

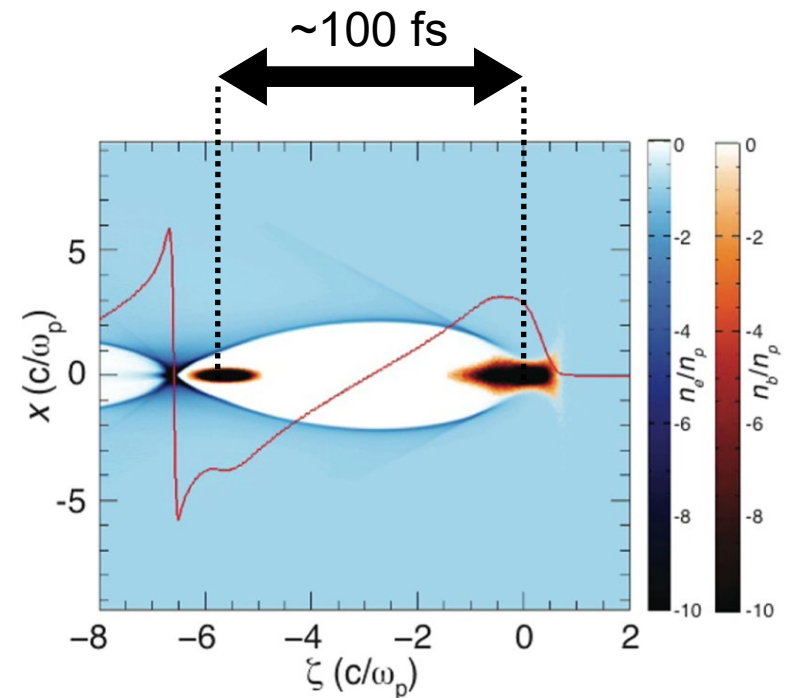
Electro-Optic Sampling Beam Position Monitor Status and Plans

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FACET-II User Meeting 2023



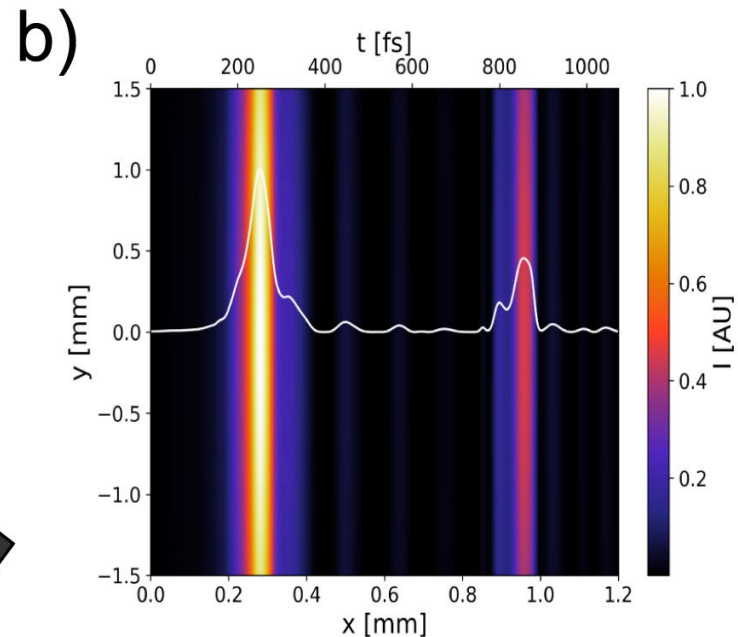
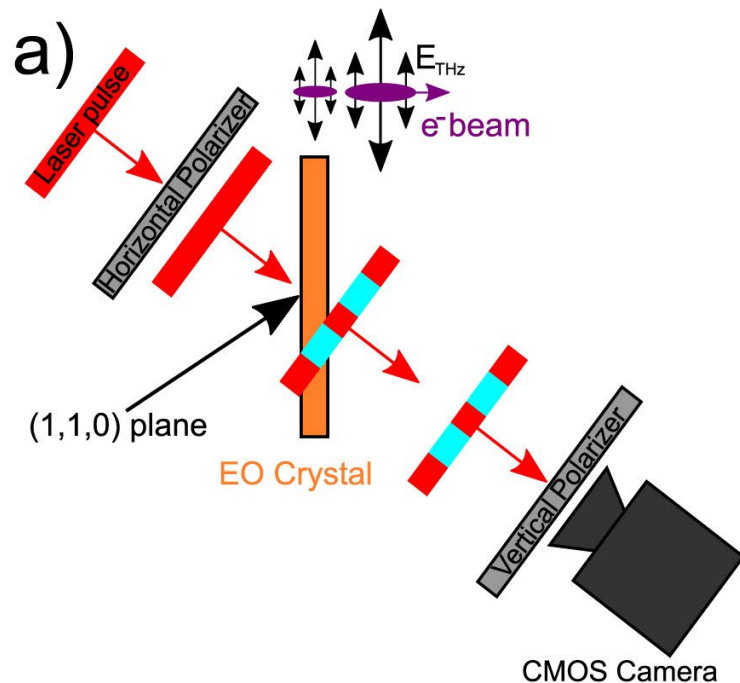
Motivation

