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Novel photoinjector laser providing advanced pulse shaping for FLASH and EuXFEL

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We recently commissioned the Next GenerAtion Photocathode Laser system (NEPAL) in Hamburg's XFEL facilities (FLASH and EuXFEL) and at DESY's Photoinjector Test Facility (PITZ). The system delivers deep UV pulse trains up to 1 ms long at repetition rates as high as 4.5 MHz, with temporal and spatial shaping capabilities and individual amplitude control for bunch charge manipulation. The shaping features enable the generation of exceptionally low emittance electron beams, essential for extending the EuXFEL X-ray photon energy beyond 25 keV and for future high duty cycle upgrades. Temporal shaping is achieved through a high-resolution spatial light modulator in the near-infrared driver laser, allowing precise spectral amplitude and phase control of UV pulses. We will present advanced control schemes that pre-compensate for laser nonlinearities and initial experimental results at EuXFEL. We generated UV flat-top pulse profiles with durations ranging from 10ps to 20ps and successfully transferred them onto the electron beam. This achievement represents a significant step toward emittance optimization at EuXFEL and will expand the facility's operational energy range in the near future.

Footnotes

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