Contribution ID: **215**

Type: **Oral Presentation**

#4-215 Application of Unfolding Methods on Thermal Neutron Data Measured with a Single-Chopper Time-of-Flight Setup

Wednesday, June 11, 2025 2:40 PM (20 minutes)

To support the research on chloride-based molten salt fast reactors, the NAUTILUS project focuses on measuring nuclear data of chlorine. Experimental approaches to reach this goal utilize neutron activation analysis, neutron transmission and pile oscillation methods within the neutron field of the AKR-2 training reactor (Chair of Hydrogen and Nuclear Energy, Dresden University of Technology, Germany). However, performing an accurate quantitative analysis of the experimental results depends on a detailed characterization of the underlying neutron field. Thus, another key objective of the NAUTILUS project is to determine the spectral neutron flux across various energy ranges for the AKR-2.

The neutron flux in the thermal energy range can be experimentally determined by Time-of-Flight measurements with neutron choppers. The latter are disk-like instruments that are placed in the neutron beam and rotated at desired frequencies. Through a plating of their turning blades with a material with a high capture cross section for thermal neutrons –cadmium or gadolinium are suitable for this purpose –different velocities can be filtered from the neutron beam. The combined use of multiple neutron choppers allows further filtering for narrower velocity regions. This especially can be utilized for determining the spectral neutron flux of individual thermal energies.

However, the described method is only practical if a sufficiently high thermal neutron flux is available at the given source. Otherwise, one must account for long measurement times to assure counting statistics with small relative measurement uncertainties. Neutron facilities that fall under this category are zero power reactors like the AKR-2.

Within the scope of the NAUTILUS project, a method is being developed for the experimental determination of the spectral thermal neutron flux with a single-chopper Time-of-Flight setup. It uses the moments of opening a disk-type neutron chopper spinning at a set frequency as start times. The events inside a helium-3 counter are utilized as stop times. With knowledge of the flight distance, flight times are determined and sorted into a histogram. Then, the unfolding method is applied using the flight time responses of different neutron velocities. The latter have their origin in the energy-dependent neutron capture cross-section of helium-3 and the finite opening width of the neutron chopper. Finally, the unfolding method yields the initial flight times from which the spectral neutron flux can be calculated.

Currently, different unfolding methods have been tested on data measured with a single-chopper Time-of-Flight setup. This was done to further validate this approach and to draw comparisons between the different unfolding techniques. Theoretically determined neutron flight times seemed to be reproduced by some of the unfolding algorithms. However, further investigations are planned to fully validate this method.

In general, this contribution will present experimental data obtained with a single-chopper Time-of-Flight setup. The results after applying the different unfolding algorithms to the data will be discussed. Analog data yielded with the neutron ray-trace simulation package McStas will be used for comparison. Further validation approaches for the presented method will be covered.

Primary author: MELZER, Vincent (TU Dresden)

Co-authors: Mr KNOSPE, Alexander (TU Dresden); Mr STEIN, Louis (TU Dresden); Dr VIEBACH, Marco (TU Dresden); Dr LANGE, Carsten (TU Dresden); Prof. HURTADO, Antonio (TU Dresden)

Presenter: MELZER, Vincent (TU Dresden)

Session Classification: #04 - Research Reactors and Particle Accelerators

Track Classification: 04 Research Reactors and Particle Accelerators