The High Energy Density (HED) instrument at the European XFEL – status and perspectives

Ulf Zastrau[*1], K. Appel[1], C. Baehtz[2], S. Göde[1], H. Höppner[2], Z. Konôpková[1], H.-P. Liermann[3], M. Makita[1], M. Nakatsutsumi[1], A. Pelka[2], T. Preston[1], C. Strohm[3], T. Toncian

[1] *European XFEL, Schenefeld, Germany*

[2] *Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany*

[3] *DESY, Hamburg, Germany*

The advent of the first free-electron X-ray lasers (XFELs), FLASH in 2004 and LCLS in 2009, may prove to be the most profound development since the invention of the laser and, equally, the synchrotron. Sharp improvements in a number of laser parameters, most notably intensity and pulse duration, support this expectation. This brings scientific dreams within reach. Indeed, the unprecedented opportunities and expectations have triggered considerable research activities worldwide.

In 2019, the High Energy Density Science (HED) instrument at the European X-ray Free-Electron Laser Facility in Schenefeld, Germany, will allow investigations of a wide range of materials and systems at extreme conditions. For sample excitation a variety of high energy drivers will be installed [1]. In particular, a 100 J ns and a 200 TW fs optical laser will be available for warm- to hot-dense-matter creation, dynamic compression and laser-plasma interaction in electron-relativistic regime. These drivers will allow studying various phase space parameters with time-resolution down to 10 fs, pressures into the TPa regime, and electric field strength up to 10^{20} W/cm. This unique instrument is designed to enable the application of various x-ray probes including spectroscopic, diffraction and imaging methods [2]. It will operate in the photon energy range from 5 to 25 keV and will feature a variety of platforms facilitating the usage of different techniques in user-driven experiments. The capabilities of the HED instrument, which is built in strong symbiosis with the HIBEF user consortium [3], will be presented along with selected science cases.

REFERENCES

[1] M. Nakatsutsumi, K. Appel, G. Priebe, I. Thorpe, A. Pelka, B. Muller, Th. Tschentscher, Technical design report: Scientific instrument High Energy Density Physics (HED), XFEL:EU TR-2014-001, Germany, 196 p (2014). doi:10.3204/XFEL.EU/TR-2014-001. See also www.xfel.eu/research/instruments/hed

[2] K. Appel, M. Nakatsutsumi, A. Pelka, G. Priebe, I. Thorpe, Th. Tschentscher, Plasma Phys. Control. Fusion 57, 014003 (2015).

[3] www.hibef.de

[*] email: ulf.zastrau@xfel.eu