Call for a master's thesis topic

Topic: Determination of neutron cross-sections on tellurium for the 0νββ experiment SNO+

SNO+ is an experiment aimed to discover the still undetected neutrinoless double beta decay (0νββ). This decay would be an indication for Physics beyond the Standard Model and is currently under intensive investigation by numerous experiments. Two promising candidates for detecting the extremely rare 0νββ decay are Tellurium-128 and Tellurium-130, which are both present in high quantities in natural tellurium.

The main component of SNO+ consists of a 780-ton liquid scintillation detector that detects the light produced in particle reactions using 10000 photomultipliers. Additionally, the liquid scintillator is surrounded by a 7000-ton water Cherenkov detector and to further reduce background, the experiment is located 2 km underground in the Sudbury Mine in Canada. In the future, several tons of tellurium will be integrated into the scintillator detection volume, making SNO+ one of the most promising experiments for studying 0νββ decay.

Due to the comparatively low energy resolution of the scintillation detector and the extreme rarity of the 0νββ signal, it is essential to have accurate knowledge of all components of the experimental background. In particular, muon-induced neutrons can lead to activation reactions in tellurium, resulting in the creation of radioactive nuclides that emit gamma rays and charged particles, contributing to an increased background. To estimate the impact of these background components to the spectrum, a precise knowledge of the relevant neutron cross-sections is crucial.

In the context of this master's thesis, the cross-sections of various neutron reactions at different energies on natural tellurium are to be measured, some of which have never been experimentally determined before. Various neutron sources are available for this purpose, such as the deuterium-tritium (DT) generator of the Chair of Nuclear Physics at TU Dresden, located at the Helmholtz-Zentrum Dresden-Rossendorf, the research reactor AKR-2 at TU Dresden, and an AmBe source that generates neutrons of different energies. The activated samples will then be measured using the HPGe detector "TU1," one of the most sensitive HPGe detectors in the world. The evaluation includes determining the activity of the activated tellurium samples based on gamma spectronomy, calculating the neutron flux using reference targets, and performing Monte Carlo simulations of the extended samples on the detector TU1.

If you are interested in this topic, please contact Marie Pichotta (marie.pichotta@tu-dresden.de)