

ps laser-produced C and Al plasmas characterization by interferometry and emission spectroscopy

A. Morana¹, S. Bastiani-Ceccotti¹, A. Do¹, M. Dozières², L. Lecherbourg³, A. Lévy⁴, F. Thais², T. Vinci¹

¹LULI, Ecole Polytechnique, CNRS, CEA, UPMC, 91128 Palaiseau Cedex, France

²LIDYL, CNRS, CEA, Centre d'Etudes de Saclay, 91191 Gif-sur-Yvette Cedex, France

³CEA, DAM, DIF, F-91297 Arpajon, France

⁴Sorbonne Universités, UPMC Univ. Paris 06, UMR 7588, CNRS, INSP, F-75005, Paris, France

ambra.morana@polytechnique.edu

X-ray spectroscopy plays a key role in the domain of laser-generated plasmas as a crucial tool for the investigation of their atomic properties and hydrodynamic evolution. Its role is essential when the evolution of the plasma is mostly determined by radiative transfer phenomena. This is the case for both direct and indirect-drive in Inertial Confinement Fusion (ICF) configurations.

Reliable atomic models are needed for hydrodynamic and atomic kinetic codes to simulate the evolution of the plasma. To validate their assumptions and approximations, experimental data must be provided that cover both the emission spectrum and the hydrodynamic evolution with mutually independent diagnostics.

We will present the first stage of a pluri-annual project. We tested an experimental setup by characterizing well-known elements: C and Al. The configuration of the target structure and the drive laser parameters have been optimized in order to obtain a homogeneous plasma.

The experimental campaign was realized on the ELFIE laser facility of the LULI laboratory. A 5 ps laser pulse at moderate intensity ($I = 10^{15} - 10^{16} \text{ W/cm}^2$) was focused onto a structured target composed by a Si_3N_4 substrate coated by a C or Al layer. The electronic density has been measured with a Nomarski interferometer using the standard Abel transform. The Al X-ray and the C XUV emission spectra was measured with a reflection grating spectrometer. A pinhole camera was used as lens-free X-ray optical tool to measure the plasma lateral dimension.

The experimental results indicate that the plasma was fairly homogeneous. The results concerning hydrodynamic and spectral properties of the laser-generated plasma have been compared to the output of the MULTI hydrodynamic code and of the PrismSPECT atomic kinetic software, confirming the reliability of the setup. Future work should focus on the study of ICF ablaters such as Ge.