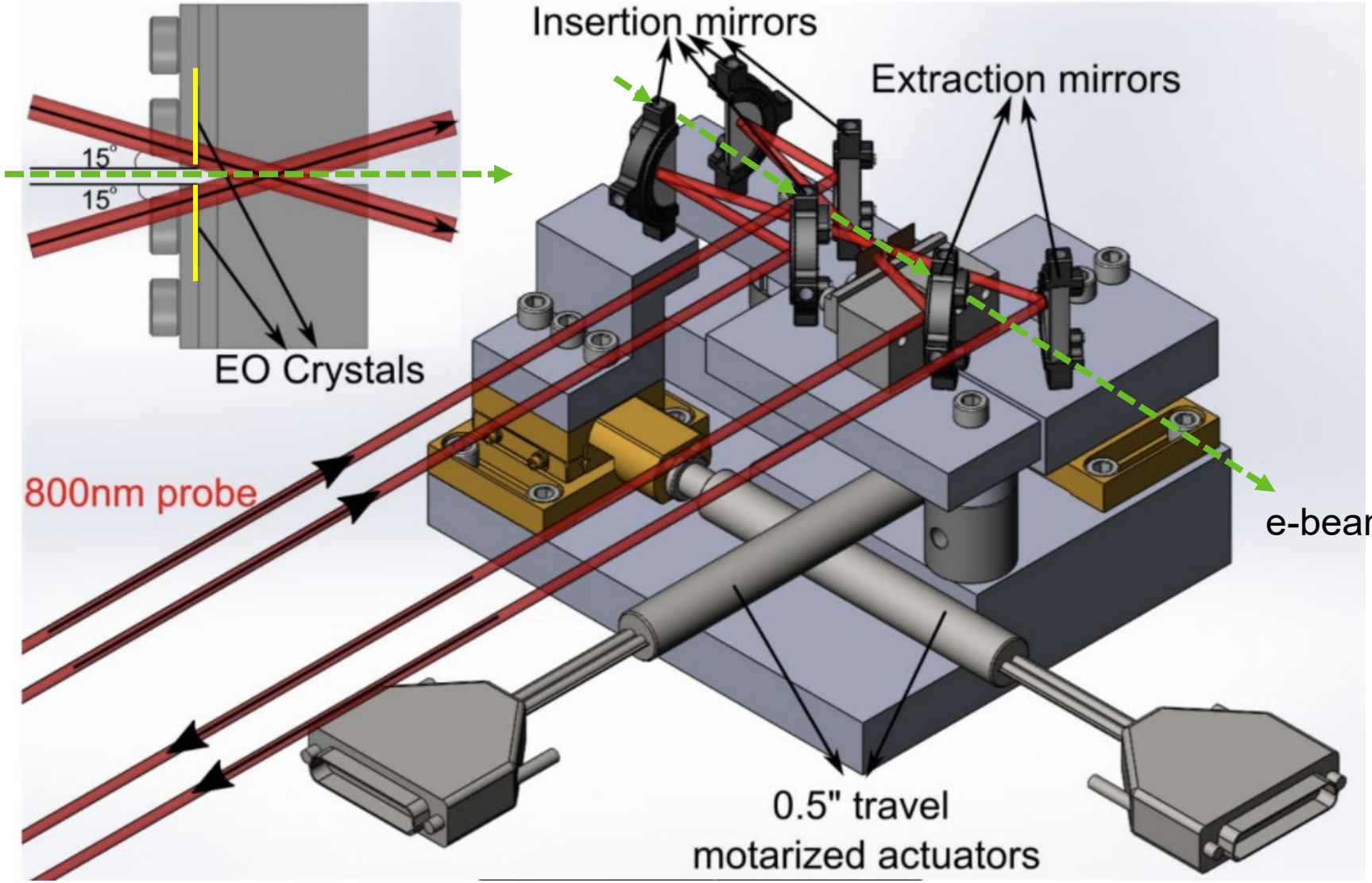
# EOS Status – May 2022
## E300 Collaboration Meeting

