SUPRATHERMAL ELECTRONS IN KJ-LASER PRODUCED PLASMAS: M-SHELL RESOLVED HIGH-RESOLUTION X-RAY SPECTROSCOPIC STUDY OF TRANSIENT MATTER EVOLUTION

F. Condamine[1,2*], M. Šmíd[3], O. Renner[3], M. Dozières[4], F. Thais[4], P. Angelo[1,2], F. Rosmej[1,2*]

[1]Sorbonne University, Pierre and Marie Curie UPMC, UMR7605, LULI, case 128, 4 Place Jussieu, F-75252 Paris Cedex 05, France

[2]Ecole Polytechnique, LULI, CEA-CNRS, Route de Saclay, F-91228 Palaiseau, France

[3]Institute of Physics of the ASCR, ELI Beamlines project, Prague, Czech Republic

[4]CEA/DSM/IRAMIS/LIDyL, Saclay, Gif-Sur-Yvette, France

*florian.condamine@etu.upmc.fr, frank.rosmej@upmc.fr

Suprathermal electrons are of key importance to understand many physical processes in plasma physics. Although numerous studies have contributed to this subject, it is still difficult to simulate their behaviour namely due to the non-equilibrium physics involved. Improving our knowledge about hot electrons is also of principal interest for fusion science and the interaction of high intensity laser beams with matter.

Suprathermal electrons impact strongly on atomic physics as almost all radiative properties are seriously modified. This in turn provides the possibility for their detailed characterization by high-resolution spectroscopic methods. Of particular interest is X-ray spectroscopy due to reduced photoabsorption in dense matter.

We report on a study of the copper Kα X-ray emission conducted at the ns, kJ laser facility PALS, Prague, Czech Republic. Thin copper foils (1-6 μm) with and without plastic tamper have been irradiated with 1ω and 3ω pulses. Two spherically bent quartz Bragg crystal spectrometers with high spectral ($\lambda/\delta\lambda > 3000$) and spatial resolution ($\delta x \approx 30$ μm) have been set up simultaneously to achieve a high level of confidence for the analysis of the complex K-alpha emission group. In particular, we have identified emission on the red wing of the $K\alpha_2$ transition ($\lambda = 1.5444$ Å) that could be indentified with complex atomic structure calculations to include configuration interaction and intermediate coupling.

Finally we discuss possible implications for the analysis of non-equilibrium phenomena and present first atomic physics simulations.