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Determinations of flavor ratios and flavor transitions of astrophysical neutrinos

We argue that effective flavor discrimination in neutrino telescopes is the key to probe the flavor ratios of astrophysical neutrinos at the source [1,3] and flavor transition mechanisms [2] of these neutrinos during their propagations from the source to the Earth. We first discuss how well one can reconstruct the flavor ratios of astrophysical neutrinos at the source, given achievable efficiencies of neutrino telescopes in flavor discriminations and expected understandings of neutrino mixing parameters in the future. It will be shown that the signatures for tau neutrinos are energy dependent, hence the methods for flavor reconstruction depend on neutrino energies as well. We then discuss how to probe flavor transition mechanisms of propagating astrophysical neutrinos. In this regard, we propose a model independent parametrization for neutrino flavor transitions, with the neutrino oscillation as a special case. We illustrate how one can determine parameters of this parameterization by neutrino telescope measurements. The situation with non-conservation of neutrino flux during neutrino propagations (such as that caused by neutrino decays) is also discussed.

Refs.: [1] T. C. Liu, M. A. Huang and G. L. Lin, arXiv: 1004.5154. [2] K. C. Lai, G. L. Lin and T. C. Liu, arXiv: 1004.1583. [3] K. C. Lai, G. L. Lin and T. C. Liu, Phys. Rev. D80, 103005 (2009).

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