



ERASMUS MUNDUS JOINT MASTER IN NUCLEAR PHYSICS

Academic Year 2026/2027

MASTER THESIS PROPOSAL

TITLE: Laser-Radiofrequency Double Resonance at S3-LEB

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ABSTRACT

Atomic nuclei are intricate many-body systems, and their structure remains only partially understood. Among the experimental tools available for probing nuclear properties, **laser spectroscopy** stands out due to its unique ability to determine nuclear electromagnetic moments in a model-independent manner. To date, these techniques have provided access only to the two lowest-order electromagnetic moments: **the magnetic dipole and electric quadrupole moments**. These observables have been studied for years, enabling a deeper understanding of nuclear structure and its evolution in unstable nuclei [1]. To our knowledge, the next-order moment, **the magnetic octupole moment**, has been measured in only 21 stable nuclei and never in radioactive isotopes [2].

This project proposes to develop the **Laser-Radiofrequency Double Resonance** method, which will enable, for the first time, the measurement of the **octupole moment** in radioactive atoms. Successfully achieving this would unlock a new pathway for investigating the properties of short-lived atomic nuclei, advancing our understanding of nuclear structure.

By joining this project, you will participate in commissioning the **Laser-Radiofrequency Double Resonance** method on stable ions. The work will involve:

- Operating and aligning lasers,
- Developing laser/RF schemes,
- Conducting measurements,
- Performing data analysis using Python.

You will be integrated into a large, collaborative research team, working closely with PhD students, postdocs, and permanent research staff members.

- [1] [X. F. Yang *et al.*, **Laser spectroscopy for the study of exotic nuclei**, Progress in Particle and Nuclear Physics \(2023\)](#)
- [2] [S. Bofos, T.J. Mertzimekis, **Revisiting the nuclear magnetic octupole moment**, Atomic Data and Nuclear Data Tables \(2024\)](#)