

MASTER SUMMER TRAINING PROPOSAL

Academic Year 2025/2026

TITLE: Constraining the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ fusion by analyzing transfer data with quantified uncertainties.

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UNIVERSITY/RESEARCH CENTER of the TRAINING:

Michigan State University; Facility for Rare Isotope Beams (FRIB);
International Research Laboratory NPA.

LEVEL

Expected level of student: Master 2.

DURATION

Max 4 months, including max 3 months at FRIB.

TOPIC:

Nuclear astrophysics, Nuclear reaction theory, Uncertainty Quantification, Bayesian statistics.

ABSTRACT

Fusion processes involving α -particles are central to understanding the lifecycle of massive stars and the formation of heavier elements. Directly measurements of these reactions are very difficult and most of the time impossible as the Coulomb repulsion between the nuclei suppresses the reaction probability. Instead, these reaction rates are often evaluated using nuclear properties inferred from transfer reactions measurements in which an α -particle is transferred to the nucleus of interest. The quality of these evaluations depends strongly on the accuracy of the reaction theory used to interpret these transfer data.

In this project, the student will use nuclear reaction models to analyse $^{12}\text{C}(^7\text{Li},t)^{16}\text{O}$ transfer reaction data. In this process, they will quantify the uncertainties associated with the inputs of these models onto $^{12}\text{C}(^7\text{Li},t)^{16}\text{O}$ transfer cross sections, using Bayesian statistics. By comparing their predictions to $^{12}\text{C}(^7\text{Li},t)^{16}\text{O}$ data, they will infer constraints for the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ fusion rate.

Please note that this spring-summer training does not imply a continuation for a PhD.

More information is available on the website <https://npa.in2p3.fr/summer-training-program/>