

Scientific opportunities at the HED beamline, European XFEL

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European X-ray Free Electron Laser Facility (XFEL) is a high-brilliance free-electron laser facility in the soft to hard X-ray regime [1], commissioned since mid 2017. The High-Energy Density (HED) science instrument is dedicated to the studies of matter at extreme pressure and temperature conditions [2 - 4]. The unique combination of XFEL pulse and the three optical lasers at this beamline allows for studies of ultra-short time-resolved HED dynamics, warm- and hot-dense matter, dynamic and static compression, x-ray isochoric heating, relativistic laser-plasma interaction and more.

In this talk I will present the scientific scope and capabilities of the HED instrument, and some preliminary results from the operations in 2019/2020. In particular, the results from the performed user experiments such as x-ray isochoric heating, x-ray focus characterisation, and high pressure experiments, will be highlighted.

Lastly, the current status and upcoming possibilities of the beamline will be discussed, in particular updates of the three optical pump lasers will be presented; *PP laser* (2–45mJ, 15fs - 1ps) – in commissioning in Oct 2020, *Amplitude laser* (~5J, 25fs) – commissioned in Dec 2019, and *DiPole laser* (~100J, 10ns) – planned commissioning in Spring 2021.

[1] www.xfel.eu

[2] M. Nakatsutsumi and Th. Tschentscher, Conceptual Design Report: Scientific instrument HED, doi: 10.3204/XFEL.eu/TR-2013-003 (2013)

[3] M. Nakatsutsumi et al., Technical Design Report: Scientific instrument HED, doi: 10.3204/XFEL.eu/TR-2014-001 (2014)

[4] U. Zastra et al., The High Energy Density Instrument at the European X-ray Free Electron Laser (in preparation)