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Fine tuning QRPA calculations for ν_e - ^{40}Ar cross section

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Converting an observed neutrino flux into a luminosity requires knowledge of the neutrino-nucleus cross sections for the detector material. For any nearby supernova, astronomical observations will yield distances measured up to 10% or better. The same level of accuracy for the neutrino-nucleus cross sections is required to prevent the neutrino-nucleus uncertainty from dominating the uncertainty on the supernova's luminosity. The liquid argon detector is the preferred technology choice for large-mass future neutrino experiments as, for example, in the DUNE experiment. The most relevant cross section for LArTPC detectors of DUNE, is coming from the charged-current reaction $^{40}\text{Ar}(\nu_e, e^-) ^{40}\text{K}^*$ in the 10-100 MeV ν -energy range, and it has never been experimentally measured. A recent work to study the impact of cross-section uncertainties on supernova neutrino spectral parameter fitting in the Deep Underground Neutrino Experiment, employed several theoretical ν_e - ^{40}Ar (PHYSICAL REVIEW D 107, 112012 (2023)). We performed a fine tuning in some weak observables in ^{40}Ar to constrain the theoretical ν_e - ^{40}Ar cross section, using weak available experimental data, such as beta decay and electron capture rates in very low energy region up to 20 MeV, and with exclusive and inclusive muon capture rates in the region close to 100 MeV. Our conclusions reveal that although ν_e -A cross sections with QRPA calculations shown to be closer, the number particle projected procedure is necessary from the point of view of nuclear structure to ensure that other weak observables to be consistent.

Altas energias

Author: Dr R. SAMANA, Arturo (UESC)

Presenter: Dr R. SAMANA, Arturo (UESC)

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