Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Aimé Cotton
CNRS identification code: UMR 9188
Internship director'surname:Lignier
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Internship location: Laboratoire Aimé Cotton, Orsay

Thesis possibility after internship: YES
Funding already obtained for a PhD: NO If YES, which type of funding:

Study of the capture of a Rydberg electron by a molecule (BaF,BaF+)

This internship deals with the cooling of BaF molecules in order to perform tests of fundamental physics.

In our experiment, a cold jet of barium fluoride (BaF) is obtained by a supersonic expansion. The internal degrees of freedom (rotation and vibration) are cooled by optical techniques we have recently developed. However, the average velocity of these molecules is about 600 m/s with a dispersion on the velocity of about 20 m/s (which corresponds to a temperature in the kelvin range).

Our objective is now to stop the molecules. To do so, we are developing an original strategy: an electric pulse slows down the temporarily ionized molecules before being neutralized. Last year, we have demonstrated that our electric decelerator is working well on BaF^+ resulting from the BaF photionization.

From now on, we want to neutralize the molecules thanks to the capture of an electron provided by a Rydberg atom. The Rydberg source is an oven of caesium atoms duly excited by three CW laser sources.
The objective of the stage is to achieve and study two types of capture: neutralization of BaF^+ to BaF and ionization of BaF to BaF. In particular, we want to understand which Rydberg state(s) is (are) more suitable for the electron capture, in which state neutralized molecules will be and, importantly we want to evaluate heating on the molecules.

Theoretical support will be solicited to help us identify the details of the process under study.

The internship can ideally be extended into a thesis.

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