Christopher Doss, May 3, 2022

U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

# EOS-BPM Hardware



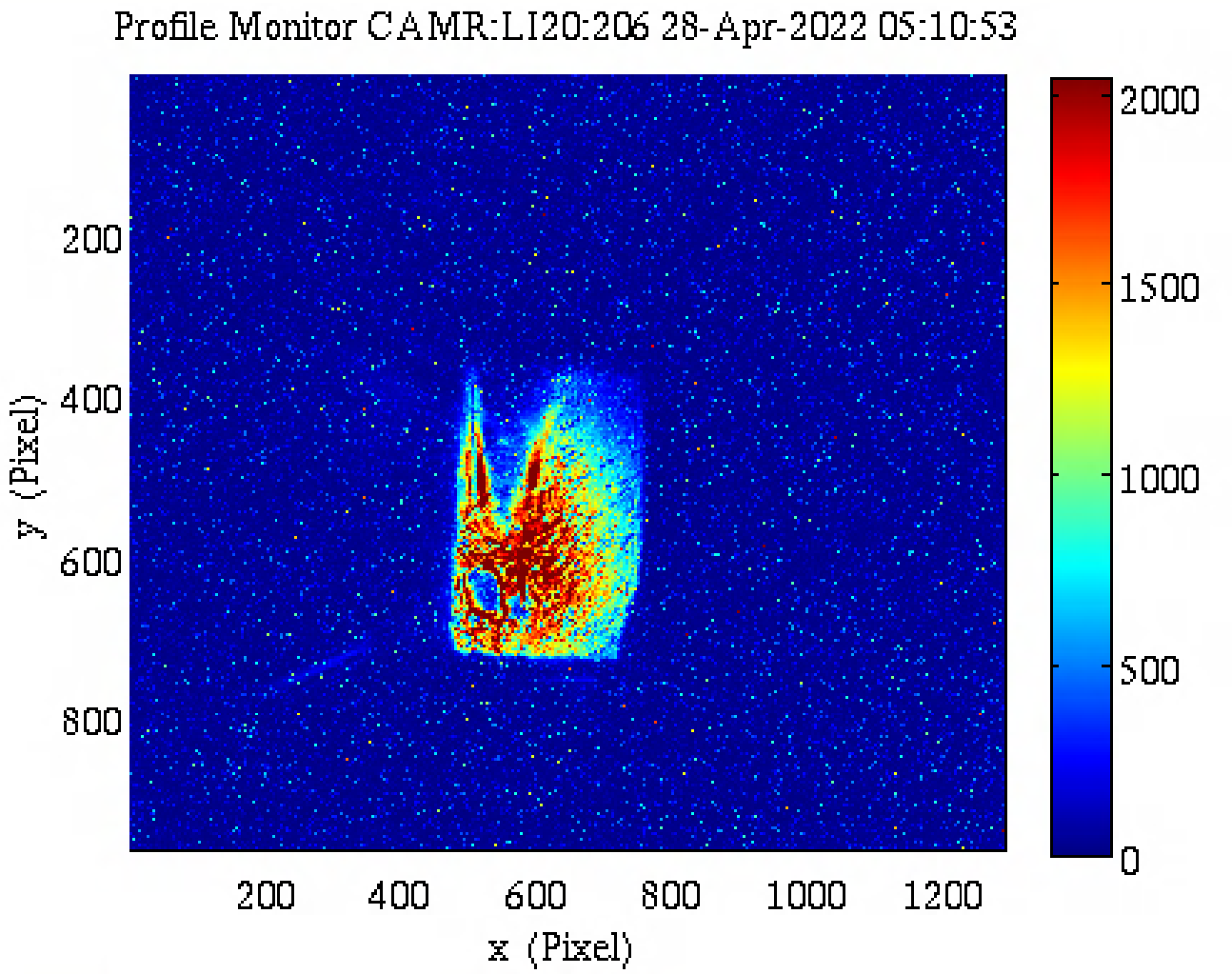
# EOS Status



- Currently installed is a single, 1 mm thick ZnTe crystal.
  - ZnTe crystals are high signal, low resolution.
  - GaP crystals are low signal, high resolution.
- With only one crystal, we don't have access to BPM capabilities.
- Current ZnTe crystal will have a saturated signal, so no beam current resolution yet.
- Next step is a first commissioning shift of this single crystal to find any signal and optimize the timing between the probe laser and the electron beam.
- For the future two-bunch electron beam, we have two 100 um GaP crystals waiting to be installed.

# EOS1 Camera Image from last access

NAME **EOS1**, X_ORIENT Negative, Y_ORIENT Negative, RESOLUTION 17.94



# EOS Commissioning Plan

SLAC

Goals:

- Find measurable signal using low-res, high-signal crystal.
- Measure timing stability between laser and e-beam.

Shift Plan:

- Requires a stable e-beam orbit and laser alignment.
- Requires coarse laser/e-beam timing to start within ~1 ns for EOS signal search (e.g. from plasma/e-beam timing or from laser/e-beam timing on OTR screen)
- Scan laser delay via digital delay until EOS signal is found.

