Contribution ID: **431** Type: **Poster**

Toward Accurate Prediction of Neutron Multiplicity Associated with Neutrino Interactions

Wednesday 30 August 2023 15:34 (1 minute)

The importance of predicting neutron multiplicity associated with neutrino interactions has increased. This study focuses on residual nuclear deexcitation, which contributes to neutron multiplicity, and aims to accurately predict this process.
Liquid scintillator (LS) detectors such as KamLAND can detect ˜100% of 2.2 MeV gamma rays emitted by neutron capture. They are suitable to observe inverse beta decay. This is useful in searching supernova relic neutrinos (SRN), because atmospheric neutrinos, serious backgrounds, can be reduced by requiring the presence of a neutron. Super-Kamiokande (SK), a water Cherenkov (WC) detector, is improving detection efficiency by dissolving Gd. As well as LS detectors, neutron multiplicity is a hot topic.
However, prediction is very challenging because of complex nuclear effects. Furthermore, existing neutrino interaction simulators usually do not describe residual nuclei's deexcitation. Neutrino knockout nucleons in the nucleus leaving it often with high excitation energies. The nuclei often emit neutrons in going to the ground state. A prediction with a nuclear reaction simulator, TALYS, has been started. A recent comparison with observed data was available KamLAND data[1]. Since its uncertainty was large, it needs to be improved for future experiments. Various studies are ongoing: oxygen targets for WC detectors and implementation in neutrino interaction simulators.
[1] S. Abe et al., Phys. Rev. D 107, 072006 (2023)

Submitted on behalf of a Collaboration?

No

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Session Classification: Poster session

Track Classification: Neutrino physics and astrophysics