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Tunneling away the relic neutrino asymmetry

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The Earth acts as a matter potential for relic neutrinos which modifies their index of refraction from vacuum by $\delta \sim 10^{-8}$. It has been argued that the refractive effects from this potential should lead to a large $\mathcal{O}(\sqrt{\delta})$ neutrino-antineutrino asymmetry at the surface of the Earth. This result was computed by treating the Earth as flat. In this talk, I revisit this calculation in the context of a perfectly spherical Earth. I demonstrate, both numerically and through analytic arguments, that the flat-Earth result is only recovered under the condition $\delta^{3/2} kR \gg 1$, where k is the typical momentum of the relic neutrinos and R is the radius of the Earth. This condition is required to prevent antineutrinos from tunneling into classically inaccessible trajectories below the Earth's surface and washing away the large asymmetry. As the physical parameters of the Earth do not satisfy this condition, I find that the asymmetry at the surface should only be $\mathcal{O}(\delta)$. While the asphericity of the Earth may serve as a loophole to my conclusions, I argue that it is still difficult to generate a large asymmetry even in the presence of local terrain.

Mini Symposia (Invited Talks Only)

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