INVESTIGATOINS OF HIGH-ENERGY-DENSITY STATE AT EUROPEAN XFEL

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The High Energy Density Science (HED) instrument at the European X-ray Free-Electron Laser Facility in Hamburg, Germany, is dedicated to the investigation of a wide range of materials and systems at extreme conditions of pressure, temperature, ionization or electro-magnetic field. For sample excitation a variety of high energy drivers will be installed at this instrument [1]. Three separate optical laser systems 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/cm2. In addition, a pulsed-magnet will provide magnetic fields up to 50-60 T. 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 3 to above 20 keV and will feature a variety of platforms facilitating the usage of different techniques in user-driven experiments. Due to the often non-reversible extreme excitation of the samples automated sample replacement schemes will have to be employed.
Being on the baseline instrument of European XFEL, first user experiments are planned for 2017. The installation of the high energy and high intensity lasers as well as of the pulsed magnets will be available through contributions by the Helmholtz International Beamline for Extreme Fields (HIBEF) User Consortium [3].
Capabilities planned for the HED instrument together with several science cases are presented.

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