Shock wave physics: from collisional to weakly collisional

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

Supervisor : Albertazzi Bruno, b.albertazzi@hotmail.fr, tel : +33169335413

Inertial Confinement Fusion is now a growing domain following the NIF recent results. Demonstration of a gain greater than has been recently performed inducing new insight int the physics processes that intervene in capsules implosions. Among these processes, one can find shock physics, equation of state, radiation, hydrodynamic instabilities, …. In Particular, Foams are of significant interest for inertial-confinement-fusion capsules, due to the control they provide over the convergence ratio of the implosion and the opportunity this affords to minimize hydrodynamic instability growth. However, the equation of state for fusion-relevant foams are not well characterized, and many simulations rely on modeling such foams as a homogeneous medium with the foam average density.
At LULI we developed for many years different platforms in order to study experimentally these processes.
In this internship, the student will study the influence of a porous material on a shock wave propagation, analyzing experimental data obtained on the Gekko laser in japan. Comparision will be made with different models that have been developed in this field.
In addition, shock waves are fundamental in ICF as they drive the capsule implosion, generating high pressure in its materials that drive the foam properties, in particular how the void closure. These are also an inherent phenomenon of our Universe. It can be found in a variety of systems ranging from micron to astrophysical scale. occurs. To understand this phenomenon, a dedicated study on shock wave physics will be performed. However, the physics related to shock waves is extremely complex and many challenges remain to disentangle. In this internship, the student will also participate to an experimental campaign on LULI2000 (the most powerful academic laser facility available in Europe) in April 2024. Here, we will study collisional and collisionless shocks respectively, Coulomb collisions or collective particle-wave interactions are the key factor in determining the shock transition.

The student will then help to analyze data of the experiment and begin to interpret it in collaboration with astrophysicists.

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 Inertial Confinement Fusion and laboratory astrophysics experiments using high power lasers and shock wave physics with the perspective to follow this internship with a PhD thesis.