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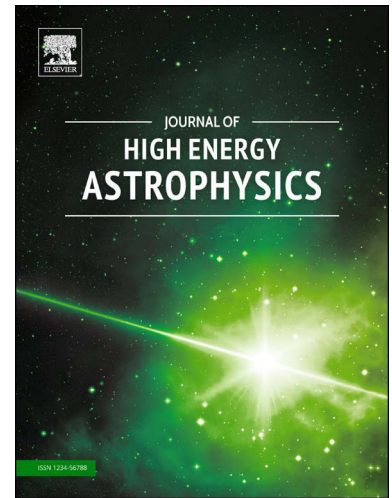
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Propagation of GeV neutrinos through Earth

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Abstract

We have studied the Earth matter effect on the oscillation of upward going GeV neutrinos by taking into account the three active neutrino flavors. For neutrino energy in the range 3 to 12 GeV we observed three distinct resonant peaks for the oscillation process $\nu_e \leftrightarrow \nu_{\mu,\tau}$ in three *distinct* densities. However, according to the most realistic density profile of the Earth, the second peak at neutrino energy 6.18 GeV corresponding to the density 6.6 g/cm^3 does not exist. So the resonance at this energy can not be of MSW-type. For the calculation of observed flux of these GeV neutrinos on Earth, we considered two different flux ratios at the source, the standard scenario with the flux ratio 1 : 2 : 0 and the muon damped scenario with 0 : 1 : 0. It is observed that at the detector while the standard scenario gives the observed flux ratio 1 : 1 : 1, the muon damped scenario has a different ratio. For muon damped case with $E_\nu < 20 \text{ GeV}$, we always get observed neutrino fluxes as $\Phi_{\nu_e} < \Phi_{\nu_\mu} \simeq \Phi_{\nu_\tau}$ and for $E_\nu > 20 \text{ GeV}$, we get the average $\Phi_{\nu_e} \sim 0$ and $\Phi_{\nu_\mu} \simeq \Phi_{\nu_\tau} \simeq 0.45$. The upcoming PINGU will be able to shed more light on the nature of the resonance in these GeV neutrinos and hopefully will also be able to discriminate among different processes of neutrino production at the source in GeV energy range.

Keywords: Neutrino, IceCube, PINGU

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