Quantitative X-ray Phase Contrast Imaging of a laser driven shock wave

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X-ray Phase Contrast Imaging (XPCI) [1] is a technique based on the photon phase-shift caused by an intense density gradient. It is therefore particularly indicated to probe materials which present density interphases such as a biological sample. However, this technique could also present several advantages compared to standard absorption radiography in the study of high energy density (HED) physics and warm dense matter (WDM). In particular, laser-induced shock-waves present high density gradients (in particular on the shock front) and they can propagate in materials at very different densities (e.g. multi-layer targets). To prove this, we performed an experiment at GSI using the laser PHELiX. In particular we used a ns laser pulse to lunch a shock-wave in a plastic cylinder and a sub ps laser pulse to generate a short X-ray back-lighter. The X-ray source was limited in space by the dimension of the target (5 μm diameter tungsten wire) to guarantee lateral coherence. From each experimental image, the amplitude and the phase map were extracted allowing a direct comparison with a hydrodynamic simulation, demonstrating the validity of such approach in HED and WDM physics.

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