

# S20 laser and diagnostic probe lines

2023 FACET-II User Meeting

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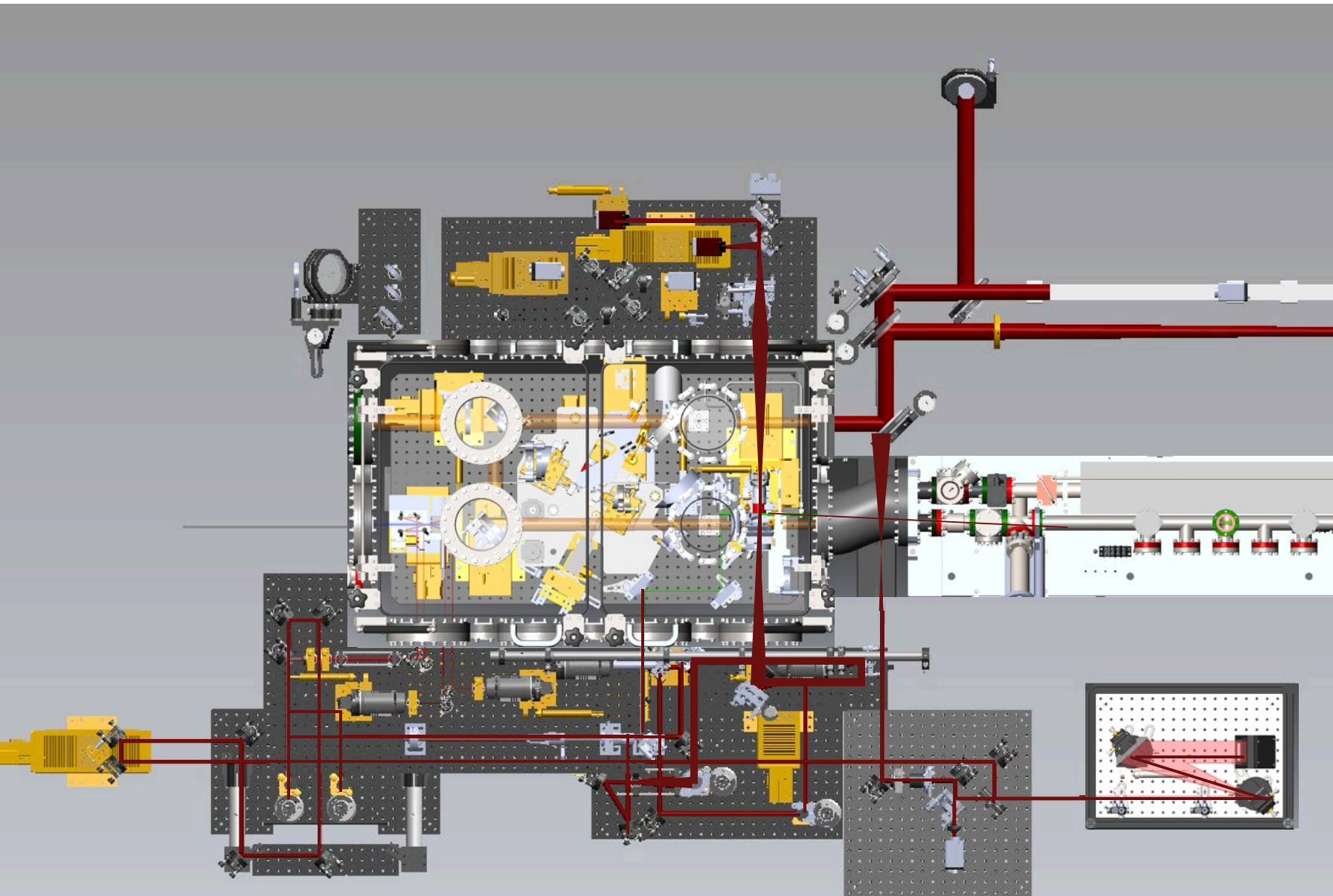
October 17-19, 2023



