New Ellipsoidal Laser at the Upgraded PITZ Facility.

I. Hartl, S. Schreiber, DESY, Hamburg, Germany.
A. Andrianov, E. Gacheva, E. Khazanov, S. Mironov, A. Poteomkin, V. Zelenogorsky, IAP, Nizhny Novgorod, Russia
E. Syresin, JINR, Dubna, Moscow Region, Russia
O. Lishilin, G. Pathak, Hamburg University, Hamburg, Germany.

# james.david.good@desy.de
† INRNE, Sofia
‡ Assiut University, Egypt
§ JLab, USA
$ SOLEIL, Paris
¶ IMP/CAS, China

Abstract

Last year the facility was significantly upgraded with a new prototype photocathode laser capable of producing homogenous quasi-ellipsoidal pulses. Previous simulations have shown that the corresponding pulses allow the production of high brightness electron bunches with minimized emittance [1]. A laser system was developed in collaboration with the Institute of Applied Physics (Nizhny Novgorod, Russia) and the Joint Institute of Nuclear Research (Dubna, Russia).

Furthermore, a new normal-conducting RF gun cavity was installed with a modified two-window pair RF feed layout for improved stability and reliability [2]. The supporting RF and water cooling systems for this gun were also improved. A detailed photoemission and emittance (see MOD04) measurement program was carried out. Finally, a new Transverse Deflecting Structure (TDS) (see MOD09) was installed and commissioned in July, and initial proof-of-principle experiments with a plasma cell for beam-drive plasma acceleration have begun.

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:
- IR cross-correlator coupled camera
- Future UV/IR cross-correlator [3]
- Electron beam diagnostics

Experimental results (1st electrons generated in April 2015)

Top: Laser pulses imaged – by help of wire cross - onto the virtual camera (VC2)
Above: Electron bunch behind booster, imaged at camera High112r (5.74 m behind cathode)

Photoemission Studies

- Studies of quantum efficiency degradation over time
- Observable development of hot/cold spots
- Consistent across surface
- Photocathode laser core/halo investigation [4]
- Improved radial beam profile taken from measurement
- Full suite of comparative experimental data taken
- Explanation for previous charge extraction behavioral discrepancies

Refurbished Gun 4.2 and RF Feed Layout

- refurbished Gun 4.2 with re-machined backplane
- Cathode spring updated to new contract stripe design
- RF feed (up to 8 MW) migrated from a single RF window layout [5] to a two-window setup [2]
- one 10 MW in-vacuum Thales window solution [5]
- RF power now shared over two Thales RF windows
- After conditioning, no problems anymore with the double RF window pair setup

References