

The eclipse of the center of our Galaxy by the Sun

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Annotation

A new phenomenon has been discovered - beta decay slows down globally at a time when the Sun is eclipsing the center of our Galaxy.

In its apparent movement through zodiacal constellations, the Sun eclipses the center of our Galaxy at the end of December.

This opens up the possibility to test the effect of the Sun on the flow of cosmic neutrinos generated by the galactic center.

Due to the fact that the neutrino flux is the cause of beta decay, as a result of the lensing of the neutrino flux by the Sun, beta decay on the Earth should slow down by about twenty percent globally for almost a day at the end of December.

This effect was first observed on December 2024 and re-measured a year later on December 2025.

Keywords

center of Galaxy

Sun

neutrino

Earth

beta decay

1 Neutrino is magnetic excitation of the ether

1.1 Radiation of a magnetic dipole in Maxwell's theory

Let us consider the description of the emission of electromagnetic waves by a magnetic dipole in vacuum, which is given by Maxwell's theory. To simplify, we will assume that electric charges and currents, other dipoles and quadrupoles are absent. Let the only source of electromagnetic fields in the following consideration be the time-varying magnetic dipole moment $\mathbf{m}(t)$.

According to Maxwell's equations [1], the electromagnetic field in this case can be represented by its vector potential

$$\mathbf{A}(R, t) = \frac{[\dot{\mathbf{m}}(\mathbf{t}^*) \times \mathbf{n}]}{cR}, \quad (1)$$

(to account for the delay of the electromagnetic signal, a retarded time is introduced here $t^* = t - \frac{R}{c}$).

By definition, in the absence of free charges (i.e., at $\varphi = 0$)

$$\mathbf{E}(R, t) = -\frac{1}{c} \frac{d\mathbf{A}(R, t)}{dt^*} = -\frac{1}{c^2 R} [\ddot{\mathbf{m}}(t^*) \times \mathbf{n}]. \quad (2)$$

The magnetic field in a wave created by a magnetic dipole

(assuming $\varphi = 0$) by definition ([1],Eq.46.4)

$$\mathbf{H}(R, t) = \text{rot}\mathbf{A}(R, t) = \left[\nabla \times \frac{[\dot{\mathbf{m}}(t^*) \times \mathbf{n}]}{cR} \right] = \frac{1}{c} \left[\nabla \times [\dot{\mathbf{m}}(t^*) \times \mathbf{n}] \cdot \frac{1}{R} \right] \quad (3)$$

In the general case, the rotor of the function \mathbf{F} , depending on the parameter ξ , can be written as:

$$[\nabla \times \mathbf{F}(\xi)] = \left[\text{grad } \xi \times \frac{d\mathbf{F}}{d\xi} \right]. \quad (4)$$

Therefore, since $\text{grad } t^* = \nabla(t - R/c) = -\mathbf{n}/c$, we get

$$\text{rot } \dot{\mathbf{m}}(t^*) = \left[\text{grad } t^* \times \frac{d\dot{\mathbf{m}}(t^*)}{dt^*} \right] = -\frac{1}{c} [\mathbf{n} \times \ddot{\mathbf{m}}(t^*)]. \quad (5)$$

The second term obtained by differentiating Eq(3) has the form

$$\frac{1}{c} \left[\nabla \frac{1}{R} \times [\dot{\mathbf{m}}(t^*) \times \mathbf{n}] \right] = \frac{1}{cR^2} [\mathbf{n} \times [\dot{\mathbf{m}}(t^*) \times \mathbf{n}]]. \quad (6)$$

Finally, the magnetic field in an electromagnetic wave

$$\mathbf{H}(R, t) = -\frac{1}{c^2 R} [\mathbf{n} \times [\ddot{\mathbf{m}}(t^*) \times \mathbf{n}]] + \frac{1}{cR^2} [\mathbf{n} \times [\dot{\mathbf{m}}(t^*) \times \mathbf{n}]] \quad (7)$$

Thus, according to Maxwell's theory, electromagnetic waves excited in vacuum by a magnetic dipole must have an electric field component defined by Eq.(2) and a magnetic component with intensity Eq.(7), which are appropriately oriented.

