Contribution ID: **313** Type: **Talk**

Neutrino flavor oscillations in a rotating spacetime

Wednesday 14 December 2022 12:00 (15 minutes)

We study neutrino oscillations in a rotating spacetime under the weak gravity limit for the trajectories of neutrinos which are constrained in the equatorial plane. Using the asymptotic form of the Kerr metric, we show that the rotation of the gravitational source non-trivially modifies the neutrino phase. We find that the oscillation probabilities deviate significantly from the corresponding results in the Schwarzschild spacetime when neutrinos are produced near the black hole (still in the weak-gravity limit) with non-zero angular momentum and detected on the same side, i.e., the non-lensed neutrino. Moreover, for a given gravitational body and geometric parameters, there exists a distance scale for every energy scale (and vice versa), after which the rotational contribution in the neutrino phase becomes significant.
Using the sun-sized gravitational body in the numerical analysis of the one-sided neutrino propagation, we show that even a small rotation of the gravitational object can significantly change the survival or appearance events of a neutrino flavor registered by the detector, which is located on the earth. These effects are expected to be prominent for cosmological/astrophysical scenarios where neutrinos travel past by many (rotating) gravitational bodies and for large distances. Thus rotational effects of all such bodies must be incorporated in analyzing oscillations data.

Session

Neutrino Physics

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Session Classification: WG7 - Neutrino Physics