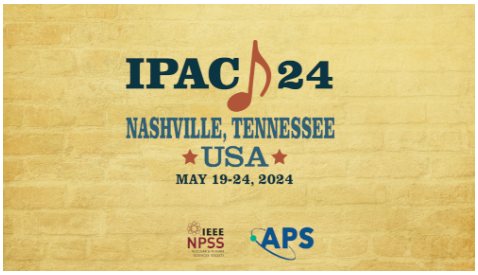


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# Realizing high average power temporal laser shaping for photocathode emittance reduction

*Tuesday, 21 May 2024 16:00 (2 hours)*

Generating low emittance electron bunches from the photocathodes backing free-electron lasers (FEL) is a potential source of significant improvement in achievable X-ray peak powers. Temporally shaping the photoexcitation lasers with intensity profiles that are perfectly flattop or ellipsoidal has been demonstrated to improve the emittance of the emitted electron bunch. However, experimental techniques to achieve these profiles have not been demonstrated at the high-energy, high-repetition rate conditions required by next-generation XFELs, such as LCLS-II(HE). We present an experimental demonstration of the dispersion controlled nonlinear synthesis (DCNS) technique* which has been shown in theory to produce emittance-reducing laser profiles under these conditions. Our implementation generates 20 picosecond pulses in the ultraviolet with a flattop intensity profile. We compare the simulated emission of electron bunches to the currently implemented Gaussian temporal profiles and the performance of LCLS-II XFEL with electrons generated from both laser profiles. Finally, we suggest methods to adapt DCNS to non-uniform shaping and for lasers using other nonlinear conversion processes.

## Footnotes

- Lemons, Randy, et al. PRAB 25.1 (2022): 013401.

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## Paper preparation format

## Region represented

North America

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