- PWFA requires diagnostics of drive-witness separation and transverse offset beyond the capabilities of conventional beam position monitors.
- EOS-BPM is a non-destructive single shot diagnostic that can provide this information, as well as information about total charge and beam tilt.



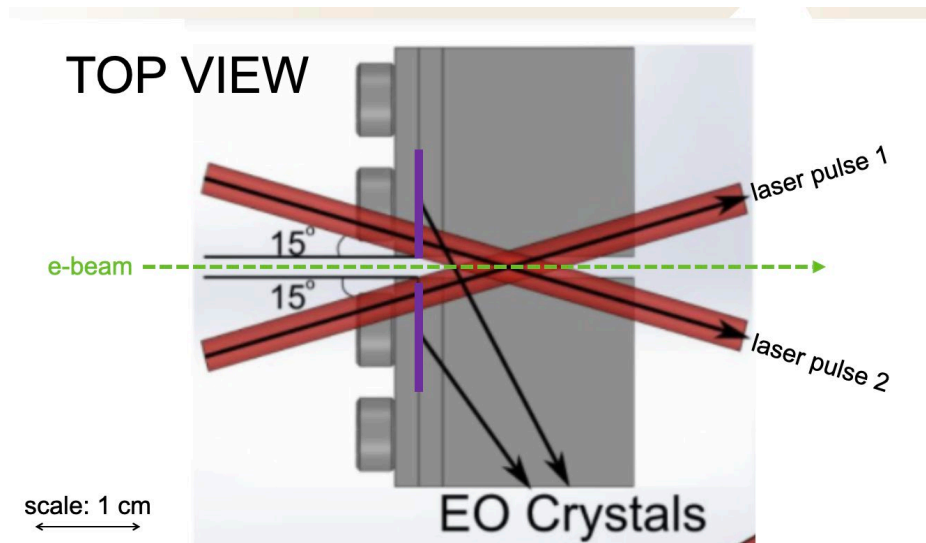
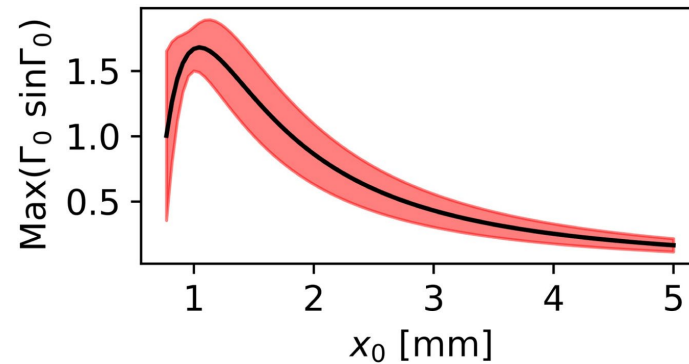
Electro-Optic Sampling

- Two passing bunches send two half cycle THz pulses propagating through an electro-optic crystal which induce a birefringence
- A horizontally polarized laser pulse passes through the crystal at an angle picking up a spatially encoded polarization rotation. Then a vertical polarizer removes everything but the signal, which is imaged.
- The image is analyzed to obtain the bunch separation with a theoretical resolution of 10fs.

