

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: IJCLab

CNRS identification code: CNRS IJCLab/UMR9012

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Internship location: 15 Rue Georges Clemenceau, 91400 Orsay

Thesis possibility after internship: NO

Funding: NO

If YES, which type of funding:

Improving Reaction Models for Helium-Fusion and Transfer Processes in Nuclear Astrophysics

Fusion processes involving helium nuclei, or α particles, are central to understanding the lifecycle of massive stars and the formation of heavier elements. Directly measuring these reactions in the range of energies relevant for astrophysics is very difficult or impossible, because the Coulomb repulsion between the nuclei suppresses the reaction probability. Accurate theoretical predictions are therefore needed to extrapolate higher-energy data to low energies. These extrapolations are often constrained with information gleaned from other reaction measurements, such as transfer reactions in which an α particle is transferred to the nucleus of interest. The quality of these analyses depends strongly of the accuracy of the reaction models used to interpret these existing data.

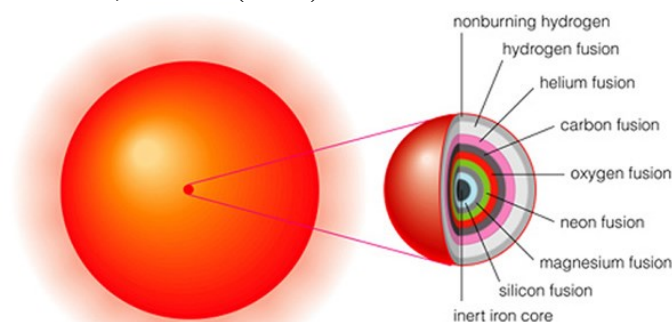
In this project, the student will first develop an understanding of the nuclear reaction models typically used to analyze these transfer and fusion reactions. The second step will be to reproduce existing analysis of transfer reactions. Finally, possible improvements to these analyses will be investigated.

Relevant materials:

F. Hammache, N. de Sereville, Transfer Reactions as a Tool in Nuclear Astrophysics, *Frontiers* 8, 602920 (2021)

C. Hebborn et al., Impact of the $Li6$ asymptotic normalization constant onto α -induced reactions of astrophysical interest, *Phys. Rev. C* 109, L061601 (2024)

C. Hebborn, G. Hupin et al., Ab Initio Prediction of the $He4(d,\gamma)Li6$ Big Bang Radiative Capture, *Phys. Rev. Lett.* 129, 042503 (2022)



Life of a star and stellar nucleosynthesis

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES/NO

Soft Matter and Biological Physics: YES/NO

Quantum Physics: YES/NO

Theoretical Physics: YES/NO