a celestial body is enormous, there is still considerable gravity force between celestial bodies. See my paper [https://www.academia.edu/56276015/THE\\_ORIGIN\\_OF\\_GRAVITY](https://www.academia.edu/56276015/THE_ORIGIN_OF_GRAVITY)

**Why did the primeval nucleus stop growing?** I postulate that the growth of the nucleus stopped when it reached the maximum physical values possible in the Universe. In addition to the accepted maximum velocity in vacuum space, there is also a maximal 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. Based on cosmological observations, the explosion occurred ~13.7 billion years ago. An open question is, how long did it take for the primeval nucleus to reach its maximum size?

**How did the matter Universe evolve into the Pivot structure?** The explosion shattered the outer layers of the primeval nucleus, specifically those regions near its equatorial plane. It caused the nucleons of these layers to flung off tangentially in the equatorial plane of the primeval nucleus and in the same direction as the primeval nucleus 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 have arranged around the Pivot in a ring-shaped visible Universe. From the GR point of view, the Pivot can be 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 gravity, which, as pointed out earlier, is the manifestation of the strong force at cosmological distances. The above description of the primeval nucleus answers the arguably greatest conundrums in physics, namely the question of why there is more matter than its antimatter. Or, in other words, why anything exists at all. As mentioned earlier, the primeval nucleus contained equal numbers of neutrons and antineutrons, or in other words, there was symmetry between matter and antimatter. At the moment of the explosion, there was a breaking of the symmetry between matter and antimatter. It so happened that the Pivot remained with more antineutrons than the neutron, whereas the visible Universe contained more neutrons than antineutrons. Neutrons and antineutrons are stable when confined in the nucleus. However, free neutrons and free antineutrons that flung off the primeval neutron outside the nucleus are not stable. Within ~15 minutes after the explosion, the free neutrons decayed into protons, electrons, and antineutrinos. At the same time, the free antineutron decayed into antiprotons, positrons, and neutrinos. In this soup of matter and antimatter in the visible Universe, a mutual annihilation occurred, i.e., protons and antiproton, electron and positron, and neutrino and antineutrino. The annihilation of the matter and antimatter particles into energy released a considerable amount of energy that reached high temperatures. The result was that only matter, i.e., protons and electrons remained in the visible Universe. The Pivot includes more antineutrons than neutrons; nevertheless, it is stable because its constituents, the neutrons, and antineutrons are stable when confined in the nucleus.

It is observed that the visible Universe contains 85% protons (with an equal number of electrons) and just 15% neutrons. The question arises: what is the source of neutrons in the atom's nucleus? This is due to the Beta (+) decay process. In this process, which generally occurs in a proton-rich nucleus, a proton inside the nucleus can convert to a stable neutron, while emitting a positron and an electron neutrino.

Note:

The description here is qualitative. There are open questions such as:

- 1) What is the probability of neutron-antineutron creation in vacuum space?
- 2) How long did it take before the primeval nucleus exploded?
- 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?