Quasi-Ellipsoidal Photocathode Laser at PITZ.

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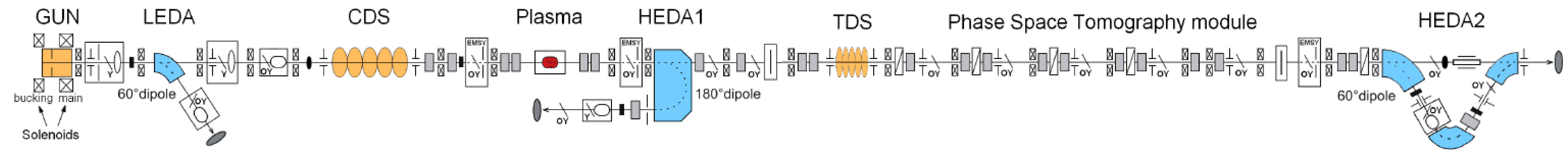
Abstract

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).

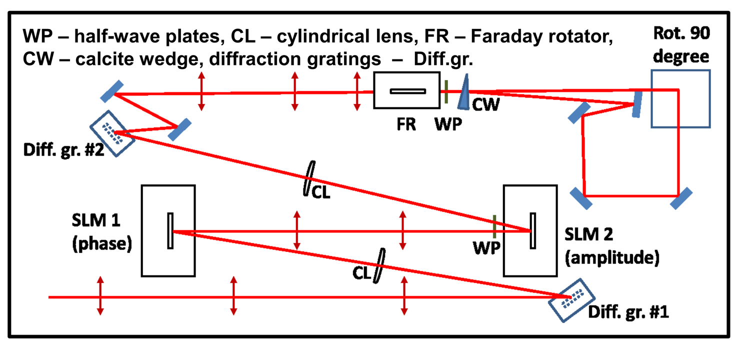
Here is presented the recent on-table calibration and characterization results, envisioned infrared, and ultraviolet, spectrograph designs, revisions and potential simplified, stability-focussed, redesign.

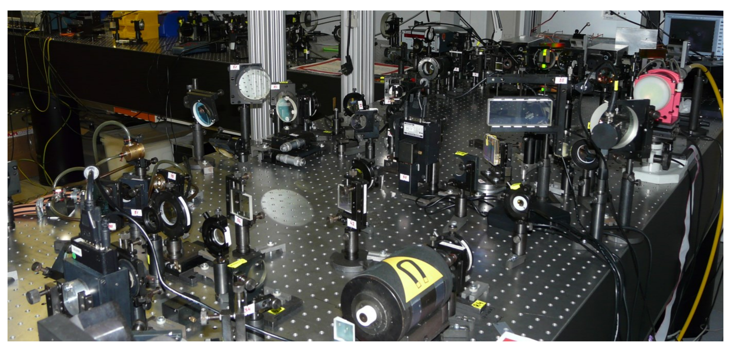


Above: Current PITZ beamline with TDS and Plasma Cell

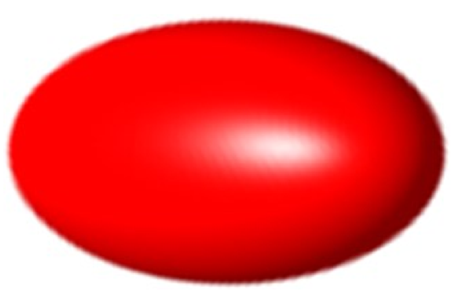
Quasi-Ellipsoidal Photocathode Laser System*

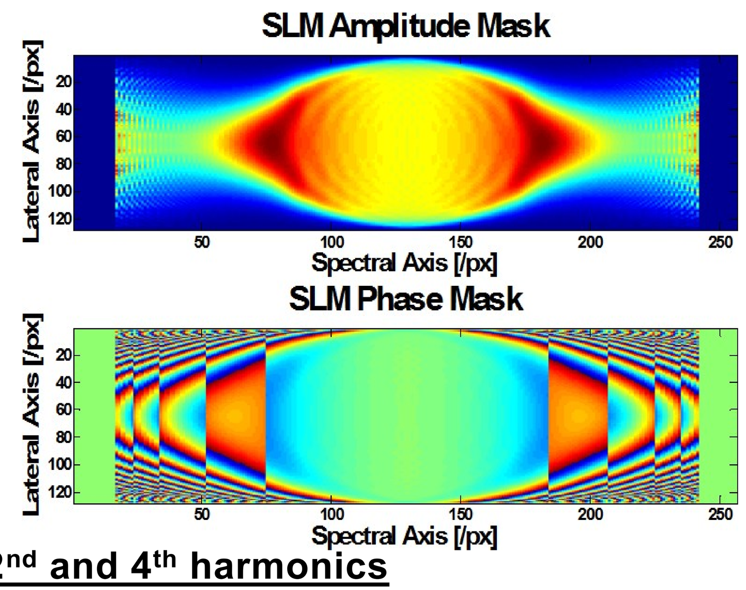
Double-pass spectral amplitude-phase masking technique





