# Magnetized radiative shocks: their role in the structuration of the interstellar medium (ISM)

Internship at LULI (Laboratoire pour l'Utilisation des Laser Intenses), Ecole Polytechnique, Palaiseau, France

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Over the past two decades, high-power laser facilities have advanced our understanding of physical processes occurring in the Universe through a relatively new field: laboratory astrophysics. Conventional techniques such as numerical simulations or observations are unable to tackle some of the main astrophysical issues. Simulations cannot, for example include all the complexity and/or interplay of the physical mechanisms involved; observations are often limited by low spatial and temporal resolutions even if huge progress have been made recently. Therefore, scaled experiments in the laboratory are useful to investigate the microphysics involved in long-range astrophysical systems.

https://www.radiofrance.fr/franceculture/podcasts/la-methode-scientifique/le-cosmos-en-pipette-6373974

This internship will concern the study on how new stars are generated as a result of a supernova explosion. To fulfil this goal, main processes involved such as radiative shocks (RS) and magnetic field are

First, RS are among the most ubiquitous phenomena observed in the Universe. They are found in many astrophysical systems, such as SNR, YSO, cataclysmic variables, accretion disks …. They can be responsible to disturb and inject energy into the ISM, affecting the rate of star formation in galaxies for example. Understanding their physical properties are fundamental since they are the basis for the interpretation of observations of astrophysical phenomena.

Second, magnetic (B) fields are also ubiquitous in the Universe, influencing a wide range of astrophysical objects and the medium in between. For example, the magnetized InterStellar Medium (ISM) is stirred by many physical processes where B plays an important and often integral role. All these phenomena influenced by B-field have also retroaction modifying the B-field topology and amplitude. This means that any astrophysical model must treat self-consistently all processes involving B field.

In the context of star progenitors, the coupling of a RS and a B-field occurring in Super Novae Remnants (SNR) interaction with the ISM will be studied for the first time in laser experiments. Up to now very little is known about the structure of such astrophysical shock and how it can interact with a molecular cloud, triggering star formation both by observations or simulations. Here, by performing laboratory experiments we will try to answer some of the main questions. To this end, one experimental campaign is planned on LULI2000 (starting beginning of March until April). The student will participate to the experiment, integrating an international collaboration. She/he will help next to analyze the experimental data in collaboration with the group of Pr. C. Li from MIT. The student should also be interested to develop numerical skills in using a 2D/3D MHD radiative code (FLASH developed by Chicago University) to design and interpret experimental results.

We are looking for a highly motivated candidate interested in both ICF and laboratory astrophysics experiments using high power lasers and radiative magneto/hydro dynamics physics with the perspective to follow this internship with a PhD thesis.