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Detecting Charged-Current Neutrino-Nucleus Interactions on Oxygen in a Heavy-Water Cherenkov Detector

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At Oak Ridge National Laboratory (ORNL), the COHERENT collaboration has built a heavy-water Cherenkov detector to measure the neutrino flux coming from the Spallation Neutron Source (SNS) via the scattering of neutrinos on deuterium nuclei, with the primary aim of improving the precision of past and future CEvNS measurements. The detector was fully completed and began taking measurements in the summer of 2023. Although this heavy-water Cherenkov detector was built primarily to measure the SNS neutrino flux, it can also be used to measure the cross section of neutrino-nucleus charged-current interactions on ^{16}O nuclei. Charged-current $^{16}\mathrm{O}(\nu_e, e^-)\mathrm{X}$ reactions produce e^- that will emit Cherenkov radiation within the detector. The SNS is the most powerful pulsed source of accelerator-based neutrinos in the world, which also happens to produce ν_e in a similar energy range to supernova neutrinos. Thus the measurement of this charged-current neutrino reaction in oxygen has implications for supernova neutrino detection. This neutrino-oxygen interaction has also never been experimentally measured, and thus its measurement can be a test of nuclear models. This presentation describes methodology for detecting and measuring the cross section and event rate of this charged-current interaction between ν_e and ^{16}O nuclei.

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