Contribution ID: **73** Type: **not specified**

Optimization of imaging techniques for background suppression of stellar Nucleo-Synthesis reactions with i-TED

Tuesday 3 October 2023 09:30 (15 minutes)

The study of the slow neutron capture process is fundamental for understanding the creation of isotopes heavier than ^{56}Fe in stars and, by extension, the relative abundances of the different elements.
One of the most prominent methods to constrain the stellar models for the s-process is measuring the neutron capture cross-section (n,γ) in the neutron energy range of astrophysical interest (1 - 100 keV) in neutron time-of-flight experiments.
However, for some isotopes, these are experimentally limited by the overwhelming γ-ray background radiation induced by the neutrons scattered from the target and interacting with the surroundings.

i-TED, a total-energy detector with imaging capabilities based on the Compton camera design, was proposed to tackle this limitation by suppressing background
events based on their spatial origin, different from the sample under study.
After several years of development, the multi i-TED array, composed of four modules, was mounted and successfully used for the first ^{79}Se(n,γ) cross-section measurement at CERN n_TOF. Recently, we have implemented several hardware and software upgrades to optimize its performance further.

This contribution will present a brief summary of the recent upgrades and first characterization of the final multi i-TED detector setup.
The results of the first systematic study of the background suppression capabilities based on selections in the Compton imaging domain will be presented, comparing the performance of several methodologies.
An outlook into future simulation work and the applicability of ML methods for the optimization of event selection will also be included.

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Session Classification: CPAN - Red Temática de Física Nuclear (FNUC)

Track Classification: CPAN - Red Temática de Física Nuclear (FNUC)