In this case, there are two options, since two types of waves are possible.

1.1.1 Photons

This option is explored in all courses of electrodynamics. It is realized when a magnetic dipole performs a motion described by a differentiable function of time. That is, the motion of a magnetic dipole is described by a function that has two first time derivatives. A typical example of such motion is the harmonic oscillation of a dipole $\mathbf{m}(t) = \mathbf{m} \cdot \sin\omega t$,

for which both, E-field and H-field, exist since

$\dot{\mathbf{m}}(t) \neq \mathbf{0}$ and $\ddot{\mathbf{m}}(t) \neq \mathbf{0}$.

The same solution have problems in which oscillations of the magnetic moment are described by more complex formulas, if the spectrum of these oscillations can be decomposed into harmonic factors.

For harmonic oscillations at a considerable distance from the oscillating dipole, the second term in Eq(7), which depends on $\ddot{\mathbf{m}}$, is λ/R times smaller than the first term. (Where λ is the generated wave length, R is the distance from the dipole).

Therefore, it can be neglected.

As a result, we get that in this case fields E and H (Eq(2) and Eq(7)) of an electromagnetic wave are equal and only rotated relative to each other by 90 degrees.

1.1.2 Magnetic excitation of the ether

Other solutions of Eq(2) and Eq(7) are obtained if $\mathbf{m}(\mathbf{t})$ is a discontinuous function and it is described by an acute Heaviside step function. In this case, $\dot{\mathbf{m}} \neq 0$ since the derivative of the Heaviside step is δ function, but $\ddot{\mathbf{m}} = 0$ since δ function does not have a derivative. Therefore, in this case, a purely magnetic wave arises in which $H \neq 0$, but $E = 0$ [2].

More precisely, this ether excitation should be classified as a peculiar particle, since it is characterized by a very short time interval.

This particle appears at beta decay, in which a free electron carrying a large magnetic moment arises relativistically quickly.

Another example is the transformation of π meson into μ meson.

π meson does not have a magnetic moment, but μ meson does.

The uncertainty ratio makes it possible to estimate the time of transformation of π meson into μ meson:

$$\tau_{\pi \rightarrow \mu} \approx \frac{\hbar}{(M_{\pi} - M_{\mu})c^2} \approx 10^{-23} \text{sec} \quad (8)$$

Thus, the time dependence of the magnetic moment in this reaction has the form of a very sharp Heaviside step, which is zero

for negative arguments and one for positive ones. (At zero, this function requires additional definition. It is usually considered convenient to set it to zero equal to $1/2$):

$$He(t) = \begin{cases} 0 & \text{if } t < 0 \\ 1/2 & \text{if } t = 0 \\ 1 & \text{if } t > 0 \end{cases} \quad (9)$$

The unusual property that a magnetic photon \mathbf{m} should possess arises from the absence of magnetic monopoles in nature. The fact is that ordinary photons with an electrical component are scattered and absorbed in matter due to the presence of electrons in it. In the absence of magnetic monopoles, a low-energy magnetic photon should interact extremely weakly with matter. Its free path in the medium should be about twenty orders of magnitude (!) longer than that of ordinary photon.

In addition, being circularly polarized, a full-fledged photon with both a magnetic and an electric component has spin equals to \hbar . It seems natural to assume that a circularly polarized magnetic photon, devoid of an electrical component, should have spin equal to $\hbar/2$.

Thus, Maxwell's equations say that the escape of free electron during beta decay, which carries a large magnetic moment, should be accompanied by the emission of magnetic excitation.

It is similar to a photon, but has half the spin and weakly interacts with matter.

1.2 Neutrinos and antineutrinos

The instantaneous occurrence of a magnetic dipole moment occurs during beta decay (the reverse process is K-capture).