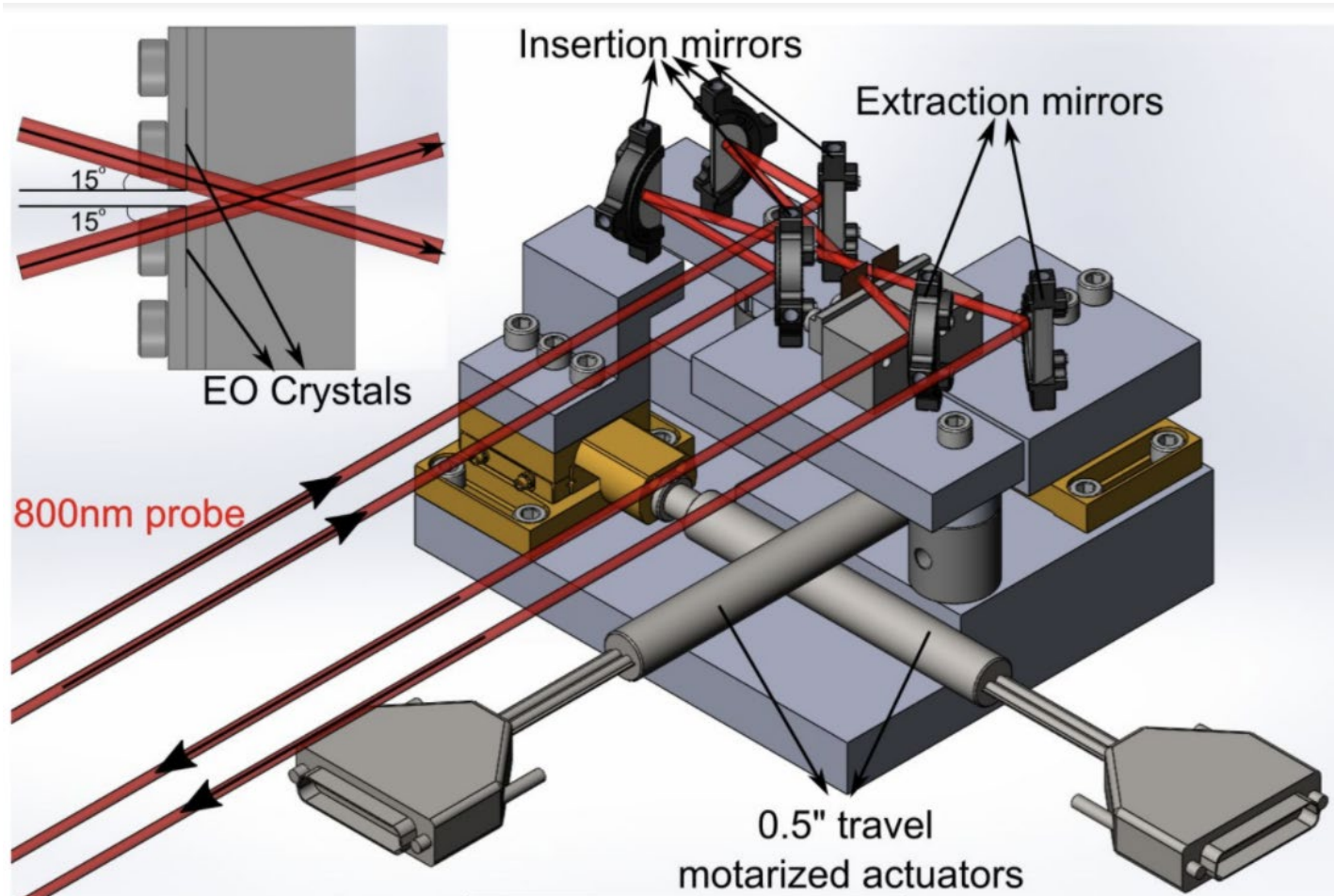


Electro-Optic Sampling Beam Position Monitor

- By comparing the signal strength from two electro-optic crystals on either side of the beam, the transverse offset can be determined to $\sim 1 \mu\text{m}$ resolution.
- Crystals are either 1mm ZnTe (High Signal, Low Resolution) or 100 μm thick GaP (Low Signal, High Resolution).

