

Innovative Research with the Helmholtz International Beamline for Extreme Fields at European XFEL

Ulrich Schramm and Tom Cowan, Helmholtz Zentrum Dresden Rossendorf, Germany

The HIBEF facility will establish ultra-intense and high power lasers, and pulsed magnets and high pressure cells, at the High Energy Density (HED) instrument of the European XFEL. Key research areas will include the creation and exploration of matter under extreme conditions of high pressure, temperature and electromagnetic fields. These will have great relevance for HEDP, relativistic laser plasmas, planetary science, material dynamics and damage, strong-field QED, and new magnetic phases.

Fundamental research at HIBEF will provide substantial benefit to future applications of high power lasers. One example is laser-ion acceleration for tumor therapy. Rapid progress is made in system design, dose delivery, and in-situ dosimetry, but the major remaining scientific challenge is to increasing the proton energies to above 200 MeV. Present experiments reveal the onset of strong electron transport instabilities at increased laser intensity. Coherent x-ray probing of relativistic laser-matter interactions with HIBEF at XFEL will be used to develop a predictive understanding of the complex interplay of electron acceleration, ionization dynamics, return current generation, electron transport, and the energy coupling to accelerator ions.