# Goals for the EOS-BPM in the Future



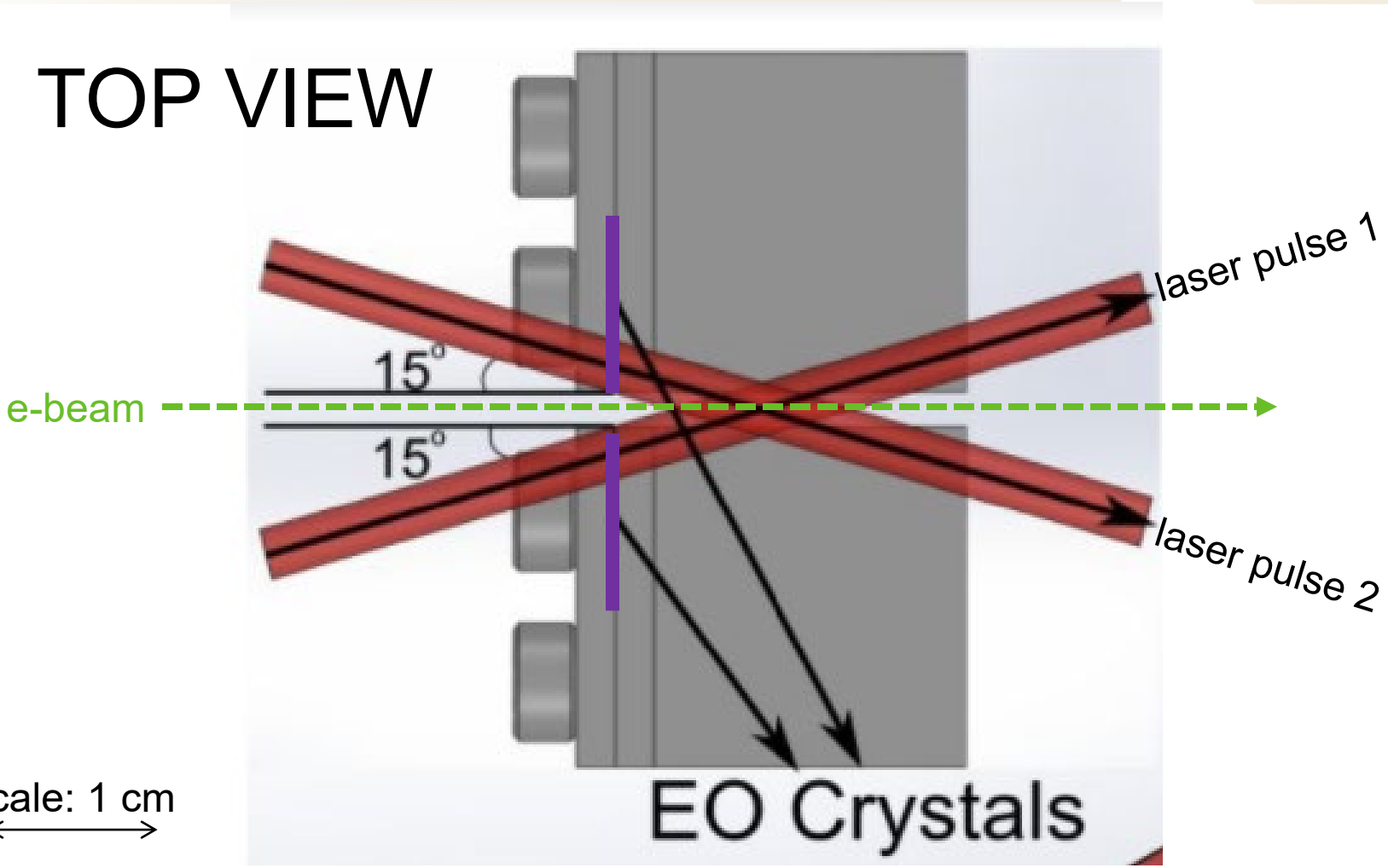
- With 2 thin 100 μm GaP crystals installed, the EOS-BPM will be a non-destructive tool for measuring both transverse and longitudinal beam positions for each bunch on a shot-by-shot basis.
  - Transverse Resolution of 1 μm
  - Longitudinal/Temporal Resolution of 10 fs.
- A crystal-beamline separation of 1.3 mm will maximize the signal imparted on the probe laser
  - Detectable signal of 8% laser energy for a weak e-beam of $Q = 800$ pC and $\sigma_z = 40$ μm.

