

Individual Neutrino Masses From a Supernova

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A nearby supernova will carry an unprecedented wealth of information about astrophysics, nuclear physics, and particle physics. Because supernova are fundamentally neutrino driven phenomenon, our knowledge about neutrinos – particles that remain quite elusive – will increase dramatically with such a detection. One of the biggest open questions in particle physics is related to the masses of neutrinos. Here we show how a galactic supernova provides information about the masses of each of the three mass eigenstates individually, at some precision, and is well probed at JUNO. This information comes from several effects including time delay and the physics within the supernova. The time delay feature is strongest during a sharp change in the flux such as the neutronization burst; additional information may also come from a QCD phase transition in the supernova or if the supernova forms a black hole. We consider both standard cases as dictated by local oscillation experiments as well as new physics motivated scenarios where neutrino masses may differ across the galaxy.

Presenter: Dr DENTON, Peter (Brookhaven National Laboratory)

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