X and XUV emission from well-characterized, NLTE, mid-Z laser-produced plasmas

Serena BASTIANI-CECCOTTI [1], Alexandre DO [1], Ambra MORANA [1], Fabien DORCHIES [2], Maylis DOZIERES [3], Anna LEVY [4], Jean-Raphaël MARQUES [1], Frédéric THAIS [3], Tommaso VINCI [1]

1) LULI, CNRS, Ecole Polytechnique, CEA, UPMC, Palaiseau, France

E-mail: serena.bastiani@polytechnique.fr

2) CELIA, CNRS, CEA, Université de Bordeaux, Bordeaux, France

3) CEA, IRAMIS, LIDyL, Saclay, Gif-sur-Yvette, France

4) INSP, UPMC, Paris, France

Multicharged ions are present in hot dense plasmas and rule the radiation transport in numerous environments, like stellar atmospheres, or plasmas used for inertial confinement fusion. In the past years, non local-thermodynamic-equilibrium (NLTE) collisional-radiative models, often based on the superconfiguration description of the atomic levels, have widely progressed for the calculation of spectra emitted by multi-charged mid-Z ions but several discrepancies still remain. Benchmarking by well-diagnosed experiments is thus still needed for the validation of such codes. In past years, several experiments have been performed at LULI aiming to validate atomic kinetic codes. We concentrated our efforts to testing and enhancing reliability of hydrodynamic diagnostics, beside spectroscopic diagnostics, to fully characterize the plasma emissive region. The hydrodynamic diagnostics permit to constrain hydro-radiative codes, which can then be used as input data for atomic kinetic codes.

In the experiments described in this presentation, we attempted to produce quasi-homogeneous plasmas in two different regimes, in which the laser pulse has a nanosecond or a sub-picosecond duration. In the first experiment, performed on the LULI2000 laser facility, we irradiated Al and KBr dots with one frequency doubled, 1.5 ns duration beam to reach an intensity on target of a few 10^{13} W/cm^2. X-ray time-integrated spectra were recorded, together with time-resolved Thomson scattered spectra, allowing the measurement of the electronic density and temperature, and time-resolved and time-integrated interferometry images, allowing the description of the spatial density distribution in the plasma. A second experiment was performed on the ELFIE laser facility with a 300 fs-long laser pulse, in which we recorded the time-integrated XUV emission of C and Al targets. We also implemented an interferometer, a pinhole camera and a Frequency Domain Interferometer diagnostic. In both cases, the hydrodynamic measurements have been used to constrain the 1-D MULTI hydro-radiative code. The atomic physics codes PrismSPECT and SPECT3D have then be used as a post-processors of the hydrodynamic code, to reproduce the experimental X and XUV spectra. The results of these analyses will be presented.