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Quantifying Liquid Argon Neutrino Detector Sensitivity to Supernova Burst Neutrinos

We produced figures of merit that show how many neutrinos can be detected for supernovae as a function of distance and compactness. Compactness is the ratio of the mass contained within the radius of the progenitor at the time of core bounce as defined by O'Connor and Ott (2011). This was used to quantify the sensitivity of a 40-kiloton liquid argon detector to core-collapse supernovae. We calculated neutrino event rates for a range of compactnesses. Compiling the results of the neutrino fluxes with a probability distribution of supernovae with respect to compactness and a probability distribution of supernovae with respect to distance allows the generation of useful data visualizations. Specifically, it produces a histogram that shows the number of neutrinos likely to be detected as well as the probability of seeing core-collapse supernovae as a function of both compactness and distance. With these histograms, we are able to determine how many models can be observed given a neutrino event threshold for this type of detector. These methods can be repeated for other types of detectors in the future.

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