Contribution ID: **94** Type: **Invited talk**

Enhancing XFEL Performance Through Laser-Based Manipulation

Friday, June 23, 2023 11:30 AM (25 minutes)

While XFEL electron bunches can be manipulated for tailored x-ray generation via laser-electron interactions in select locations along the accelerator, such as laser heaters, XFEL performance is dominantly impacted by the electron bunch parameters directly after generation in the photoinjector. Optimal performance of the photoinjector requires excitation laser pulses, typically in the ultraviolet (UV), with non-Gaussian temporal intensity profiles and durations on the order of 10s of ps. We demonstrate a photoinjector laser shaping method with a numerical and experimental implementation to generate ˜25 ps flat-top pulses in the ultraviolet designed for MHz-rate photoinjectors which have been shown in simulation to reduce transverse emittance by upwards of 25%. We achieve upwards of 30% conversion efficiency during the nonlinear shaping stage allowing for applications of this method beyond XFELs to ones with higher bunch charge requirements. In supplement to the demonstrated experimental method, we show a machine learning extension aimed at kHz-level adaptive laser shaping for XFEL experiential multiplexing and fast-response machine performance optimization.

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Session Classification: Advanced concepts and Conclusions