Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 20/10/2017

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*: LULI

Code d'identification :UMR 7605 — Organisme :Ecole Polytechnique-CNRS

Site Internet / *web site*: https://portail.polytechnique.edu/luli/fr

Adresse / *address:* Ecole Polytechnique, Route de Saclay, 91120 Palaiseau, France

Lieu du stage / *internship place*: Laboratoire LULI

Titre du stage / *internship title*: **Dynamics of Stars Death and Birth : from the cosmos to the laboratory**

General context. Recent developments in power lasers, motivated mainly by the quest for inertial confinement fusion, have also led to the emergence of a new discipline: laboratory astrophysics. Using these large facilities, we can today recreate in the laboratory conditions of high temperature and density typical of astrophysical objects or situations such as radiative shocks, jets of young stars or the phenomena related to the process of accretion in cataclysmic variables. Thus, a complementary tool to astronomical observations is available, which is particularly useful for questions concerning the dynamics of astrophysical phenomena, which are often too slow and beyond our reach.

Figure 1 : The double supernova remnants DEM L316 in the Large Megellanic Cloud

Objectives. The main goal of this internship is to study both experimental and numerical aspects of the physics of supernova remnants (SNRs) which results of the interaction between the supernova ejecta and an ambient medium. This is a crucial point in the structuration and the dynamics of the interstellar medium (ISM) and in the high energy astrophysics. Indeed, when two isolate massive stars are relatively closed and exploded, the resulting SNRs can interact and lead to a more complex structure of the ISM. The impact zone presents a fascinating complex hydrodynamic physics which depends on (i) the age of SNR, (ii) its relative evolution stage and (iii) the relative position of the two stars.

Methodology. In this internship, the student will study the processes involved in the astrophysical situation described above by analysing data from an experiment where two strong blast waves are generated on the LULI2000 laser facility. The blast waves will propagate in a low Z gas and interact on the axis. Various optical diagnostics will be implemented to access to the waves variables (velocity, density, temperature, …) and possible B-field generation when the two blast waves interpenetrate each other. When going to the second phase (interaction with a spherical objects), an x-ray diagnostic will be used to observe the collapse of the sphere positioned on the target chamber axis. By changing the backlighter beam delay from shot to shot, we are able to follow the dynamic of this phenomenon. The analysis of all the data will be done with tools existing in our group, new ones to be developed if necessary. Also, 2D& 3D simulations using the High Energy Density modules of the Multidimensional Radiative Hydrodynamics Code FLASH in collaboration with the University of Chicago will be performed for the interpretation of the results.

new experiment, related to radiative shocks and their interaction with molecular clouds, will be scheduled end of May. T
ident will participate and learn the different experimental techniques, how to run the diagnostics and obtain the requir
ta. If time allows, some preliminary analysis will be done

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

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***: Ecole Doctorale, CEA**

Lumière, Matière, Interactions	**x**	Lasers, Optique, Matière	