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The detectability of fast time oscillations in supernova neutrino flux and energy in DUNE (Deep Underground Neutrino Experiment)[1]

ARYIL BECHTEL, KATE SCHOLBERG, Duke University — During a type II core collapse supernova, initial perturbations in infalling matter can lead to intense turbulence and sloshing of the shock front, a phenomenon dubbed "Standing Accretion Shock Instability" (SASI). SASI could play an important role in the reignition of the shock wave, a poorly understood process that leads to the expulsion of the star's outer shell. It has been shown that the sloshing motions of SASI would cause time-dependent oscillations in neutrino number flux and neutrino energy emitted from the supernova. These oscillations may be measurable by neutrino detectors on earth. Understanding our current prospects of measuring SASI can help us improve our detection abilities in anticipation of a type II event. In this study, we seek to examine what analysis techniques, detector parameters, and event conditions could increase the prospect of observing SASI with the upcoming DUNE 40 kiloton liquid argon detector. We used SNoWGLoBES software and a simulation of a 27 solar-mass progenitor to model what the detector will measure. A likelihood ratio in the frequency domain was used as a SASI detection indicator for neutrino fluxes at different distances. Using results across many shot-noised time series, we found that SASI activity can be identified in around 90 percent of the cases with about 10 percent false identification rate for supernovae within 4 kpc. We are currently researching ways to incorporate neutrino energy oscillations into a likelihood ratio test as well as comparing results to other simulated supernova models.

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