

Physics and Applications of High Brightness Beams



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Status of the high-brightness photoinjector accelerator R&D and applications

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The Photo Injector Test facility at DESY in Zeuthen (PITZ) develops high brightness photocathode RF guns, advanced diagnostics and applications of the high brightness electron beams, which currently can be accelerated up to 22 MeV. In this talk, we will present the latest development at the L-band normal conducting photoinjector (e.g., new prototype RF gun Gun5.1, photocathode laser shaping and green cathode) and two applications: the worldwide first high-power THz SASE free-electron laser (FEL) and a new R&D platform (FLASHlab@PITZ) for FLASH radiation therapy and radiation biology.

The Gun5.1 was designed for the operation with an RF pulse length of 1 ms at a cathode gradient of 60 MV/m. It has been installed at PITZ since late 2021. The results from gun conditioning and its current performance will be discussed.

The THz SASE FEL aims at producing high power tunable narrow band THz pulses with an energy of hundreds of μJ per pulse. This can be realized by transporting and matching an electron beam with a bunch charge of 2 to 4 nC and a peak current up to 200 A into an undulator. Methods have been developed at PITZ for the beam envelop and trajectory optimization of the strongly space charge dominated electron beam. Results from the electron beam matching, THz lasing and seeding at 3 THz will be presented.

The R&D platform FLASHlab@PITZ for radiation therapy and radiation biology is being prepared at PITZ. PITZ can provide a uniquely wide parameter range for studying this newest modality of radiation treatment against cancer. A startup beamline has been installed, first successful experiments have been done and an upgrade plan for exploiting the full capability of PITZ has been developed. All these will be summarized in the talk.

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