Radiative cooling of an Al plasma in an AlTi or AlAu mixtures heated by an ultraintense laser pulse

L. Lecherbourg[1,2]*, Ch. Blancard[1,2], S. Baton[3], A. Chaleil[1], P. Cossé[1,2], L. Duthoit[1,3], G. Faussurier[1,2], L. Gremillet[1,2], B. Loupias[1], F. Perez[3], J-.C. Pain[1,2], O. Poujade[1,2], and P. Renaudin[1]

[1]CEA, DAM, DIF, F-91297 Arpajon, France
[2]Univ. Paris-Saclay, CEA, LMCE, 91680 Bruyères-le-Châtel, France
[3]LULI, CNRS, École Polytechnique, CEA, Sorbonne université, 91120 Palaiseau, France

The rapid heating and cooling dynamics of thin solid foils driven by an ultraintense ($\sim 10^{18}$ W/cm^2) picosecond laser pulse has been experimentally studied through time-integrated and time-resolved x-ray emission spectroscopy as well as 2D x-ray imaging. Targets consisted of plastic foils with buried Al, $Al_{42}Ti_{58}$, or $Al_{85}Au_{15}$ layers, with Al as a tracer to infer the plasma conditions. Our measurements indicate that the Al K-shell emission occurs over a shorter duration and from a narrower region in AlTi or AlAu mixtures compared to pure Al samples.

The experimental data are then compared with the 2D hydrodynamic-radiative code TROLL and the atomic physics code SAPHyR. Approximating the heating phase using a simple description of a collisional heating, the simulations reproduced the trends to a good approximation, and pinpoint the importance of radiative cooling in high-Z samples.

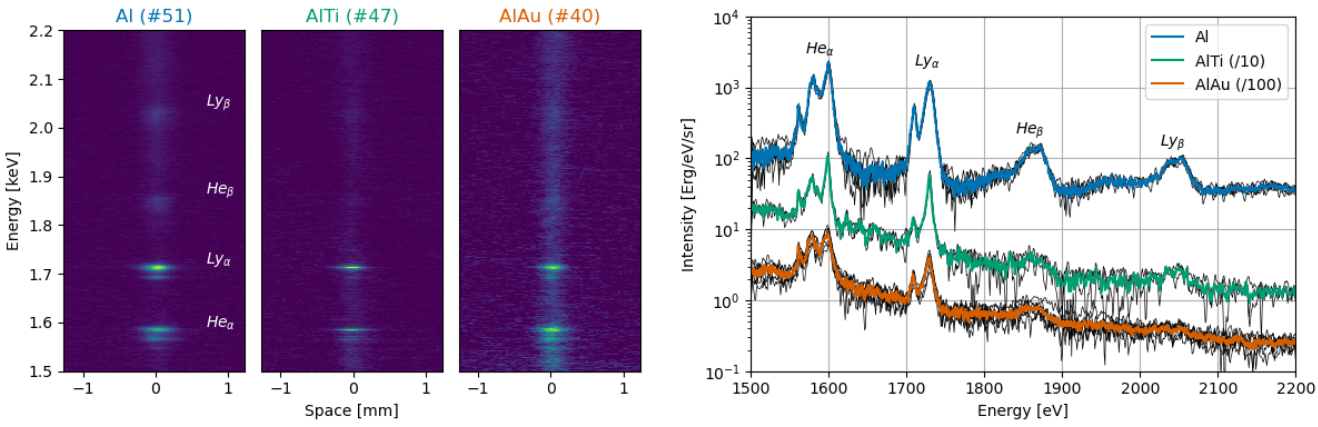

Figure 1. Example of time-integrated and space-integrated high resolution spectra of Al, AlTi and AlAu samples. (left) Raw data, (right) line profiles.

*E-mail: ludovic.lecherbourg@cea.fr