Two-year postdoctoral position. Open March 2012.

Production and excitation of ortho-positronium for the GBAR project

Project leader: Patrice Pérez (patrice.perez@cea.fr).

The aim of the GBAR project [1] is to measure the free fall of antihydrogen atoms in the gravitational field of the Earth. A critical step of the experiment is to produce a dense cloud of ortho-positronium (o-Ps) to serve as a target for the low energy antiprotons delivered by the AD/ELENA decelerator complex at CERN.

The positronium cloud is formed by dumping in less than 100 ns a bunch of a few keV positrons onto a porous material (for example silicate). Positrons are ejected from a Penning-Malmberg trap in which they have been accumulated beforehand. The production efficiency of o-Ps has been measured in similar experimental conditions as those needed by GBAR, and is found as high as around 30% [2]. This process has now to be realized by the collaboration at Saclay, where a positron prototype source and a Penning-Malmberg trap are running.

The post-doc will be in charge of the installation the e^+/o-Ps converter with the needed detectors to characterize the positronium production: efficiency, energy spectrum, density, for various samples and geometries.

In addition, in order to maximize the production of $\overline{H}^+$ ions by the antiproton interactions with the o-Ps cloud, the o-Ps has to be partially excited by a laser pulse. The post-doc will contribute to the laser system installation and to the measurement of its performances.

This development is part of an IRFU-LKB-IPCMS-CSNSM-ETHZ collaboration and is the subject of a PhD thesis.

[1] P. Perez & al., *Proposal to measure the Gravitational Behaviour of Antihydrogen at Rest GBAR*, CERN-SPSC-2011-029 / SPSC-P-342.

[2] D. B. Cassidy, P. Crivelli, T. H. Hisakado, L. Liszkay, V. E. Meligne, P. Pérez, H. W. K. Tom and A. P. Mills, Jr., *Positronium cooling in porous silica measured via Doppler spectroscopy*, Phys. Rev. A 81, (2010) 012715.

Candidate skills:

The post-doc must have a strong motivation for experimental work and preferably have an experience with ultra-vacuum technology and particle detectors. In addition he/she should be educated in fundamental physics in order to understand the general framework of GBAR.