ON THE ABSORPTION OF NEUTRINOS IN COSMIC SPACE

(Letter to the Editor)

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(Received 6 January, 1975)

The current progress of physical sciences converges to a conclusion that the main constituent of Cosmos is a certain kind of matter usually called the 'physical vacuum'. The quantum electrodynamics considers vacuum as material substance influencing the behaviour of elementary particles. A specific concept of vacuum is used in relativistic quantum theories.

In the fundamental field theory (FFT) (Gerlovin, 1973) dealing with a definite structure of vacuum the concept of vacuum assumes a new aspect. It enables us to explain the properties of gravitational field standing on a unique point of view (Krat and Gerlovin, 1974). The vacuum structure consisting of an enormous sample (about 10^{39} cm^{-3}) of elementary vacuum particles (EVP) can be directly observed only in the process of vacuum excitation. The structure of each EVP is smaller than the Schwarzschild sphere, and so these particles can be considered to constitute 'black holes'. A pair of annihilating antiparticles (proton-antiproton, electron-positron, etc.) disappears in the macro-space forming an EVP; however, it really exists in their proper subspace. In one and the same volume of macrospace there exist EVP's of all kinds (9 types of vacuum) penetrating into one another. The first (proton-antiproton) vacuum consists of the heaviest particles. The EVP of the vacuum type 3, 4 and others can form only virtual pairs and do not produce 'normal' particles in macrospace.

A neutrino, like any elementary particle, can be absorbed, forming a light quantum. On the basis of the FFT we can derive the mean life-time (τ) of a neutrino moving in free vacuum to be

$$\tau \approx \frac{\lambda_n - \lambda_1}{2\pi c(1 - \beta_n^2)^{1/2}} + \frac{\lambda_2 - \lambda_1}{2\pi c(1 - \beta_2^2)^{3/2}}, \tag{1}$$

where λ_n is the wavelength corresponding to the proper frequency of vacuum of the considered type; β_n, the relative velocity of subparticles in the proper space (Gerlovin, 1973); and c, the velocity of light.

In the FFT the absorption of a neutrino will be accompanied by propagation of vacuum excitation – i.e., by light. The radiation will be emitted not only at the proper frequency but also at all the harmonics multiple to it. The condition for absorption is

$$\lambda_n > \frac{2hc}{U_n} \tag{2}$$

(U_n being the energy of neutrino). If

$$U_n > \frac{2hc}{\lambda_n}, \tag{3}$$

the energy of a neutrino will be absorbed by the vacuum of higher rank having greater λ_n. In Table I λ_n in centimeters and the approximate mean free path ($\mathscr{L}_n$) of neutrino are given. The approximate limits of $\mathscr{L}_n$ are given in connection with the probable τ.

TABLE I

No. of vacuum	λ_n (cm)	$\mathscr{L}_n$ (cm)
1	1.40×10^{-13}	–
2	2.58×10^{-10}	10^3–10^4
3	8.70×10^{-10}	10^3–10^4
4	3.70×10^{-9}	10^3–10^4
5	3.15×10^{-8}	10^3–10^4
6	1.07×10^{-6}	10^3–10^4
7	6.32×10^{-6}	10^3–10^4
8	0.370	10^{12}–10^{13}
9	1.59×10^3	10^{19}–10^{20}

It must be emphasized that only a part of energy equal to the energy of resonance is really absorbed. A neutrino itself does not disappear and continues its motion with the reduced energy smaller than U_n. It will contact with vacuum particles of the order of $n+1$ whereas the process of absorption will be repeated once more. At least the absorption process will reach the particles of the 9th vacuum. What will afterwards occur to the neutrinos of exceedingly small energy is not predicted now by the theory. The existence of these particles cannot be verified by the experiment at present.

We see that all 'hard' neutrinos will be absorbed at small distances not exceeding 10^5 cm. On the Earth, solar neutrinos transmitted only by the 8th and 9th vacuums, having the energies less than 10^{-7} eV, can be observed. No neutrinos with the energies larger than 10^{-7} eV can reach us from stars and galaxies.

We can mention here that there must exist a 'background' cosmic radiation in lines situated in the radio diapason of radiation. The predicted emission lines can be observed with large radio telescopes if there is a considerable flux of neutrinos produced by the nuclear reactions in stars. The lines and their multiple harmonics can considerably contribute to the so-called 'relict radiation'.

References

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