X-ray phase contrast imaging applied to laser driven shocks

L. Antonelli\textsuperscript{1,2}, F. Barbato\textsuperscript{3}, S. Atzeni\textsuperscript{1}, D. Mancelli\textsuperscript{4}, J. Trela\textsuperscript{4}, G. Boutoux\textsuperscript{4}, D. Mancelli\textsuperscript{4}, G. Zeraouli\textsuperscript{5}, L. Volpe\textsuperscript{5}, C. Brabetz\textsuperscript{6}, V. Bagnoud\textsuperscript{6}, P. Neumayer\textsuperscript{6}, D. Bleiner\textsuperscript{3}, A. Schiavi\textsuperscript{1} and D. Batani\textsuperscript{4}

1) Dipartimento SBAI, Università degli Studi di Roma ”La Sapienza”, Via Antonio Scarpa 14, 00161, Roma, Italy
2) York Plasma Institute, Department of Physics, University of York, York, YO10
3) Empa - Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, CH8600 Dübendorf, Switzerland
4) Université de Bordeaux, CNRS, CEA, CELIA (Centre Lasers Intenses et Applications), UMR 5107, F-33405 Talence, France
5) CLPU, Centro de Láseres Pulsados, Edificio M5. Parque Científico. C/ Adaja, 8. 37185 Villamayor - Salamanca – Spain
6) GSI Helmholtzzentrum für Schwerionenforschung GmbH Planckstraße 1, 64291 Darmstadt, Germany

X-ray phase contrast imaging (XPCI) is an imaging technique based on the phase-shift of an X-ray photon induced by the refractive index. In particular, the phase-shift is related to the real part of the refractive index, while the imaginary part is related to the absorption. A coherent X-ray source such as a synchrotron or X-ray free electron laser are the best choice for XPCI, however, it is possible to use broadband incoherent X-ray sources by limiting the source size and careful positioning of the experiment and detector. The interaction of high power laser with matter produces X-rays according to the intensity, energy and pulse duration. These sources can be used for XPCI. In this poster we present the characterization and the application of XPCI using a laser-produced bremsstrahlung source to a shock. The X-ray source was created by irradiating a 5 μm diameter tungsten wire with a Nd:Glass laser pulse 0.5 ps long and energy of 25 J in first harmonic. This produces a strong bremsstrahlung radiation. We applied this source to XPCI static objects and a laser-driven shock-wave in a plastic target. In both cases the XPCI clearly indicates the presence of density interfaces with 5 μm spatial resolution. This proof-of-principle experiment shows how this technique can be a powerful tool for the study of warm and hot dense matter on large scale high-energy-density facilities.