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CEvNS Detection via 12C Recoils in Large Scale Liquid Scintillation Detectors - Prospects, R&D and Challenges -

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In the coming year, two next-generation neutrino detectors, JUNO and JUNO-TAO, will start taking data. These neutrino observatories will realize unprecedented energy resolution and linearity in the field of liquid scintillator technology. Both detectors have a very broad physics
program, with a focus on the precise spectroscopy of reactor anti-electron neutrinos via the inverse beta decay of a proton in their scintillating target media based on hydrocarbon compounds. A successful observation of CEvNS from carbon nuclei in JUNO would open a new detection channel for the experiment's supernova and atmospheric neutrino studies. Nevertheless, the detection of recoils on 12C nuclei is very challenging due to the low energy transfer and the high scintillation quenching of these heavy ions. In order to better evaluate this potential with neutron induced 12C recoils two beamlines at the INFN-LNL accelerator complex in Legnaro (Italy) were modified and equipped with dedicated targets in such a way that both quasi-monoenergetic neutrons up to 4 MeV and neutrons with a broad spectrum up to approx. 100 MeV can be generated for the irradiation of scintillator samples. Detailed studies of the typical quenching factors as well as the pulse shape of proton recoils in liquid scintillators have already been carried out in several beamtimes. While the available data sets for the detection media of JUNO and JUNO-Tao are currently being analyzed for indications of visible 12C recoils, the used detectors are being upgraded to allow lower energy thresholds and fixed neutron scattering angles. Within this talk we review the status of these facilities for the study of nuclear recoils in detectors, the yet available data and the potential and challenges for enriching the detection channels in large-scale LS detectors with CEvNS.

Author: Dr STEIGER, Hans Theodor Josef (Physics Department, Technical University of Munich)

Presenter: Dr STEIGER, Hans Theodor Josef (Physics Department, Technical University of Munich)

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