INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Institut des NanoSciences de Paris
CNRS identification code: : UMR7588
Internship director'surname: TRASSINELLI
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Internship location: Campus Jussieu

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ED PIF

Test of quantum electrodynamics in strong Coulomb field

Summary:
This internship will be centred in the preparation of a new experiment on high-accuracy x-ray spectroscopy of few electrons heavy ions for testing quantum electrodynamics (QED) in strong Coulomb field (the field of the highly charged ion). In this regime, perturbative methods cannot be used for theoretical predictions and contributions of the vacuum polarization of the electron self-energy has to be calculated to all orders. At present, the most advanced calculations of bound states QED are limited to the two-loop contributions. This work is following a recent successful experiment on the x-ray spectroscopy of heliumlike (2 electrons), lithiumlike (3 el.) and berylliumlike (4 el.) uranium ($^{238}U^{92+}$) representing, at present, one of the most stringent tests of bound state QED. The proposed experiment will measure exclusively heliumlike uranium ions but formed with different nuclear isotopes to investigate on the effect of the nuclear size and deformation. For this purpose, the twin Bragg spectrometer will be upgraded with two TIMEPIX3 detectors (developed by CERN, commercialized by ASI) for coincidence measurements. Different uranium isotopes will be produced on-flight in the accelerator.
The goal of the present internship is double. On the one hand, to setup the acquisition system of the new detector and to make first tests with fluorescence targets and (possibly) with highly charged ions in our SIMPA installation in the Pierre et Marie Curie campus. On the other hand, the candidate will estimate the sensitivity to the nuclear size and deformation effects for the planned measurement to select the most interesting uranium isotopes to be studied. Some calculations will require the use of the MCDFGME code.

Techniques/methods in use:
The candidate will become familiar with the techniques of data analysis, X-ray spectroscopy, heavy ion structure. Eventually, the candidate will work on our ion source and transport line installation SIMPA.

Applicant skills:
Knowledges in one or several following topics is required: atomic physics, x-ray spectroscopy, python.

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

Condensed Matter Physics: NO Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: NO