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



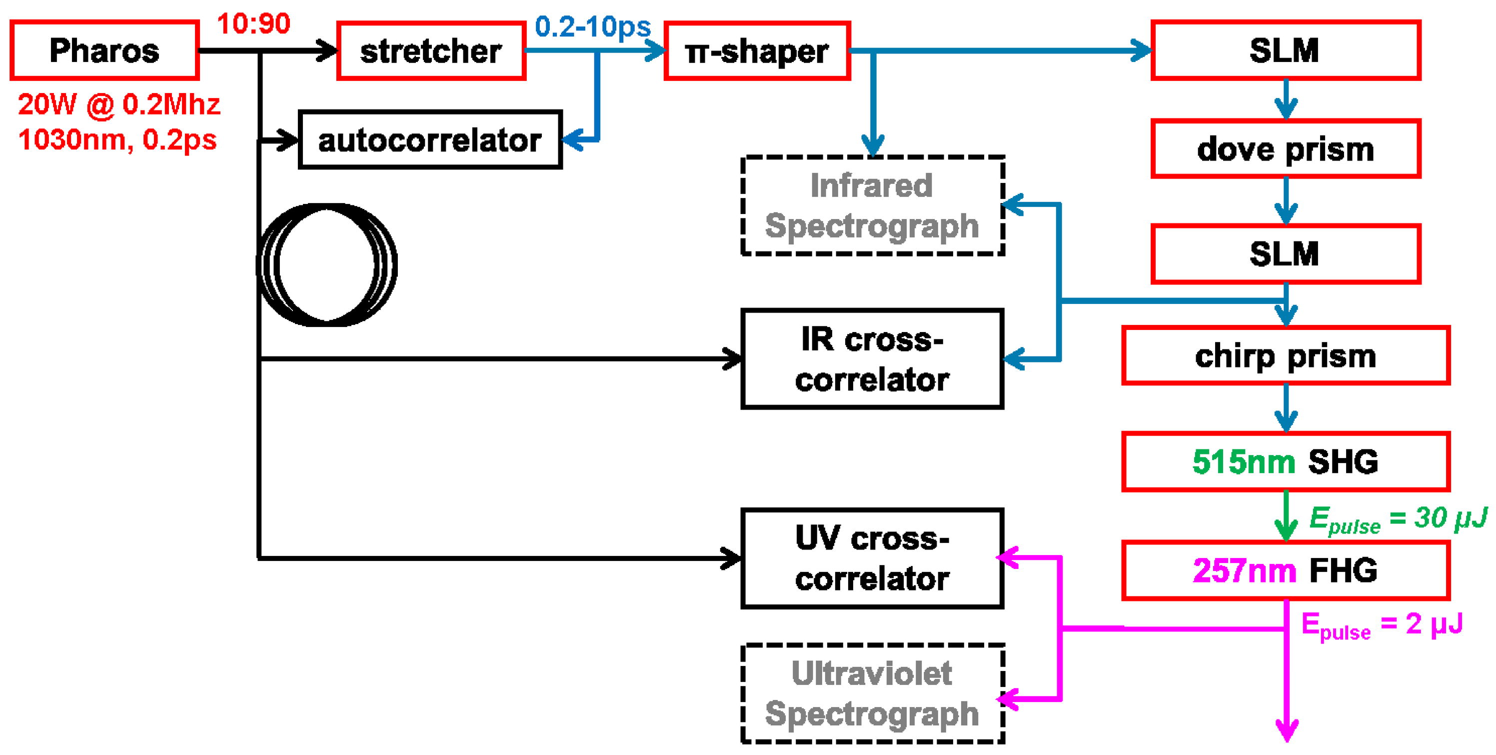


- **Frequency conversion crystals (2nd and 4th harmonics**

Characterization and optimization by:

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

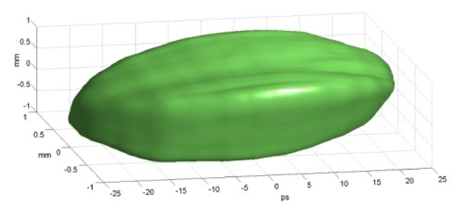
Simplified schematic overview & goals



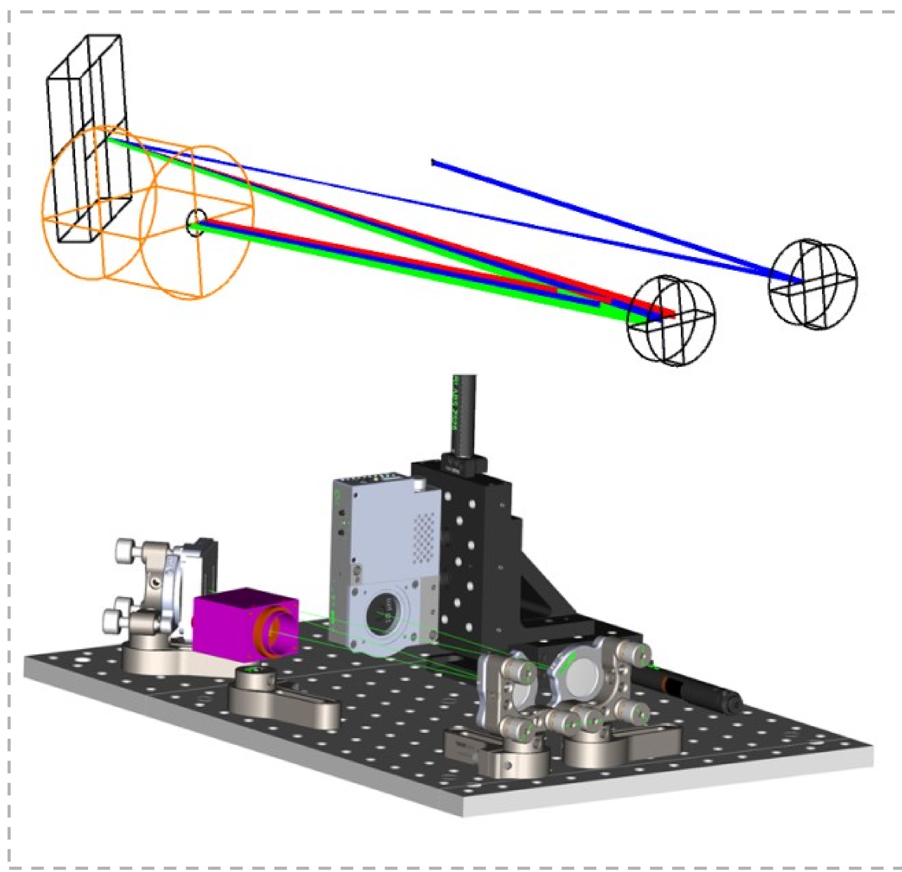
- 50% reduction in path length & optical elements
- Improved thermal robustness
- Improved pointing stability
- Greater mask resolution & temporal stability
- Single source oscillator-preamplifer (Pharos) *at reduced rep. rate*

IR/UV spectrograph designs

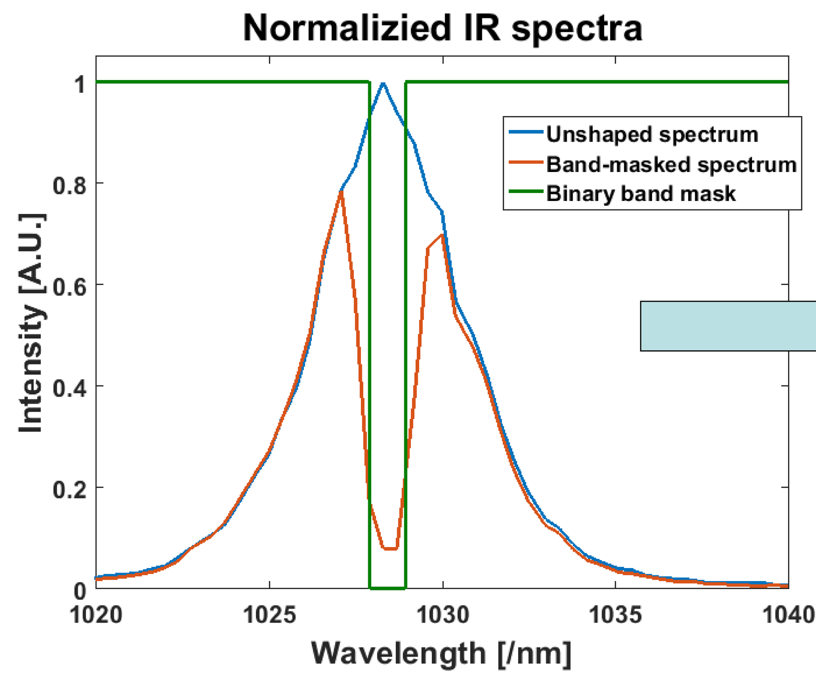
IR cross-correlator coupled
- Slit-scan spectrometer (modified IAP f600 design)

