

CSU PHYSICS COLLOQUIUM

“Seeking New Physics at Neutrino Oscillation Experiments”

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Thursday January 13th at 4:00pm

120 Engineering (Hammond Auditorium)

Abstract

One of the most important achievements in the field of particle physics was the discovery of neutrino oscillations. Despite already awarded Nobel Prize, neutrino oscillation experiments still have a lot to offer, primarily the discovery of CP violation in the lepton sector is anticipated. In addition to solving the remaining puzzles in the standard three-neutrino framework, neutrino experiments are also sensitive to new physics effects that could appear in the process of neutrino production, propagation and/or detection. After reviewing the basics of neutrino oscillations I will discuss a novel class of new physics realisations, testable already at present-day acceleration based experiments such as NOvA and T2K. This is based on the fact that neutrino mixing parameters at the scale of neutrino production and detection do not necessarily need to coincide since such parameters are subject to renormalization group evolution and the two processes occur at different energies. I will discuss this in the frame of a particular UV complete model. The second part of the colloquium is dedicated to the MiniBooNE experiment that has been recording an anomalous excess of electron-like events for over a decade, suggesting non-standard oscillation features at very short, kilometre-scale, baseline. The leading explanation for this observation features the introduction of eV-scale sterile neutrino that is capable of inducing neutrino flavour change across short baselines. I will first critically examine a number of theoretical uncertainties affecting the MiniBooNE event prediction, focusing on charged current quasielastic events, events from neutral pion decay and single-photon events from decays of heavy resonances. Finally, I will show how the aforementioned uncertainties affect the fit of a sterile neutrino scenario as well as refer to the alternative models for MiniBooNE.