According to the electromagnetic model of neutrons, the spin of relativistic electron, which forms neutron together with proton, is zero [3], [4]. Therefore, the electron magnetic moment is unobservable. During the neutron beta decay, electron gains freedom, and with it the observed spin and magnetic moment. Given that escaping electron has a velocity close to the speed of light, this process should occur abruptly.

This generates a δ -shaped burst of the magnetic field, which is commonly called an antineutrino.

Since in the initial bound state (as part of neutron) the electron spin was zero [3], and in the final free state its spin is equal to $\hbar/2$, taking into account the law of conservation of angular momentum, the magnetic γ quantum should carry momentum equal to $-\hbar/2$.

Another realization of the magnetic γ quantum should occur during the reverse process - K-capture. In this process, electron,

which originally formed the atomic shell and possessed its own magnetic moment and spin, is captured by proton from nucleus and they forms neutron. This process can be described using the inverse Heaviside's function. In this process, a magnetic γ quantum of the reverse direction of the field relative to its propagation vector \mathbf{R} should arise. Such a "reverse" emission corresponds to neutrino in a K-capture reaction.

1.3 Mesons as excited states of an electron

It has been experimentally established that three neutrinos are born in the chain of transformations pion⁻ → muon⁻ → electron (one of them is antineutrino). That is, in this reaction, there are three resets of the energy that these particles carry away. The fact that no other products than neutrinos and antineutrinos occur in these reactions means that pion and muon are excited states of electron. This circumstance makes it possible to calculate their masses [2]-[4].

1.4 Discussion

The concept of neutrinos as magnetic excitations of the ether [2] explains all their basic properties:

- extremely weak interaction with matter is the result of the absence of magnetic monopoles in nature,
- the spin of neutrinos turns out to be equal to $\hbar/2$ due to the fact that they have only a magnetic component,
- the birth of neutrinos in beta decays is due to the abrupt occurrence of magnetic moments of particles being born,
- the existence of neutrinos and antineutrinos are explained by the presence of two types of Heaviside's steps.

Additionally, this concept opens a new page in the study of mesons by quantifying their masses.

2 Beta decay and neutrinos

2.1 About the nature of beta decay

The discovery of radioactive decay has raised the question for the physics community as to whether this phenomenon is completely accidental or is it causally determined?

Previously, science had never known anything like this. Before that, it was assumed that all natural phenomena should have their own cause.

The new physics of the early twentieth century gave the phenomenon of radioactive decay a quantum mechanical explanation.

N. Bohr and his associates believed that radioactive decay is a consequence of the quantum mechanical tunneling effect, and therefore decays occur completely by chance.

But the determinists, led by A. Einstein, categorically objected to this point of view.

However, the impeccable logic of the mathematical apparatus of quantum mechanics and the general beauty of the new approach have inclined the physics community to the side of anti-determinists.

Nowadays, quantum mechanics has become a basic tool for the theoretical study of the microcosm, and radioactive decay is considered by the physical community to be a purely accidental phenomenon.

Only occasionally did some scientists recall Einstein's categorical objections.

So in the 30s, N.Tesla suggested that determinists would be right if to assume that radioactive decay is caused by some kind of radiation, the nature of which is still unknown.

2.2 The discovery of E. Falkenberg

At the beginning of the 21st century, professor E.D. Falkenberg discovered that the solar neutrino flux affects the decay rate of tritium [5].

Later, this effect was repeatedly confirmed by different researchers on various beta isotopes [6], [7].

Somewhat later, it was proved that the beta decay rate increases under the influence of a stream of reactor neutrinos [8].

