First Observation of THz SASE FEL Lasing at PITZ

Mikhail Krasilnikov [1]

[1] *THz@PITZ Team, Deutsches Elektronen-Synchrotron DESY, Zeuthen, Germany*

PITZ has reached an important milestone with the development of an accelerator-based tunable THz high-power source for pump-probe experiments at the European XFEL. After the installation of the first THz beamline and the commissioning of the electron beam, the firstp lasing at a central wavelength of ~100μm was obtained with 17 MeV/c electron beams. For this proof-of-principle experiments on high-power THz generation an LCLS- I undulator (on loan from SLAC) is installed in the tunnel annex downstream of the existing accelerator. A Self-Amplified Spontaneous Emission (SASE) FEL is used to generate the THz pulses. High radiation power can be achieved by utilizing high charge (up to several nC) electron bunches from the PITZ photo injector. This corresponds to a high beam current, which has been shown in simulations to be a key parameter for high gain THz-SASE FELs and has now been successfully demonstrated experimentally. The transport of this space charge dominated electron beam and its thorough matching into the planar LCLS-I undulator with a strong vertical focusing is one of the project challenges. A specially developed procedure for a high charge beam matching into the undulator was successfully tested resulting in a first THz pulse generation. The start-up THz diagnostics is based on pyrodetectors. First measurements of the THz generation from 1 nC, 2 nC and 3 nC bunches have been taken, the statistics properties analysis corresponds to the expected SASE performance. Currently, THz pulses with energy higher than 20 μJ have been detected at PITZ. A strong dependence of the THz SASE FEL performance on the transport and matching of high charge beams into the LCLS-I undulator was identified, further optimizations are planned. The details of the commissioning, the results of the first THz-SASE-FEL lasing at PITZ and further development steps will be presented.