PHD PROPOSAL

(One page maximum)

Laboratory name: IJCLab
CNRS identification code: CNRS IJCLab/UMR9012
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Funding: YES (If selected by CNRS joint PhD program (otherwise with ED PHENIICS)
If YES, which type of funding: CNRS

Applications of ab initio nuclear theory to electroweak process in atomic nuclei

This PhD project aims to integrate ab initio nuclear structure methods with ab initio atomic codes to enable high-precision calculations of hyperfine splitting in atoms composed of light nuclei. By bridging nuclear and atomic physics, the research will assess the accuracy of state-of-the-art nuclear Hamiltonians against ultra-precise atomic measurements from the QUARTET collaboration's muonic atom experiments. The PhD candidate will collaborate with experts in Multi-Configuration Dirac-Fock methods to incorporate charge and magnetic density distributions computed from nuclear structure codes. Additionally, the project will develop many-body techniques thattreat bound and continuum states in a unified framework. This approach will refine nuclear Hamiltonians to align with the most precise measurements of light systems, ultimately reducing reliance on empirical fitting.

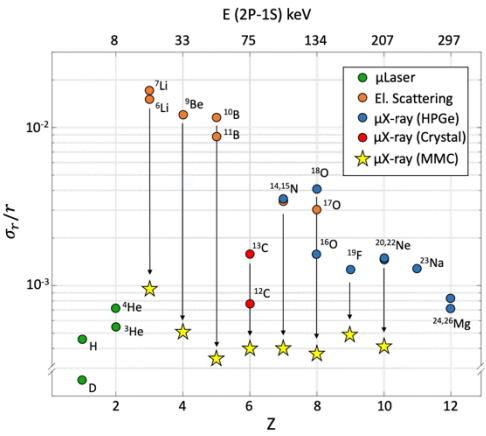

Figure 1: Current status of fractional knowledge of charge radii of light nuclei (colored dots), and the QUARTET precision goals (stars).

The PhD student will be based at IJCLab. However, there will be significant exchanges with the team working at TRIUMF (Canada), specifically to collaborate on the advancement of *ab initio* numerical codes. These codes will permit the computation of both structure and reaction observables within the No-Core Shell Model with Continuum (NCSMC) method.
Additionally, significant interactions with the metrology group of the Laboratoire Kastler Brossel, notably Prof. P. Indelicato, at Sorbonne Université (Jussieu campus) in downtown Paris, are planned during the course of the PhD. These interactions will involve feeding Dirac-Fock *ab initio* codes with nuclear physics inputs, as well as learning the atomistic ingredients and running the code itself to supplement investigations by experimentalists. Eventually, visits to universities hosting experimental colleagues in Germany or Israel can be arranged.
Within the scope of the Joint PhD program, the successful candidate will visit the TRIUMF/UBC campus for two three-week-long visits per year (a total of four visits within the span of the PhD contract). This will contribute to the development of the NCSMC.

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~~