Facility for Advanced Accelerator Experimental Tests

S20 laser and diagnostic probe lines

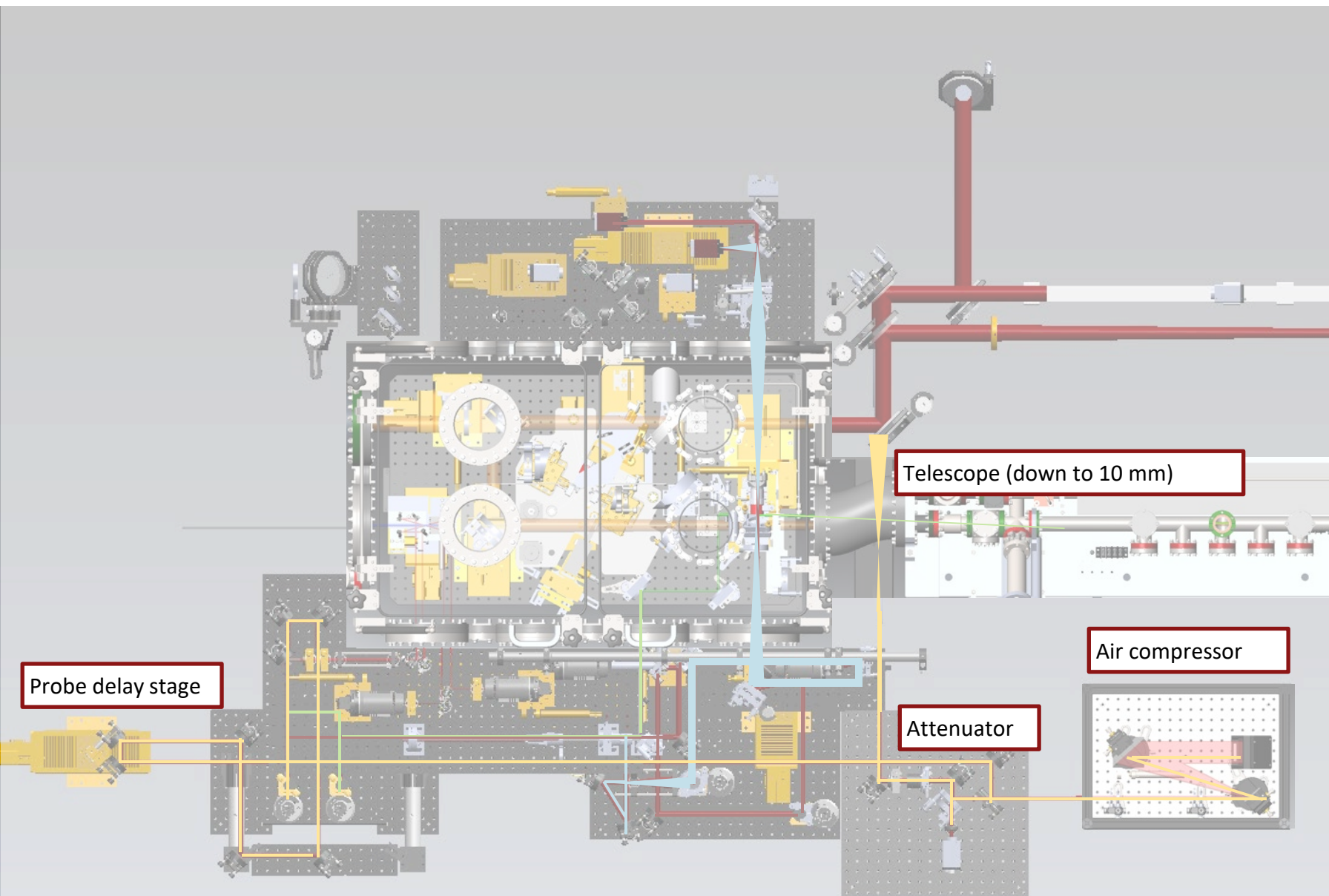
# The sector 20 probe beam



- 10+ experiments
- 4 laser arms

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- EOS
  - Plasma imaging
  - Shadowgraphy
  - Ionizer

