Turbulence in magnetized plasma

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

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

Magnetohydrodynamic (MHD) turbulence is ubiquitous throughout the Universe. Ionised gas pervades the regions between and within galaxies and inside stars. On the large scales encountered in astrophysics, even modest velocities give rise to large hydrodynamic and magnetic Reynolds numbers. Producing a complete description of MHD turbulence has therefore been described as one of the major unsolved problems in space plasma physics. Indeed, there are multiple competing theoretical frameworks, each predicting different turbulent spectra However, observational data is often limited and computational studies intractably expensive, and hence the study of MHD behaviour on small scales must be carried out in laboratory experiments. The advent of high-power lasers has made such experiments become possible and even routine in recent years. LULI, a world-leading laboratory in this field, benefits from the unique combination of short-pulse and long-pulse lasers in combination with high-strength, high-volume uniform magnetic field generation technology.

Recently, an experimental proposal at LULI was accepted in order to study the phenomenon of MHD turbulence. The proposed work during this internship is initially the undertaking of this experiment (duration: 4 weeks. The work will be performed within an experimental team of PhDs and post-docs and experienced researchers) before then taking a leading role in the subsequent data analysis in subsequent months.

The experimental methods will include laser alignment, optics, schlieren imaging and other optical imaging techniques, optical spectroscopy (including Zeeman splitting), dealing with high-voltage power supplies and magnetic field generation, x-ray radiography, streaked optical pylometry, target alignment, polarimetry, high vacuum environments etc. Any experience or interest in these methods would be advantageous.

Data analysis and processing is varied and will involve simple tasks to more in-depth ones. Existing tools, developed at the laboratory can be applied although there is scope for a motivated student to expand and improve upon these if the need arises. A primary task will be to measure the turbulent spectrum of the laboratory produced plasma, using a Fourier transforms of the 2-D radiography images. Additionally, numerical simulations using massively parallel open-source software packages such as the radiation dynamics code FLASH will assist in understanding the experimental results. We are looking for a highly motivated candidate, interested in some or all of experimental physics, plasma physics, turbulence, astrophysics and magnetic fields.