Abstract for an Invited Paper
for the SHOCK11 Meeting of
The American Physical Society

Probing Warm Dense Matter electronic structure using X-ray absorption Near Edge Spectroscopy (XANES)

ALESSANDRA BENUZZI MOUNAIX, LULI (CNRS/Ecole Polytechnique)

The behavior and physical properties of warm dense matter, fundamental for various branches of physics including planetology and Inertial Confinement Fusion, are non trivial to simulate either theoretically, numerically or experimentally. Despite important progress obtained in the last decade on macroscopic characterization (e.g. equations of state), microscopic studies are today necessary to investigate finely the WDM structure changes, the phase transitions and to test physical hypothesis and approximations commonly used in calculations. In this work, highly compressed aluminum has been investigated with the aim of bringing information on the evolution of its electronic structure by using K-edge shift and XANES. The experiment was performed at LULI laboratory where we used one long pulse (500 ps, $I_L \approx 8\ 10^{13}$ W/cm^2) to create a uniform shock and a second ps beam ($I_L \approx 10^{17}$ W/cm^2) to generate an ultra-short broadband X-ray source near the Al K-edge. The spectra were registered by using two conical KAP Bragg crystals. The main target was designed to probe the Aluminum in reshocked conditions allowing us to probe and to test theories in an extreme regime up to now unexplored ($\rho \approx 3\ \rho_0$ and T$\approx$ 8 eV). The hydrodynamical Al conditions were measured by using VISARs interferometers and self-emission diagnostics. By increasing the delay between the two beams, we have been able to observe the modification of absorption spectra for unloading Al conditions ($\rho \geq 0.5$ g/cc), and to put in evidence the relocalization of the 3p valence electrons occurring in the metal-non metal transition. All data have been compared to ab initio and dense plasma calculations.