Fédération Sciences Plasmas Fusion

Année universitaire / Academic year 2020-2021

PROPOSITION DE STAGE / INTERNSHIP PROPOSAL

Organisme / Institution : Aix-Marseille Université
Laboratoire / Laboratory : PIIM -CIML
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Conditions de stage (rémunération, voyage, logement, cantine, …) / internship conditions (salary, travel, lodging, food,…) : rémunération possible

"Stopping power of a laser cooled ion cloud in an RF trap"

A novel ion detector without upper mass limit is under development at group "Confinement d'Ions et Manipulation Laser" (CIML) from the PIIM laboratory. The detector is based on the fluorescence signal change of a laser cooled ion cloud inside a Radio-Frequency Ion Trap[2] when the ion to be detected goes through the cold ion cloud[1].
In the context of such project, the proposed stage consist in the study of some of the fundamental aspects of the interaction of the injected ion and the cold one-component plasma[3] (the laser cooled ion cloud) by using molecular dynamics simulations. In particular, the stage will concentrate on the study of the "stopping power"[4]: the quantity of energy lost per unit of length that the injected ion losses due to the interaction with the cold thermal bath that represents the cold trapped ions. Such quantity, the "stopping power", is expected to depend of the aspect ration of the cold ion cloud, the absolute ion number and the energy and Q/m ratio of the injected ion. This work is of interest also in a fundamental physics context: highly charged ions[5] or anti-hydrogen[6] are stopped inside a cold ion cloud.
The numerical work will be carried out using a high performance FORTRAN90 code developed at CIML. The analysis of the results will be perform using Python.

[1] 'Non-destructive detection method of charged particles without mass limitation'; C . Champenois, C. Dedonder-Lardeux, C. Jouvet, L. Hilico, M. Knoop, J. Pedregosa. EP20150767557 2015.

[3] https://www.lanl.gov/projects/dense-plasma-theory/research/one-component-plasma.php

[2] 'Ion dynamics in a linear radio-frequency trap with a single cooling laser'; M. Marciante, C. Champenois, A. Calisti, J. Pedregosa-Gutierrez, and M. Knoop; Phys. Rev. A 82, 033406

[4] 'Stopping of heavy ions in plasmas at strong coupling'; G. Zwicknagela, C. Toepffer, P.G. Reinhard, Physics Reports, v309, 1999

[5] 'Coulomb crystallization of highly charged ions'; L. Schmöger, O. O. Versolato, M. Schwarz, et al. Science. 2015, Vol. 347, pp. 1233-1236.

[6] 'Preparing single ultra-cold antihydrogen atoms for the free-fall in GBAR'; L. Hilico, J.-Ph. Karr, A. Douillet, P. Indelicato, S. Wolf, F. Schmidt Kaler.. 2014, Vol. 30, p. 1460269.