- IFSA2025 –

Experimental characterization of high brightness Xenon and Krypton x-ray sources at the LMJ facility

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Over the past few years, the Laser MégaJoule (LMJ) facility has been ramping up to few hundreds of kilojoules of laser energy delivered on target. Very bright multi-keV nanosecond x-ray sources can thus be generated, for example for studying x-ray interaction with materials. We have developed an experimental platform to characterize the x-ray emission in terms of spectrum, fluence and power using absolutely calibrated time-resolved x-ray diagnostics, sensitive to soft (few keV) and hard x-rays above 10 keV. At the LMJ facility, broadband x-ray spectrometers - namely the DMX [1] and mini-DMX - as well as the narrowband High Resolution X-ray Spectrometer (HRXS) are fully operational. We conducted experiments with xenon [2] [3] and krypton [4] gas bags, chosen for their peaked emission at 4-6 keV (L-band) and 13 keV (K-band), respectively, and their good laser-to-x-ray conversion efficiency.

During these experiments, the complete set of x-ray diagnostics provided consistent measurements, allowing an absolute characterization of the x-ray fluence and an estimation of the average electronic temperature (T_e) of the plasmas. Preliminary calculations, carried out with the SAPHyR atomic physics code for Non Local Thermal Equilibrium (NLTE) plasmas, corroborate T_e estimation for the krypton plasmas, using the He-like and Ly-like spectral structures measured by HRXS.

References

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