Planetology in laboratory using high power lasers

Thanks to the development of powerful pulsed devices, such as high energy lasers, today it is possible to bring matter to extremely high temperature (~10^4K) and pressure (~10^6 bar) conditions, similar to those found in planets' interiors.
Knowing the behaviour of matter at these extreme states is of primary importance to unveil the internal structure of planets. This is not only of interest in its own, but it is also critical to understand the solar system's history, formation, and evolution.
While very high pressures (multi Mbar) can be achieved by single shock compression, the temperatures reached with this technique are often too high (~several 10000 K) to be relevant for planetary interiors.
Our team has adopted an alternative technique based on multiple shocks in order to generate high pressures, while keeping lower temperatures (a few ~1000 K). In this way, data on material behaviours at conditions pertinent to planetary science can be collected. Experiments were conducted on double-shocked silicates and planetary ices (H2O/CH4/NH3 systems) and allow us to collect data on equations of state (EOS), chemical, and transport properties of such systems.
This set of data will contribute to improve the models of terrestrial-like planets, including super-Earths, as well as icy giants, such as Uranus and Neptune, and the numerous Neptune-like exoplanets recently discovered.

In this "stage", the student will learn and actively participate to the data analysis of these experiments. He/She will be in charge of the analysis of the optical data, such as velocity interferometry and self-emission for pressure and temperature estimation. The analysis also includes some auxiliary experiments for the measurement of ancillary quantities, such as the refractive index under pressure.

Upon availability, the student will have the possibility to participate to new experiments. In any case, she/he will have the opportunity to discuss the results of the analysis in the context of international collaborations, including experts in planetary modelling and *ab initio* calculations.

This work could potentially be pursued in the frame of a PhD project.

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