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Novel Photocathode Lasers for the Hard- and Soft-X-ray Free Electron Lasers EuXFEL and FLASH

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We commissioned a new type of photocathode laser systems (NExT generation Photocathode Laser NEPAL) at the superconducting XFELs FLASH and EuXFEL.

The NEPAL lasers provide temporal and spatial shaped picosecond deep UV pulses enabling very low emittance electron beams, which are needed for highest X-ray photon energies. At EuXFEL we have demonstrated an excellent transverse projected emittance of 0.375 mm mrad for the routine working point of 250 pC. The new laser systems offer advanced controls, including individual control over the generated electron bunch charge and temporal and spatial pulse shaping for emittance optimization. At EuXFEL we used the temporal shaping capability to match the electron beam properties to the existing laser, allowing fast switching in case of failures. Furthermore, we are exploring advanced shaping techniques that utilize the phase-shaping capabilities of our pulse-shaper for injector emittance optimization in an ongoing R&D project. Simulations show that the advanced beam shaping capabilities of the NEPAL lasers will both allow to push the X-ray photon-energy beyond 25 keV and to enhance special operation modes, such as attosecond X-ray generation.

Footnotes

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