AGENCE NATIONALE DE LA RECHERCHE
ANR

PLAS@PAR
Plasmas à Paris

SORBONNE
UNIVERSITY

Call for applications for PhD position in the laboratory of excellence, labex Plas@Par

Relativistic shocks in magnetized plasmas in the context of laboratory astrophysics

Project description

Charged particle acceleration in relativistic collisionless shocks and the resulting high-energy radiation emission have been identified as the main source of supra-thermal high-energy particles and radiation in astrophysics. Present experiments on laser-plasma interactions already allow to produce high Mach number shocks with a perspective to reach the relativistic regime on future laser facilities, recreating conditions resembling those of the most energetic astrophysical objects in the laboratory.

The purpose of this thesis project is to investigate the range of laser and plasma parameters and possible geometries allowing for laser-driven generation of collisionless shocks in astrophysically relevant regimes, with emphasis on the role of magnetic fields, either externally imposed or self-generated by plasma instabilities, and on the related particle acceleration. This work will rely partly on extensive Particle-In-Cell (PIC) simulations performed on supercomputers. Such simulations require the use of dedicated, massively parallel, numerical tools (available both at LULI - PIC code SMILEI - and at the University of Pisa).

The subsequent acceleration of charged particles in the shock as well as their radiation emission will be investigated into great detail using as well test-particle modeling and analytical modeling (e.g. dynamical system approaches). Another major issue will be related to proper resolution of the tail in the ion and electron distribution functions, which is crucial both to properly describe the collisionless shock formation and to resolve the spectrum of accelerated particles. To address this issue, selected problems will be used to benchmark PIC simulations with "Vlasov" Eulerian codes.

The thesis work will be under a joint supervision of Dr Mickael Grech (LULI, Université Pierre et Marie Curie, Paris and Ecole Polytechnique, Palaiseau) and Dr Andrea Macchi (CNR/INO and University of Pisa), recognized within a formal agreement between the host institutions.

Requirements for the candidate

The candidate is expected to hold a M.Sc. or equivalent degree in Physics, or to obtain her/his degree by the starting date of the position. Previous education and relevant experience on the topics of the PhD project as well as computing skills, such as knowledge of Fortran or C/C++, should be highlighted in the application.

Location and important dates

The PhD student is expected to spend comparable amounts of time both at LULI (on the campus of Ecole Polytechnique at Palaiseau, near Paris) and at Pisa (Italy). The starting date is expected to be October 1, 2014.

Applications should include: CV, copies of degree diplomas and grades, 2 reference letters, previous research work, and statement of motivation. Application deadline is May 31, 2014.

The application should be sent preferably by e-mail to:
Mickael Grech (mickael.grech@polytechnique.edu) and Andrea Macchi (macchi@df.unipi.it)

PhD offer 2014 / Ecole doctorale ED389 P2MC (Physique de la particule à la matière condensée)