

Title: Test of quantum electrodynamics in strong Coulomb field**Keywords:** highly charged ions, bound states quantum electrodynamics, x-ray spectroscopy

Scientific description: 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 ($^{238}\text{U}^{92+}$) 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.

Industrial partnership: N

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Internship location: INSP, Sorbonne Université, 4 place Jussieu, 75005 Paris

Possibility for a Doctoral thesis: Y (to be financed via the doctoral school)