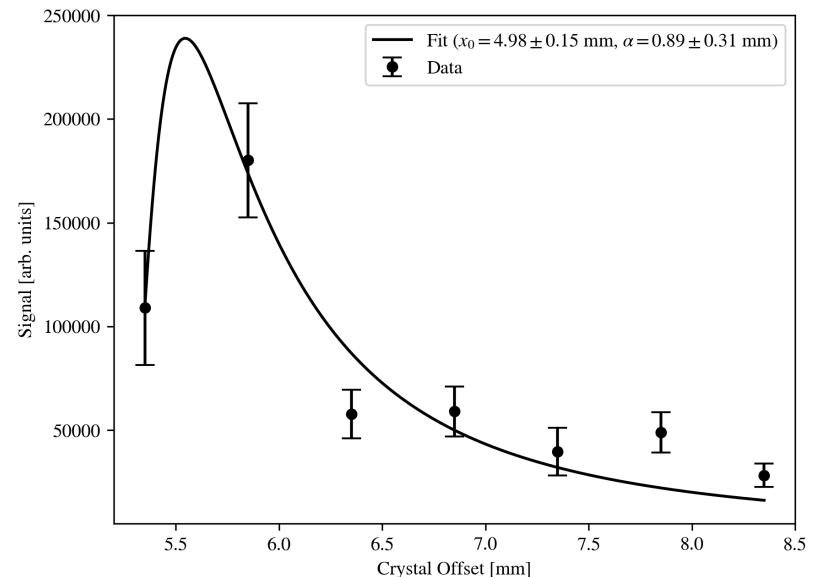
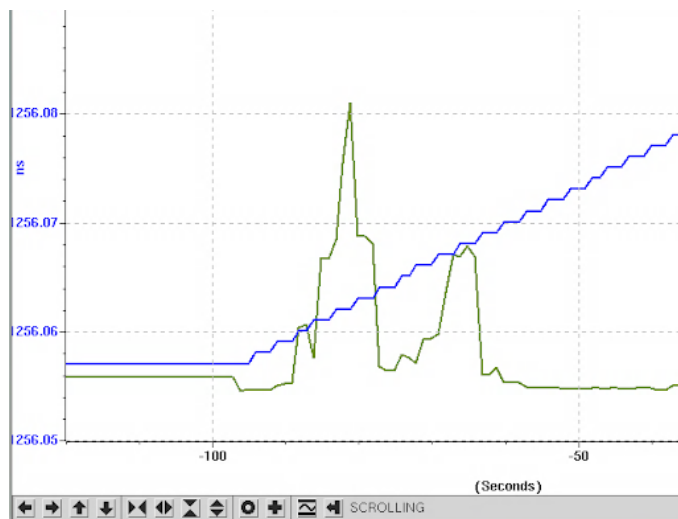


Current Setup



Last Year

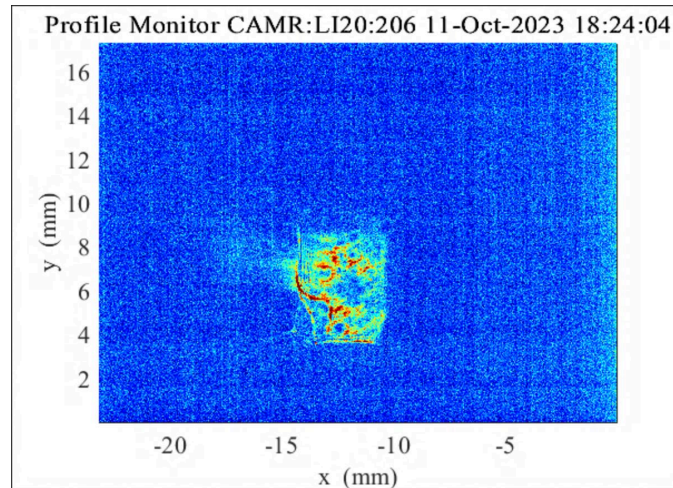
- T_0 and Time-to-Pixel conversion factor were determined
- Beam arrival time jitter was determined
- Correlation Studies were performed to look for correlation to the TCAV and upstream PVs
- A single crystal was used to estimate beam transverse position —“Poor Man’s BPM”



