

Neutrino Flavor Ratios Modified by Cosmic Ray Secondary-acceleration

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Acceleration of ν_e and ν_μ modifies the flavor ratio at Earth (at astrophysical sources) of neutrinos produced by pion decay, $\nu_e : \nu_\mu : \nu_\tau$, from $1 : 1 : 1$ ($1 : 2 : 0$) to $1 : 1.8 : 1.8$ ($0 : 1 : 0$) at high energy, because pions decay more than muons during secondary-acceleration. The neutrino spectrum accompanies a flat excess, differently from the case of energy losses. With the flavor spectra, we can probe timescales of cosmic-ray acceleration and shock dynamics. We obtain general solutions of convection-diffusion equations and apply to gamma-ray bursts, which may have the flavor modification at around PeV - EeV detectable by IceCube and next-generation experiments.

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