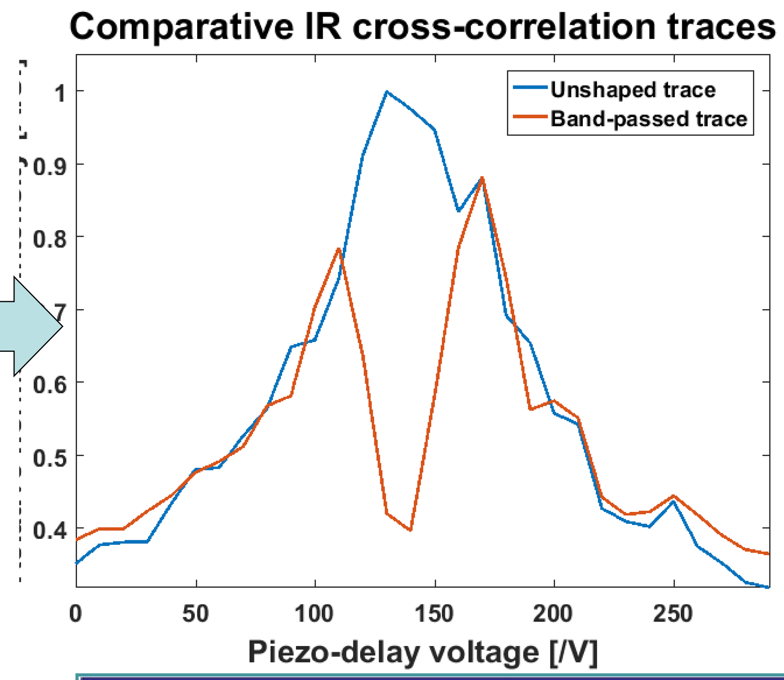


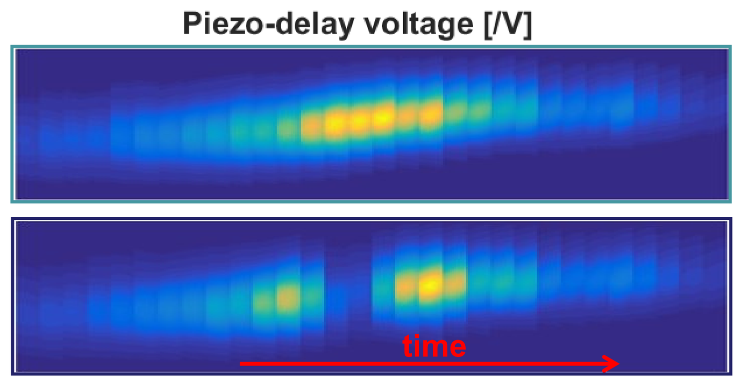
- Standard Czerny-Turner layout
- 20 nm on-camera spectral dispersion
- Modularized, stable, compact design



Binary band-masked central wavelength







- Directly comparative infrared temporal-spectral measurements

References

[1] M.Khojoyan et al., Optimization of the PITZ photo injector towards the best achievable beam quality, Proc. FEL2014, Basel, Switzerland (2014).
[2] A. Oppelt et al., Facility Upgrade at PITZ and First Operation Results, IPAC'15, Richmond, VA, USA (2015).
[3] V V Zelenogorskii, Scanning cross-correlator for monitoring uniform 3D ellipsoidal laser beams, 2014 Quantum Electron. 44 76

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