



Contribution ID: 1539 Contribution code: MOPG65

Type: **Poster Presentation**

Towards short-pulse generation at FLASH via laser-assisted electron bunch manipulation

Monday 20 May 2024 16:00 (2 hours)

The FLARE project aims to investigate special operation modes of the laser heater at the free-electron laser FLASH in Hamburg that enable the generation of few- or possibly sub-femtosecond soft X-ray pulses. To this end, laser pulses of the laser heater are split and then recombined after one pulse has been delayed. By controlling the interference of both pulses via their temporal overlap, a longitudinally non-uniform heating of the electron bunches can be achieved. Utilizing this, two short-pulse generation schemes are to be implemented as part of the FLARE project. In the first scheme, the energy spread of the bunch is increased to a degree that inhibits lasing, leaving only a small unheated region which emits a short FEL pulse. The second scheme works by imprinting an energy modulation with a linearly increasing amplitude onto the longitudinal phase-space distribution of the bunch. In subsequent magnetic chicanes, this phase-space structure results in a localized compression of the bunch, creating an extremely short current spike, which might be used to produce an X-ray pulse on the same time scale. The FLARE setup as well as first experimental results are presented.

Footnotes

Funding Agency

Funded by BMBF (05K22PE1).

Paper preparation format

LaTeX

Region represented

Europe

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Session Classification: Monday Poster Session

Track Classification: MC2: Photon Sources and Electron Accelerators: MC2.A06 Free Electron Lasers