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Measuring the ^{40}Ar(n,p)^{40}Cl cross-section above 15 MeV for future liquid Argon neutrino detectors

Next generation neutrino experiments, such as the Long-Baseline Neutrino Experiment (LBNE), will build liquid Argon time projection chambers (LAr TPCs) deep underground in order to enhance the feasibility of detecting neutrinos coming from a supernova burst within our galaxy. A supernova burst (SNB) at 10 kpc from Earth would produce roughly 1000 neutrino interactions inside a 10 kton LAr TPC. Most of the signal is expected to occur via the charged-current interaction of electron-neutrinos with 40Ar, emitting an outgoing electron and gammas accompanying the decay of 40K*. With respect to the outgoing particles and deposited energy, the signal produced from such an interaction is almost identical to the background produced by fast neutrons (> 6.9 MeV) undergoing the 40Ar(n,p)40Cl reaction. Currently, the only available experimental data for the 40Ar(n,p)40Cl cross-section exists between 9-15 MeV. The lack of data above 15 MeV results in a large uncertainty in the background estimations for SNB neutrino detection. The CAPTAIN collaboration proposes to measure this cross-section as a function of energy up to 65 MeV by exposing samples of Argon in a neutron beam at the Crocker Nuclear Laboratory 76-inch cyclotron.

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