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New Physics with Atmospheric and Astrophysical Neutrinos

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In this talk I will use data from the IceCube Neutrino Observatory to search for effects of new physics in two contexts. First, using atmospheric neutrinos, I looked for evidence of a sterile neutrino by looking for deviations in atmospheric muon neutrino spectrum as a function of zenith angle and energy. Such a sterile neutrino, motivated by the anomalies in short-baseline experiments, is expected to have a significant effect on the $\bar{\nu_\mu}$ survival probability due to matter induced resonant effects for energies of order 1 TeV. This effect makes the search uniquely sensitive to small sterile mixings. No significant evidence for an eV-sterile neutrino is found and strong limits are put on the mixing angle which improve previous bounds by more than an order of magnitude. Second, using astrophysical neutrinos, I studied the effects of new physics on the astrophysical flavor ratio. In order to do so, a model independent parametrization of new physics was constructed. Using this parametrization, we explore the allowed new physics parameter space. We find that large deviations from the standard (1:1:1) flavor ratio expectation can be found but the impact of new physics is reduced in pion production scenarios.