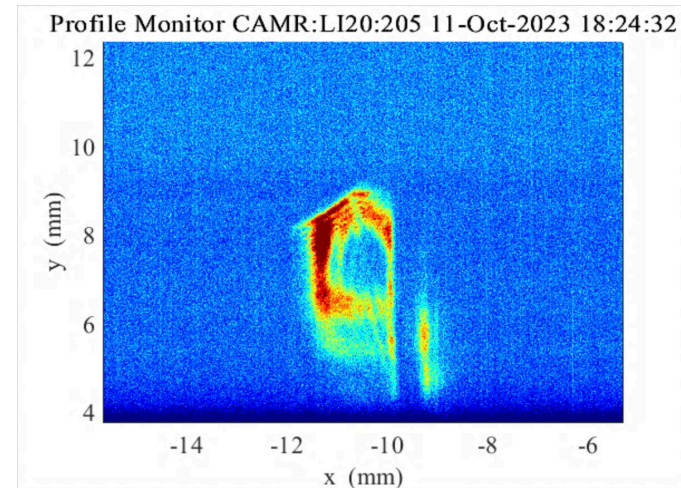
Current Status

- Currently one ZnTe and one GaP crystal are installed
- Aligned probe and EOS during the PAMM two weeks ago
- Last week attempted a timing shift, but a FACET-wide timing issue and camera server issues prevented this

EOS1

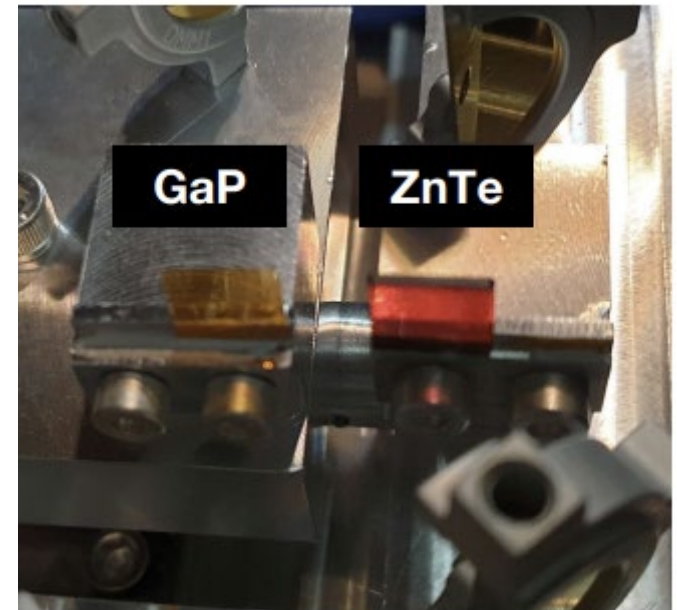


EOS2



Near-Term Plans

- Redesign crystal mount and swap ZnTe with GaP.
- Develop an EOS-BPM DAQ/DAN panel to streamline workflow
- Improve alignment procedure and general probeline upgrades. (Visible laser for alignment?)
- Realign including through the picnic basket
- Commission full BPM functionality



EOS-BPM 2.0

- Radiabeam Technologies/CU Boulder received a phase I SBIR to improve the existing EOS-BPM and design an improved EOS-BPM over the next 9 months.
- Work at RBT is being led by Loic Amoudry, who will be coming to SLAC regularly
- 4 crystals for transverse offset information in x and y
- Swappable crystals
- Higher purity polarizers
- Remote laser alignment
- Independently adjustable crystal positions

Thank You!

SLAC

Questions?