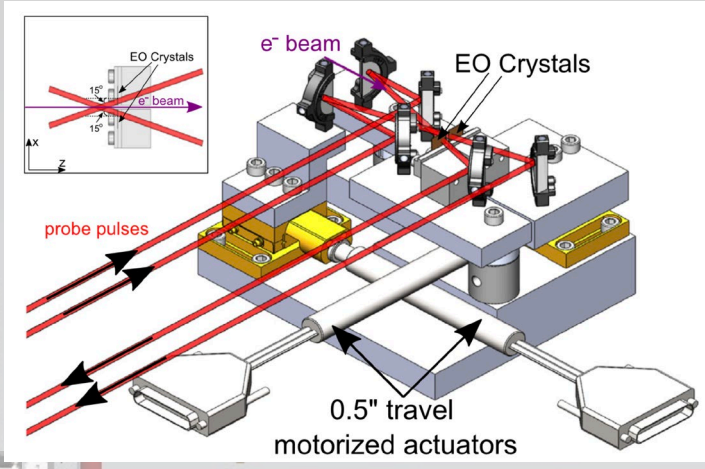
# Sector 20 probe beam: General parts



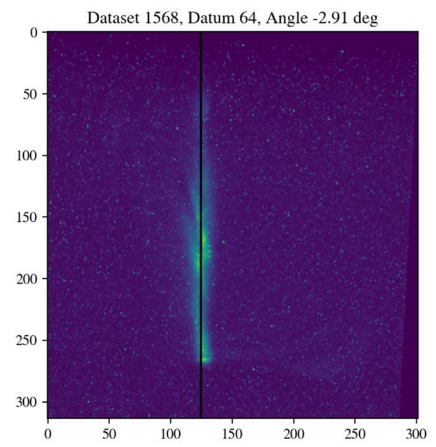
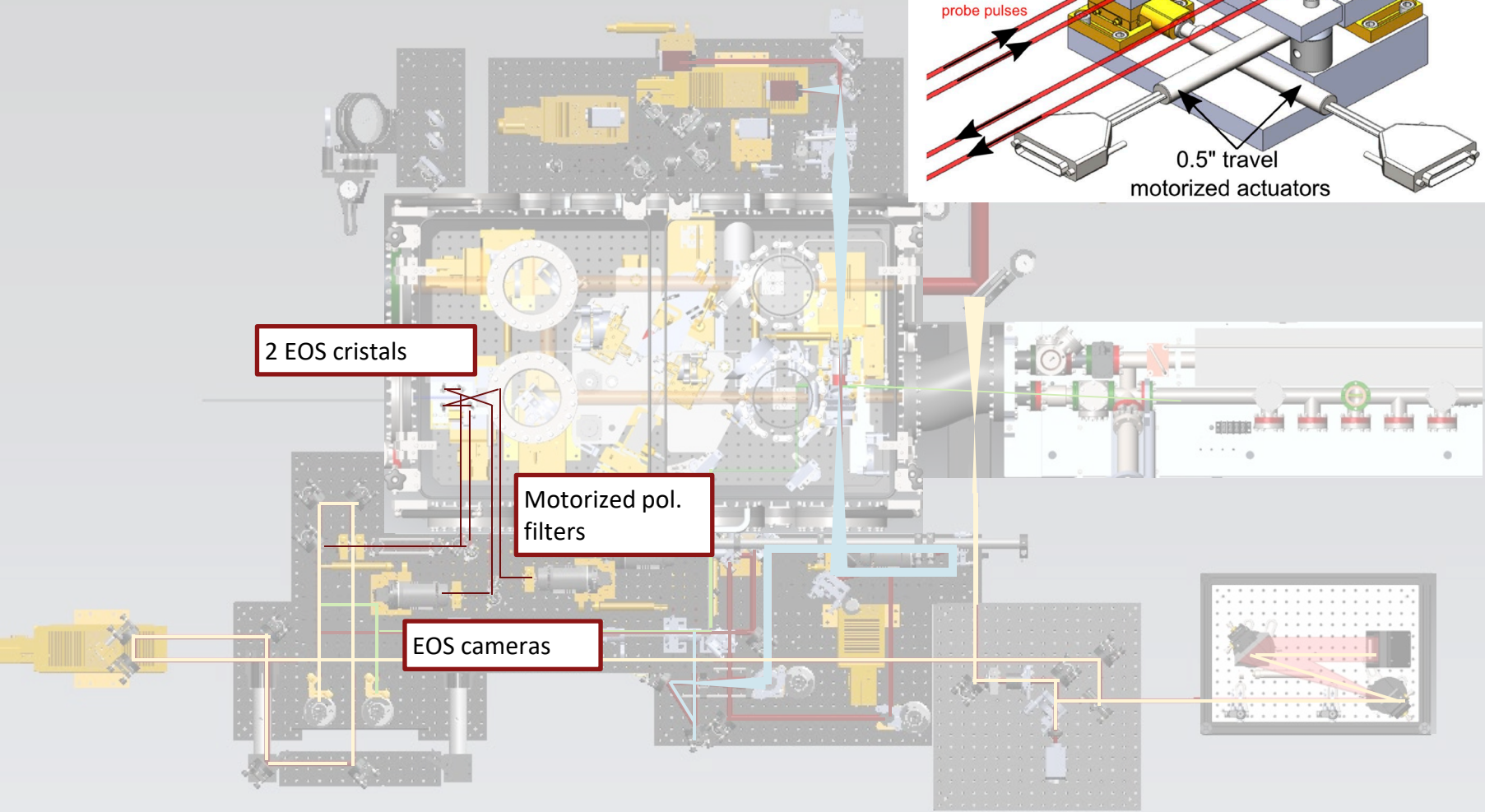
- Pulse length  $\sim 70$  fs FWHM
- Energy  $\sim 10$  mJ
- 800 nm Fiber laser up to EOS
- Collimated probe post main-laser collimation

