Quasi-Ellipsoidal Photocathode Laser at PITZ.

I. Hartl, S. Schreiber, Deutsches Elektronen-Synchrotron, Hamburg, Germany.
E. Syresin, JINR, Dubna, Moscow Region, Russia.

# james.david.good@desy.de

Abstract

Work has been on-going on the facility’s prototype photocathode laser capable of producing homogeneous quasi-ellipsoidal pulses. Simulations have shown that these pulses allow the production of high brightness electron bunches with minimized emittance [1] when compared to traditional Gaussian or cylindrical pulses. The laser system was developed in collaboration with the Institute of Applied Physics (Nizhny Novgorod, Russia) and the Joint Institute for Nuclear Research (Dubna, Russia), and with their continued support and development.

Here is presented the recent progress, calibration and characterization results, infrared spectrographic reconstruction, and the potential simplified, stability-focused redesign.

Quasi-Ellipsoidal Photocathode Laser System

Double-pass spectral amplitude-phase masking technique

- Spectrally transformed chirped pulse imaged onto SLMs
- Frequencies modulated by separate amplitude/(phase) masks
- Pulse recombined, laterally rotated, and perpendicularly reshaped

- Frequency conversion crystals (2nd and 4th harmonics

Characterization and optimization by:

- Transverse imaging (IR & UV), IR cross-correlator,
  UV/IR cross-correlator [3], IR spectrograph, & electron beam diagnostics

ASTRA simulations

IR spectrograph

IR cross-correlator coupled
- SLM-scan spectrometer [4] (modified IAP 8600 design)
- Standard Czerny-Turner layout w/ 20 nm on-camera spectral dispersion

Spectrographic reconstruction


References


Pharos-based revision

- Simplified, linear layout with modularized & mechanically robust cryostat
- 50% reduction in path length & optical
- Improved thermal robustness & pointing
- Greater mask resolution & temporal stroboscopic
- Dichroic SLMs (IR/green)
- Single source oscillator-amplifier (Pharos)
at reduced rep. rate
→ 100 µJ/pulse