Master Internship project – Erasmus Mundus

Place : Grand Accélérateur National d'Ions Lourds (GANIL) / Laboratoire de Physique Corpusculaire de Caen (LPC Caen)

Title : SENSITIVITY OF SUPERNOVA OBSERVABLES TO ASTROPHYSICAL AND NUCLEAR PHYSICS INPUTS

Project type : nuclear astrophysics : theoretical

Scientific context and project details:
This project sets itself in the theory of core-collapse supernova. In particular, it aims to study the impact of some key input data on the core-collapse dynamics of massive stars.

At the end of their life, stars with a mass greater than 8-10 times the mass of the Sun collapse under the action of the gravitational force, before exploding in a catastrophic event known as supernova. The physical conditions in density and temperature encountered during the collapse are so extreme that it is not currently possible to reproduce them exactly in terrestrial laboratories. Numerical simulations are therefore needed. The collapse dynamics and the consequent explosion depend in a crucial way on both nuclear physics and astrophysical inputs. Among the different microscopic ingredients, the equation of state of hot dense stellar matter and the electron-capture process play a key role. From the astrophysical point of view, input parameters like the star progenitor also have an important role in determining the final stages of the star.

During the Master internship, a theoretical study of different nuclear physics and astrophysical input data crucial in the supernova dynamics will be performed. Moreover, numerical simulations of the core collapse will be carried out. This will allow one to perform more systematic analyses of the impact of these input data on the collapse dynamics and on the supernova observables.

Prerequisites:
- Physics courses at bachelor level;
- Understanding of program languages and linux-based system at bachelor level.

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