Since the total luminosity of the Sun is known, the solar neutrino flux can be calculated [9]:

$$\Phi_{\odot} \approx 6 \cdot 10^{10} \frac{\nu}{cm^2 \cdot s}. \quad (10)$$

How it follows from E.Falkenberg's experiment, solar neutrinos are superimposed on the cosmic neutrino flux, which is about two orders of value larger:

$$\Phi_{\star} \approx 6 \cdot 10^{12} \frac{\nu}{cm^2 \cdot s} \quad (11)$$

If, following Einstein and Tesla, we assume that beta decay is a forced phenomenon and its cause is the effect of a neutrino flux, then taking into account Eq(11), it follows from E.Falkenberg's measurements that the cross section of this reaction is approxi-

mately equal to

$$\sigma_{\star} \approx 4 \cdot 10^{-22} \text{ cm}^2 \quad (12)$$

Such a large cross-section for the neutrino-induced process should not cause confusion.

All other neutrino-induced processes are endo-energetic. They come at the expense of the energy that neutrinos transfer to other particles involved in the reaction.

The beta decay reaction discussed above is exo-energetic. Apparently, this is the only exo-energetic reaction induced by neutrinos. It comes at the expense of the decay energy of a neutron, whose mass is greater than the total rest mass of decay products - proton and electron. Neutrinos inducing this reaction only destroys the equilibrium in the energetically unstable proton+electron system [10] .

2.3 Measurements with reactor neutrinos

The advantage of reactor experiments is the controllability of their conditions.

During experiments on a pulsed reactor (IBR-2, Dubna), it was found that its neutrino flux Φ_r caused an increase in the beta decay rate in the source.

According to measurements [8], this impact had a cross-section [10]:

$$\sigma_r \approx 1.5 \cdot 10^{-22} \text{ cm}^2 \quad (13)$$

The value of this cross-section, accurate to experimental errors, can be considered consistent with the data obtained from Falkenberg measurements (Eq.12).

Thus, in full accordance with A. Einstein's foresight, experiments show that beta decay is a forced phenomenon. Its cause is the effect of the neutrino flux.

Therefore, the question arises, is it possible to protect the beta source from the neutrino flux falling on it?

2.4 Is it possible to shield from a neutrino flux?

As J.J.Thomson showed, the absorption or scattering of photons occurs on electric charges of a medium.

Neutrinos in matter propagate without loss of energy due to the fact that there are no magnetic monopoles in nature. However, a medium must have some effect on the neutrino flux without direct energy exchange.

The neutrino flux passing through a substance induces in it

a diamagnetic reaction, corresponding to its magnetic susceptibility [12].

The excitation of a diamagnetic reaction in a substance leads to the fact that the velocity of neutrino propagation in it becomes less than in a vacuum.¹

Since neutrinos do not carry any electric fields [2], they can be called clusters of purely magnetic energy. Therefore, for them, all substances, like a vacuum, have $\varepsilon = 1$, and electric polarization does not occur during their propagation in the medium.

2.4.1 Neutrinos in a granular medium

However, when entering a granular medium as a result of refraction, the neutrino flux must dissipate.

Although granules of a medium are completely transparent for neutrinos, each of granules will act like a small lens, since its refractive index is $n \neq 1$.

The refractive index of a substance for neutrinos is determined by its magnetic permeability:

$$n = \sqrt{\mu}, \tag{14}$$

¹It is similar to the flow of ordinary photons in a substance that is transparent to them, which has a refractive index other than unity.

which can be expressed through its magnetic susceptibility:

$$\mu = 1 + 4\pi\chi \quad (15)$$

All atomic substances have diamagnetic properties, since diamagnetism is the reaction of closed atomic electron shells to an externally applied magnetic field.

In the external magnetic field H , the closed electron shell precesses. The frequency of this precession

$$\omega = \frac{e}{2m_e c} H, \quad (16)$$

As a result of it, an atom having Z electron shells acquires a magnetic moment directed against the applied magnetic field.

So the diamagnetic susceptibility of the substance is equal to:

$$\chi \approx -\frac{NZe^2}{6m_e c^2} R_a^2. \quad (17)$$

Where N is the density of atoms,

R_a is the radius of the atom electron shell.

2.4.2 Neutrino shielding by granular medium

Thus, all substances for neutrinos are completely transparent, but in them the refractive index for neutrinos is slightly less than unity.

