Ph.D. Candidate: Lilly Peters – finished Master Thesis at Aachen Univ. (Ice-Cube)

Period: 01/2022 – 01/2025 (min) - 06/2025 (max)

Experiments: NUCLEUS and its robust calibration with CRAB

Ph.D. Type: co-shared mentoring, T. Lasserre & R. Strauss

Funding envisaged from Jan. 2022 (3.5y position):
- 1.25y CEA / Université Paris Saclay - Application in 2022 – Not secured yet
- 1.25y 65% TUM NUCLEUS – Secured (ERC R. Strauss)
- 1y 65% SFB (this application)

Request: 1y 65% SFB (starting on January 2022)

Risk: CEA funding is pending on an application that will happen by spring 2022.

Risk Mitigation:
- Application to German Ph.D. fellowships in parallel, other than SFB
- Shortening the Ph.D. contract to 3y instead of 3.5y. In that case, assuming R. Strauss ERC + SFB would be approved, we would miss a minimum of 0.75y Ph.D. funding by 2024.

Ph.D. Topic: Processing & Analysis NUCLEUS & CRAB CEvNS Calibration and Physics Data

The NUCLEUS experiment aims for the detection of coherent elastic neutrino-nucleus scattering (CEvNS) at the Chooz nuclear power station using ultra-low threshold gram-scale cryogenic detectors. This technology will enable the miniaturization of neutrino detectors and has the potential to probe physics beyond the Standard Model of particle physics in a second kilogram-scale phase. The complete understanding of the NUCLEUS data will be accomplished by a dedicated calibration experiment, called CRAB, which will take place next to the Triga research reactor in Vienna. The Ph.D. concerns the analysis of data from the first phase of the NUCLEUS experiment, as well as the analysis of CRAB data, integrating the calibration results into the NUCLEUS analysis. The analysis will be carried out according to the following experimental phases: analysis of the commissioning data (TUM, 2022), analysis of the NUCLEUS blank assembly data (TUM, 2023), analysis of the NUCLEUS neutrino data (Chooz, 2024-25) and CRAB data (Vienna, 2023-25). The work first involves the development of a dedicated analysis chain, based on existing CRESST software packages, to eventually integrate the analysis of NUCLEUS and CRAB data into a common framework. The first step in the analysis typically entails large-scale processing of the raw data on computer clusters, including triggering and energy reconstruction. After this phase, the reconstructed data need to be processed to isolate the expected signals from the various backgrounds. In parallel, calibration data (from radioactive sources, light-emitting diode systems, and CRAB results) and their uncertainties need to be incorporated. Altogether, novel analysis methods have to be developed to exploit the NUCLEUS 4pi-vetoing strategy to suppress backgrounds. Connections to state-of-the-art machine learning techniques to improve analysis performance will be also explored and eventually implemented.