# Sector 20 probe beam: Electro-optical sampling

Details: Talk by C. Hansel



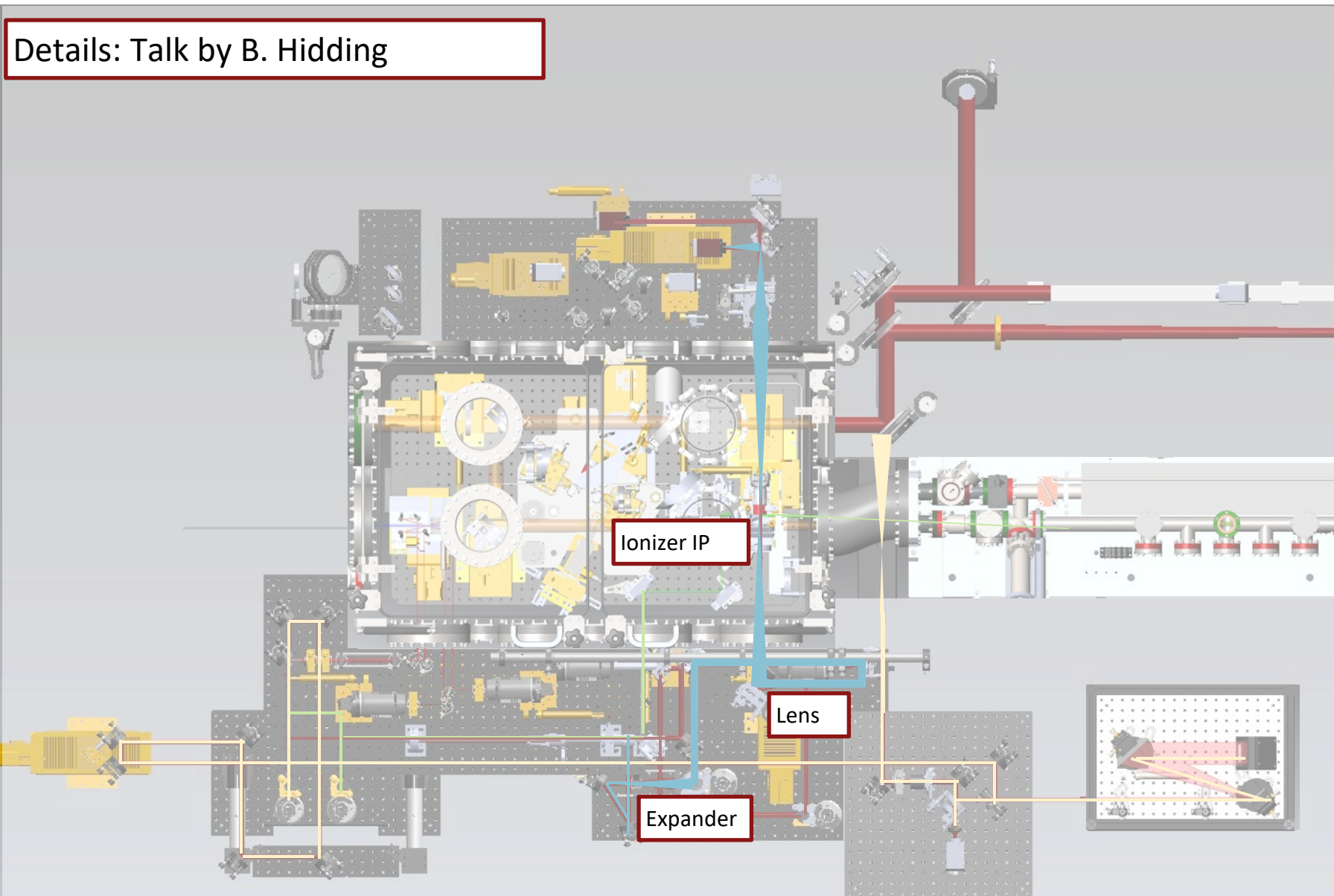
- Operational in 2022
- Need to restore  $t_0$
- Fs time stamping
- Bunch separation
- EOS BPM



