Role of Earth's Rotation in Experiments to Detect Neutrino Mass

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In the paper it is shown that the influence of the Earth's rotation is a major factor for improving the estimation of neutrino mass.
Keywords: (neutrino, Earth's rotation, and cosmology)

The lower limit of mass of the electron neutrino is m < 10 eV [1]. As will be shown below, the major factor hindering the further improvement of this estimate is the rotation of the Earth. To take into account the angular momentum communicated by the Neutrino Sea to a target moving through the Galaxy together with the Earth [2], sophisticated experiments with scattering on polarized targets are necessary [1]. On the other hand, the influence of the angular momentum of the Earth's rotation can be considered with the uncertainty relation for conjugated dynamic variables of the type "angular momentum - angle":

$$\Delta L \cdot \Delta j \geq \hbar$$

where

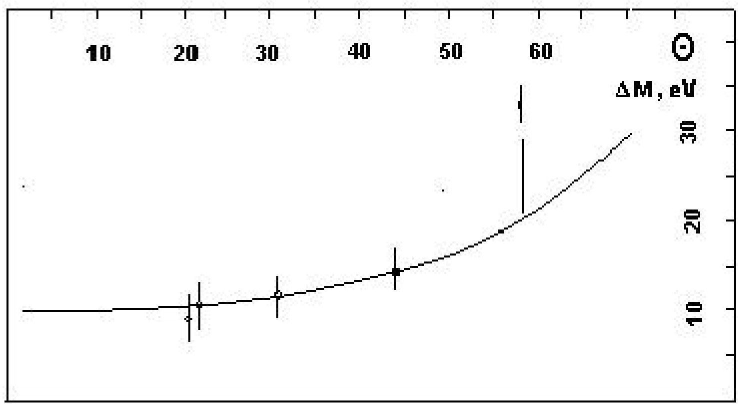

Fig. 1 The latitude dependences of limitation of the neutrino mass following from the uncertainty relation according to the angular momentum of the Earth's rotation and experimental data.

$$\Delta L = \Delta m \cdot V_E \cdot R_E \cdot \cos\Theta$$

is the uncertainty in the angular momentum and mass of the particles, and Θ is the latitude of the site where experiment is carried out. It would appear natural to take a part of the neutrino angle of the lepton anisotropy equal to that of the electron

$$\Theta_e \cong 1'$$

$$\Delta\Theta_e \approx \Theta_e \cdot 10^{-5}$$

as a measure of angular uncertainty.

Taking this into consideration, we can find the contribution of the Earth's rotation

$$\Delta m_n \geq \frac{\hbar}{v_E \cdot R_E^2 \cdot \cos\Theta \cdot \Delta\Theta_e}$$

as compared with the data for masses of neutrino measured in dependence of latitude of laboratory Θ (see Fig.1). It follows from the figure that all data are fully compatible with the latitude dependence given and hence with the lepton anisotropy [3]. The data of the Institute of Theoretical and Experimental Physics (Moscow, 57° of latitude) equal to 33 eV are extrapolated to 18 eV in accordance with the result of processing (see [1]).

What this means is, first, that the major uncertainty in measurements of neutrino mass is contributed by the angular momentum of the Earth's rotation, and, second, there exist a possibility of real measurement of the lepton anisotropy relative to the vacuum vector $\mathbf{A}_{\mathbf{gc}}$ [3] equivalent to the cosmological vector **?** $_{\mathbf{g}}$ [4] introduced by Yu.A.Baurov.

References

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