As a result of the random nature of scattering in a granular medium, the neutrino trajectory should become "entangled".

The motion of neutrinos in a granular medium with a refractive index other than unity should resemble the wandering of a drunken sailor from the famous Brownian motion problem.

At a weak scattering, the intensity of the scattered radiation, as well as its absorption, is determined by Booger's law:

$$I = I_o e^{-\frac{L}{f}} \approx I_o \left(1 - \frac{L}{f}\right). \quad (18)$$

Where L is the thickness of the scattering layer,

I_o and I are the intensity of the incident and transmitted radiation,

f is the focal length of the scattering lenses:

$$f \approx \frac{r}{1 - n}, \quad (19)$$

where r is the radius of lens, which can be considered equal to the radius of the powder-diffuser granule, if, for simplicity, the granule is considered spherical.

3 Iron powder as a neutrino flux dif- fuser

When experimenting with iron powder, we will take into account its basic physical properties:

$R_{aFe} \approx 1.2 \cdot 10^{-8} cm$, is the radius of atomic shells,

$N_{Fe} = 8.5 \cdot 10^{22} atom/cm^3$ is the density of atoms,

$Z = 26$ is the charge number.

As a result the diamagnetic susceptibility of electron shells of iron atoms is equal:

$$\chi_{Fe} \approx -1.5 \cdot 10^{-5}. \quad (20)$$

That is, for neutrinos, the refractive index of iron should differ from vacuum by a small amount:

$$1 - n_{Fe} \approx 10^{-4}. \quad (21)$$

If we use iron powder with a granule size of $r \approx 4 \cdot 10^{-2} cm$ (40 Mesh), then neutrino scattering on a powder layer with a thickness of $L \approx 5 cm$ should lead to a decrease in their flux by about:

$$\left[\frac{L}{f} \right]_{Fe} \approx 10^{-2}. \quad (22)$$

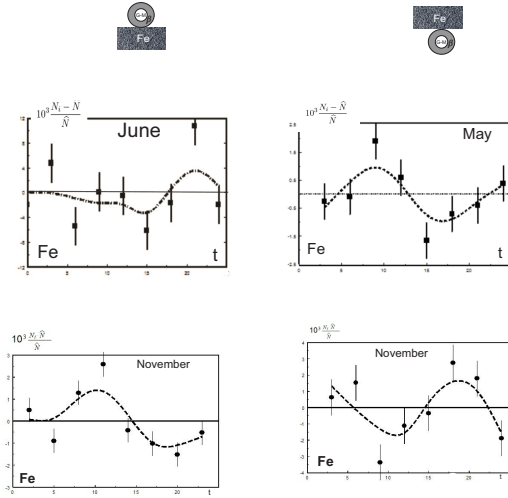


Figure 1: The measured effect of a powdered iron screen on the beta decay rate. On the left, the powder screen is placed under the Geiger-Muller counter. On the right, the screen is located above the counter. The time in hours is plotted on the abscissa axis, and the relative deviation of the measured value multiplied by $10^3 \frac{N_i - \hat{N}}{\hat{N}}$ is plotted on the ordinate axis; N_i is the result of a specific measurement, \hat{N} is the average bill for the entire cycle.

3.0.3 Measurement results of neutrino passage through iron powder

The effect of the iron powder screen on the beta decay rate was measured in two positions.

In the first position (as it is shown in the upper part of Fig.1 on the left), the powder screen was placed at the bottom, and a Geiger-Muller counter was located on top of it (in Fig.1 is designated as G-M) with a beta source.

In an another position (as it is shown in the upper part of Fig.1 on the right), the powder screen was placed above the Geiger-Muller counter.

The measurements were carried out twice - in November-December, the Sun for an earthly observer moves from the constellation of Scorpio to the constellation of Sagittarius. At this time, the galactic center, the Sun and the Earth align on the same line, and the neutrino flux generated by the center of our Galaxy falls to the Earth, passing the Sun.