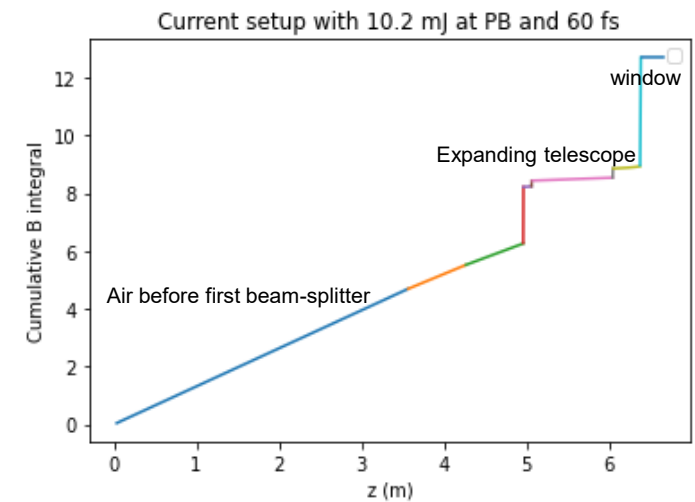
EOS1 signal from August 2022

# Sector 20 probe beam: ionizer

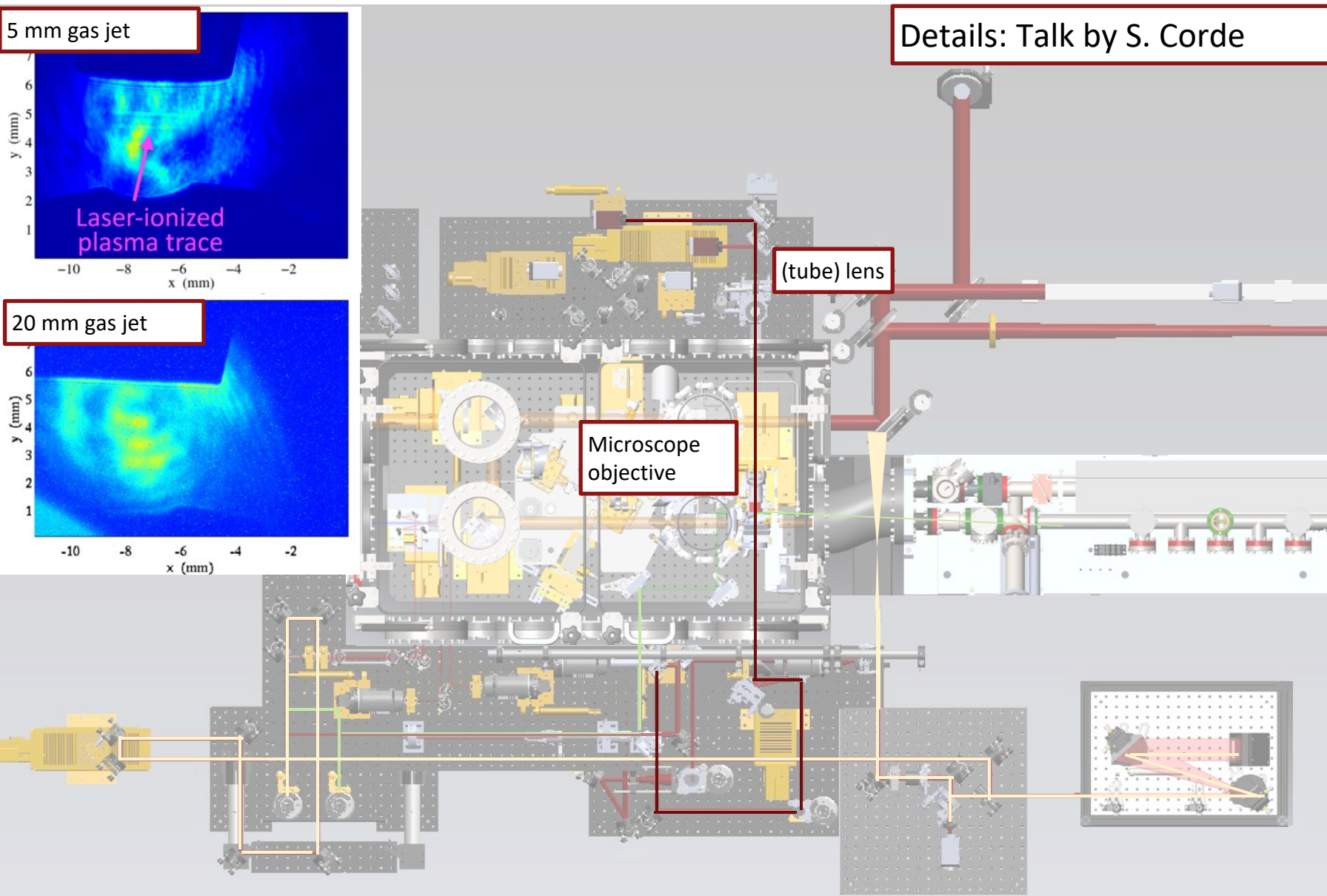
Details: Talk by B. Hidding



- OAP replaced with  $f=600$  mm lens
- No ionization, yet
- B-integral studies performed by L. Berman and A. Sutherland



