Contribution ID: **196** Contribution code: **TUP10** Type: **Contributed Poster**

Experimental Demonstration of Temporally Shaped Picosecond Optical Pulses for Driving Electron Photoinjectors

Tuesday, 23 August 2022 16:00 (20 minutes)

Next-generation electron photoinjector accelerators, such as the LCLS-II photoinjector, have increasingly tight requirements on the excitation lasers, often calling for tens of picosecond, temporally flat-top, ultraviolet (UV) pulse trains to be delivered at up to 1 MHz. *We present an experimental demonstration of temporal pulse shaping for the LCLS-II photoinjector laser resulting in temporally flat-top pulses with 24 ps durations. Our technique is a non-colinear sum frequency generation scheme wherein two identical infrared optical pulses are imparted with equal and opposite amounts of spectral dispersion. The mixing of these dispersed pulses within a thick nonlinear crystal generates a second harmonic optical pulse that is spectrally narrowband with a designed temporal profile**. In experiment we achieve upwards of 40% conversion efficiency with this process allowing this to be used for high average and peak power applications. These narrowband pulses can then be directly upconverted to the UV towards use in driving free electron laser photocathodes. Additionally, we present a theoretical framework for adapting this method to shape optical pulses driving other photoinjector based applications.

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Session Classification: Tuesday posters

Track Classification: Electron sources