# Thanks!

SLAC

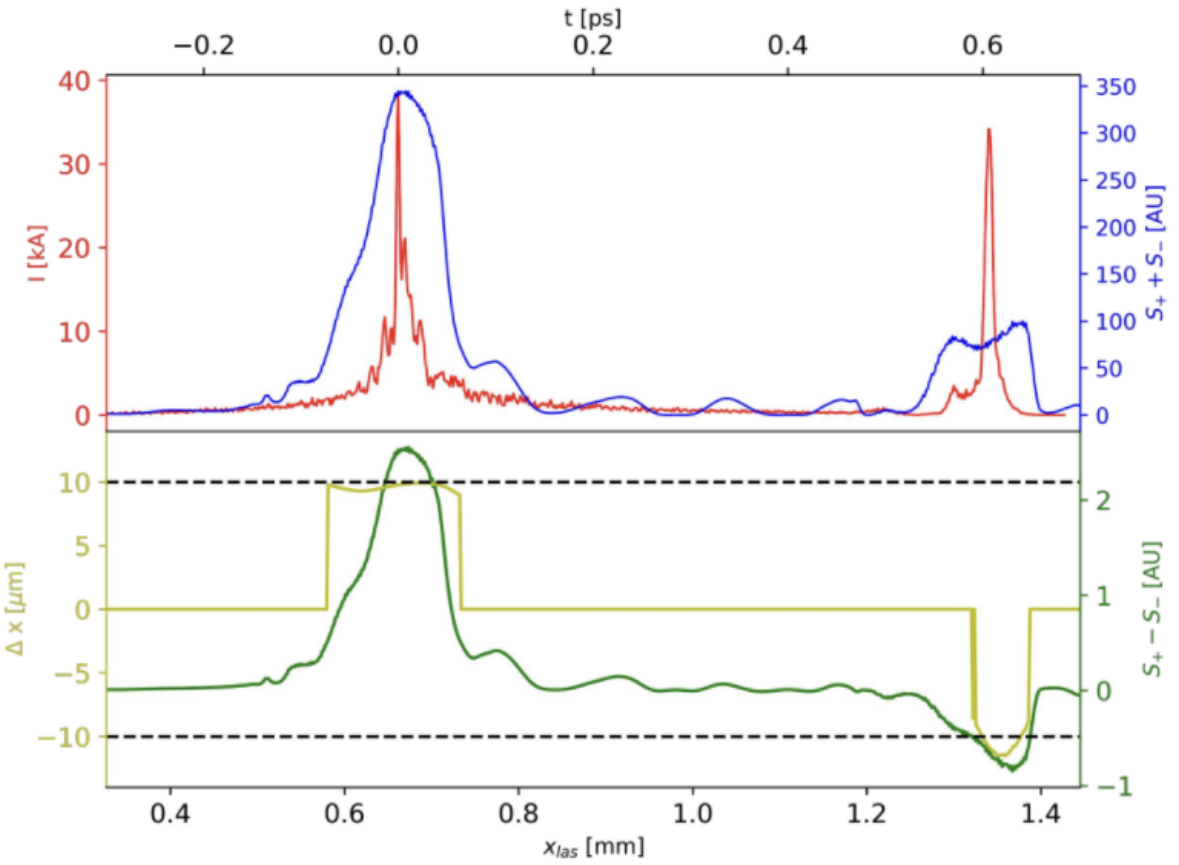
Any Questions?

# EOS-BPM Hardware




EO Crystals: 1cm x 1cm in transverse plane, 1-5 mm from e-beam axis

# Sample Data for Two-Bunch Operation




Here the drive (witness) is offset +(-) 10 microns from the center axis.

When calculating the offset a filter is applied setting the offset to 0 for

$$S_+ - S_- \leq 0.5$$

Taking the average computed offset near the drive and witness bunch gives offsets of 9.6 and -10.4 microns respectively.

First order Taylor expansion provides sub-micron measurements of bunches' transverse offsets

# 4/27/22 logbook entry from Zhijiang and Elias:

SLAC

- EOS stage "in" position is 12mm (alignment HeNe next to the ZnTe)
- We use an iris right after the ionizer/shadowgraphy beam splitters to get a flat wavefront, and
- use a 3X telescope to magnify the beam size on EOS crystal (-40mm + 125mm lenses pair)
- For EOS1 camera, we replaced the filter stack with an ND1 filter
- E5 stage (polarizer before EOS1 camera) is used to control the laser transmission.
- Without EOS effect, maximum brightness at 0 deg, minimum brightness at 90 deg