The next measurement was carried out six months later, in May-June. At this time, the Earth, due to its rotation around the Sun, again finds itself on the line between the center of the Galaxy and the Sun. At this time, the neutrino flux generated by the Galactic center falls to Earth from the side opposite to

the Sun.

In November-December, the neutrino flux coming from the galactic center, falls on the Earth laboratory from above during the day, and at night, passing through the Earth, from below.

Six months later, the situation reverses.

Since the beta decay rate is determined by the value of the neutrino flux incident on the source, a change in this rate was observed during the day.

Experience has shown that the beta decay rate does indeed change in accordance with the assumption that the main source of the neutrino flux falling on Earth is located in the central region of our Galaxy, and the effect of powdered iron with an accuracy of two approximately corresponds to the calculated estimate.

In addition to the measured effect of the iron powder screen, similar measurements were made with the dry cement powder screen.

This choice was due to the hope of creating a more efficient screen due to the fact that the grains of cement powder are an order of a value smaller than the grains of iron powder and an order of magnitude larger volume of cement is readily available.

The measurements showed that, in general, the cement pow-

der screen has almost the same effect on the beta source as the iron powder screen, despite the fact that the thickness of the cement screen was almost an order of magnitude greater.

4 About the solar eclipse of the neutrino flux generated in the central region of the Galaxy

4.1 Attenuation of the neutrino flux by the Sun

As J.J. Thomson showed, photons carrying rapidly changing electric and magnetic fields are scattered and absorbed in matter due to the presence of electrons in it. Electrons are accelerated by the electric field of photons, which leads to their scattering or absorption.

Neutrinos, which can be called magnetic photons or magnetic gamma quanta, carry only a rapidly changing magnetic field [2]. Due to the absence of magnetic monopoles in nature, such magnetic photon, which has no electrical component, must be extremely poorly absorbed by matter [11]. Therefore, all

bodies will be transparent for neutrinos. In this case, the Sun, when passing through a stream of neutrinos, will act on it like a transparent lens.

This interaction of neutrinos with the Sun should depend on the refractive index of the neutrino flux in the solar matter (Fig.2).

Usually the refractive index of a substance depends on its dielectric constant ε and magnetic permeability μ :

$$n = (\varepsilon\mu)^{1/2}. \quad (23)$$

Since neutrinos do not carry an electric field strength, they can be called clusters of purely magnetic energy. Therefore, the electrical polarization of the medium does not occur during their propagation. With respect to the neutrino flux, any medium, like a vacuum, has a dielectric constant of $\varepsilon = 1$.

Therefore, the refractive index of any substance for neutrinos is determined by its magnetic permeability:

$$n = \mu^{1/2} \quad (24)$$

The magnetic permeability of a substance μ can be expressed through its magnetic susceptibility χ :

$$\mu = 1 + 4\pi\chi \quad (25)$$

Parameters of plasma that makes up the Sun - particle density and temperature - decrease with increasing distance from the center.

An approximate estimate of the diamagnetic susceptibility of solar plasma can be obtained by entering the average density of particles in the Sun and its average temperature, which can be calculated based on their radial dependencies:

$$\chi_{\odot} \approx -10^{-5}. \quad (26)$$

Taking into account Eq.(24) and Eq.(25), we obtain that the refractive index of the solar plasma n_{\odot} differs little from unity:

$$\delta_{\odot} = 1 - n_{\odot} \simeq 10^{-4}. \quad (27)$$

Thus, the Sun, acting on the neutrino flux as a spherical lens (Fig.3), has an imaginary focal length depending on its diameter d_{\odot} :

$$F_{\odot} = \frac{d_{\odot}}{2} \frac{n_{\odot}}{2\delta_{\odot}} \approx 3 \cdot 10^{14} \text{ cm} \quad (28)$$

The radius of the Earth's orbit

$$R_{orb} \approx 1.5 \cdot 10^{13} \text{ cm}. \quad (29)$$

It is small compared to the imaginary focal length of the Sun F_{\odot} .

