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High Energy Density Physics experiments at LULI

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M. Koenig did a master in theoretical physics (1979), passed his PhD (1982) and his "these d'état" (1987) on atomic processes in warm and dense plasmas. He joined the LULI laboratory in 1998 working on the ICF implosion experimental program. When this program stopped, he created his own research group (1993) and worked on shock physics using high energy lasers. Since, the PHYHDEL group research program is mainly related to laboratory astrophysics addressing several topics: planetary interior physics, radiation hydrodynamics (eg, shocks that develops in supernova explosions, accretion systems), galactic magnetic fields generation, …

Abstract

High power lasers are an important tool to generate High Density Energy states that occurs in many astrophysical situations. In this talk, I will present only two cases among the many topics our group is working on 1) Quasi-isentropic laser driven compression on materials relevant to Earth-like planet interiors allows to access thermodynamical parameters directly connected to the extreme conditions (330-1500 GPa, 5000-8000K) of those objects. Here, I will present two series of experiments performed recently on LULI2000 and LIL facility. In both experiments a laser ramp profile system was used in order to compress the target as isentropically as possible. At LULI, with laser energy (300 J, 2 , 4 ns) pressures up to 100 Gpa were obtained. Different pressure ramp shapes, corresponding to different loading rates, were used to investigate the alpha-epsilon transition dynamics. On the LIL facility, a much higher energy and longer ramp (2.5 kJ, 3 , 20 ns) allowed to compress iron up to 900 GPa. In the meanwhile, temperature given by a rear side Streaked Optical pyrometer showed a value almost similar to the one expected in telluric planetary cores. All results will be presented, compared to simulations and discussed. 2) Jets from Young Stellar Objects (YSO) are associated with the accretion phase of the stellar evolution, which last for around the first 105 years of a young star's life. Astronomical data, along with theoretical and computational modeling, have lead to significant improvements in the understanding of YSO jets. Despite this, questions still exist surrounding the physics of both the jet launching and propagation. Several laboratory experiments were performed to produce laboratory jets on a number of different laser facilities (LULI2000 - GEKKO XII) and a diagnostic array capable of providing detailed time-resolved information that allows the temporal evolution of the jet to be well-characterized. Here, I will present the results of recent experiments that investigated the generation of laser-driven plasma jets. These jets were created through laser irradiation of thin (~ 5-7 m) conical shells. The flows of interest were generated from the rear-face of the target, isolating the jet propagation region from the laser and allowing the introduction of an ambient medium. Effects of ambient gas on the collimation were studied by varying its initial pressure.

All are welcome! Tea, coffee, biscuits will be served at 2:45 P.M.