Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 13 décembre 2012

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Code d'identification :UMR 7648 — Organisme :CNRS/Polytechnique/UPMC/Paris Sud
Site Internet / *web site*: www.lpp.fr
Adresse / *address:* Ecole polytechnique, Palaiseau
Lieu du stage / *internship place*: Palaiseau/Pise

Titre du stage / *internship title*: **Magnetopause study with a three-fluid numerical simulation**

Supervisors LPP Palaiseau: **Gérard Belmont and Laurence Rezeau**
Supervisor Pisa University: **Francesco Califano**

Abstract:
The magnetopause is a thin boundary separating the cold and dense plasma coming from the solar wind and the hot and tenuous plasma of the magnetosphere. This boundary is subject to various fluctuations, including surface waves due to Kelvin-Helmholtz instability and magnetic reconnection. The resulting penetration of the solar wind plasma inside the magnetosphere is indirectly responsible for the magnetospheric activity, magnetic substorms and polar auroras. Several numerical simulations of magnetopause-like current layers have already been performed with a two-fluid code, involving one electron and one ion populations. Starting with a tangential layer, it has so been possible to observe and investigate the development of the Kelvin-Helmholtz instability and the secondary phenomena of reconnection. Nevertheless, the equilibrium of the layer, as its subsequent instabilities, are likely to be quite dependent on the detail interpenetration of the two ion populations coming from both sides: solar wind and magnetosphere.
The proposed study consists in conceiving, writing and running a new simulation code called "three-fluid", i.e. including one electron and two ion populations (hot and cold). With a two-fluid code, any penetration of the solar wind plasma inside the magnetosphere supposes a strong ion heating, hardly compatible with the supposed polytropic evolution of the temperature. This problem would be solved by the three-fluid code where both temperature are present and can mix. This solution would be more realistic than the two-fluid ones for modeling the magnetopause collisionless plasma, but still much less computer time demanding than the complete Vlasov ones. The differences in the results coming from the two kinds of codes should be physically enlightning.

Agenda:
The work will be done in collaboration between the LPP (Laboratoire de Physique des Plasmas) in Palaiseau and the University of Pisa (Italy). The provisional agenda is: 1 month in LPP to become familiar with the subject, review existing work and write the equations to be coded; 1.5 months in Pisa to develop the new code from the two-fluid one that has already been developed in this lab, and 0.5 month (if the coding has been fast enough) to make the first numerical tests and first uses of the code.

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : oui**

Si oui, financement de thèse envisagé/ *financial support for the PhD***:**

Lasers et matière		Lumière, Matière : Mesures Extrêmes	
Optique de la science à la technologie		Plasmas : de l'espace au laboratoire	**x**