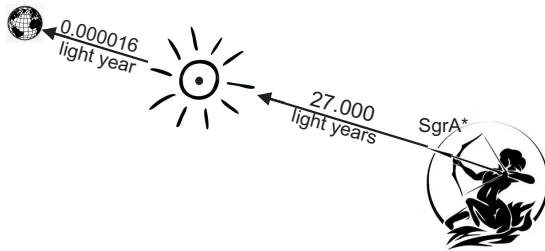


Figure 2: On December 22, the center of our Galaxy located in the constellation Sagittarius, the Sun and the Earth are aligned in a straight line.

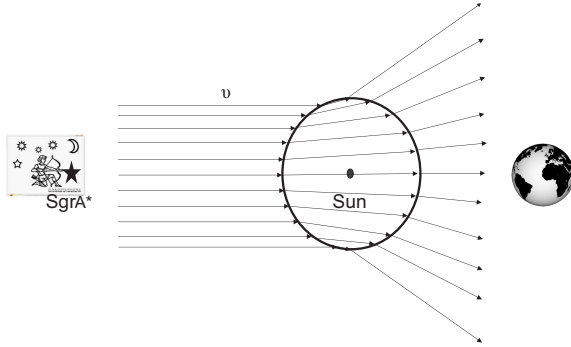


Figure 3: On December 22, the Sun dissipates the neutrino flux generated by the SgrA* quasar.

Therefore, the neutrino flux lensed by the Sun falling on the Earth Φ_{\odot} should decrease compared to the non-lensed flux Φ_0 :

$$\frac{\Phi_{\odot}}{\Phi_0} \approx \left(\frac{F_{\odot} - R_{orb}}{F_{\odot}} \right)^2 \approx \frac{9}{10} \quad (30)$$

4.2 Duration of the eclipse of the constellation Sagittarius by the Sun

The Sun, during its apparent movement through the zodiacal constellations, passes from the constellation of Scorpio to the

constellation of Sagittarius at the end of December at the speed:

$$V_{\odot} = \frac{2\pi \cdot R_{orb}}{365} \quad \frac{cm}{day} \quad (31)$$

During this movement, the Sun will shift by its own diameter d_{\odot} during

$$t_{\odot} = \frac{d_{\odot}}{V_{\odot}} \approx 0.6 \text{ day} \quad (32)$$

That is, the eclipse of the cosmic neutrino flux by the Sun should last more than half a day.

5 Solar Eclipse observation

The fact that the center of the Milky Way is located on the celestial sphere inside the zodiac constellation is a happy case, because makes it possible to observe the eclipse of the neutrino source by the Sun and detect the effect of a global deceleration of the beta decay rate.

Measurement errors in this experiment are small.

Point spreads on the chart are determined by the stochasticity of the neutrino flux emitted by the galactic center.

For the first time, the effect of an eclipse of the center of our Galaxy by the Sun was observed in 2024.

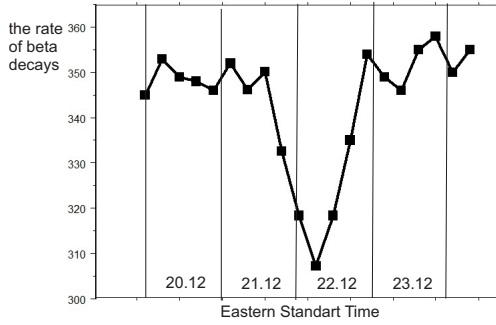


Figure 4: The Sun acts on the neutrino flux like a spherical scattering lens. As a result, the neutrino flux created by the SgrA* quasar dissipates, and on December 22, the beta decay rate on the Earth decreases globally for several hours. Here the time expressed as the Eastern Standard Time (EST) is plotted along the abscissa axis. The recorded rate of beta decays (relative units) is plotted along the ordinate axis.

A year later, in December 2025, this measurement was carried out again with a slightly better setting. The total result of these measurements is shown in Fig.4.

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How Does the Galactic Center Affect the Earth?