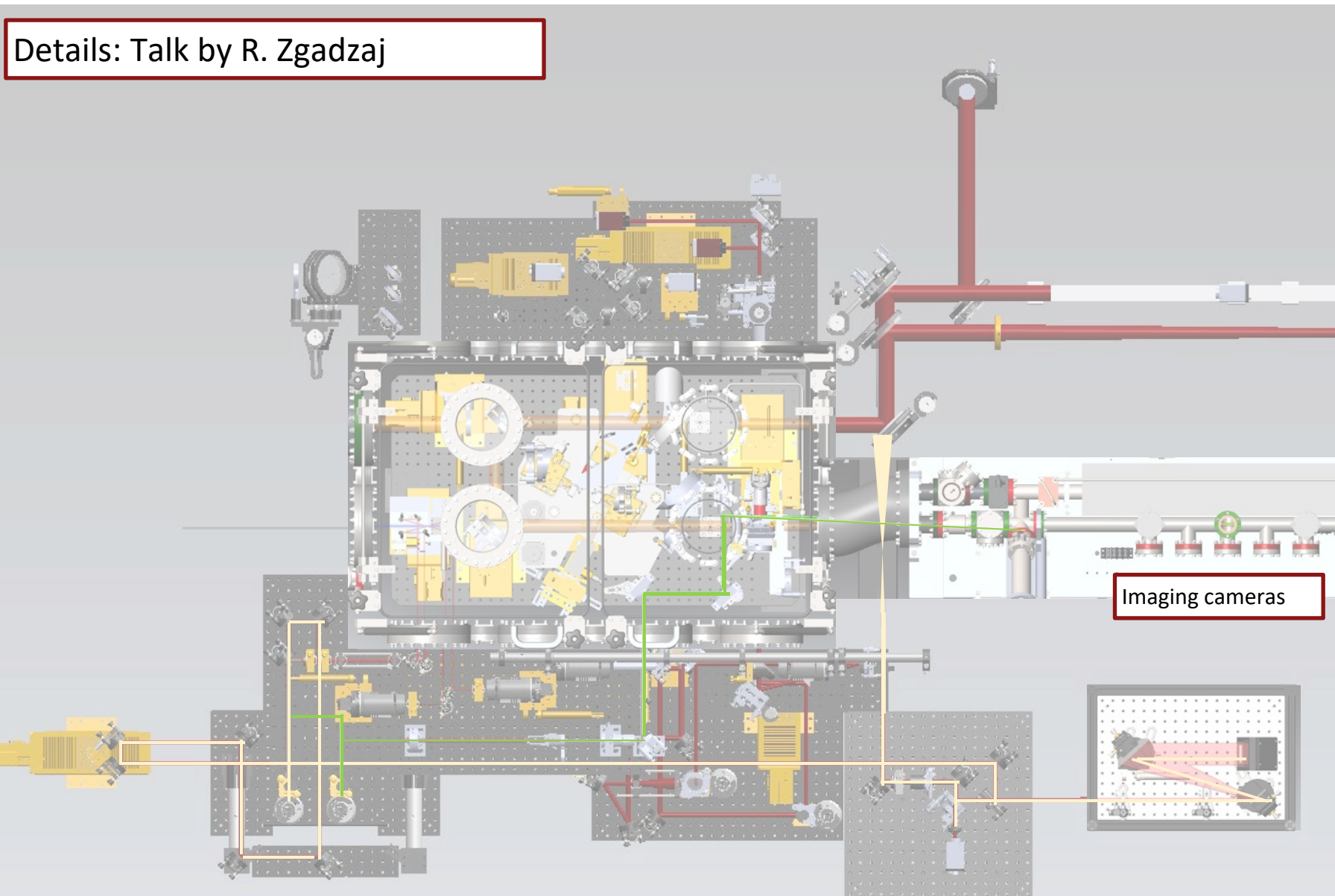
# Sector 20 probe beam: shadowgraphy



- Operational in Low-res or High-res
- Alignment re-established
- Upgrade to 400 nm planned

# Sector 20 probe beam: E324 Plasma imaging

Details: Talk by R. Zgadzaj



- Quasi-co-propagating probe
- Allows for imaging at PWFA densities

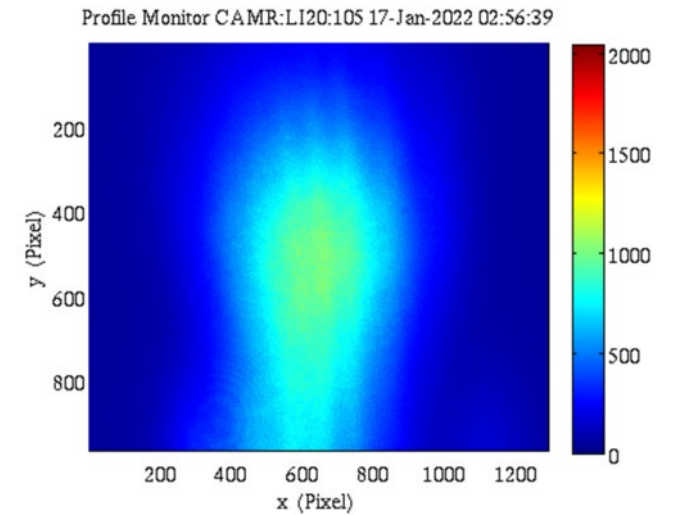
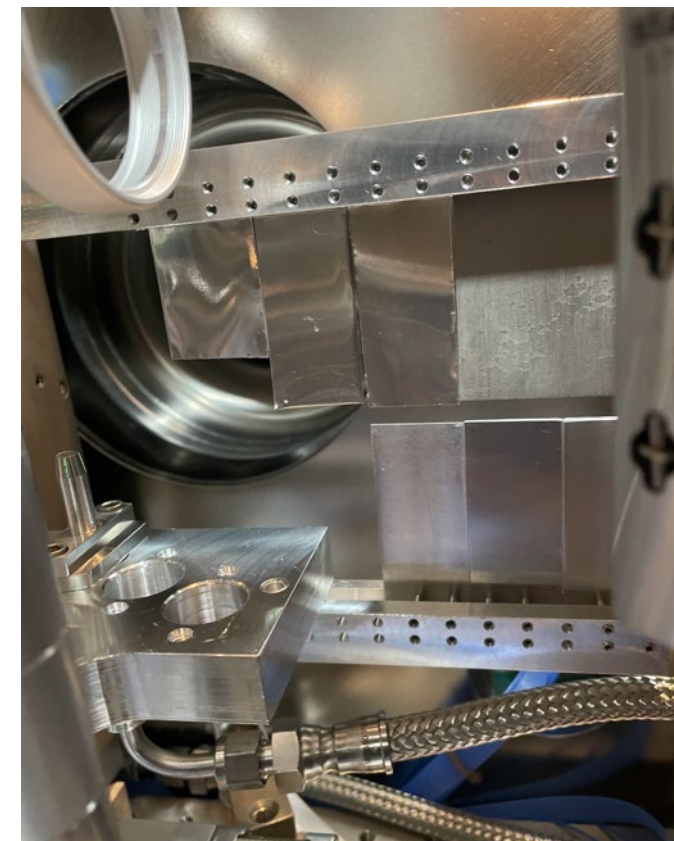
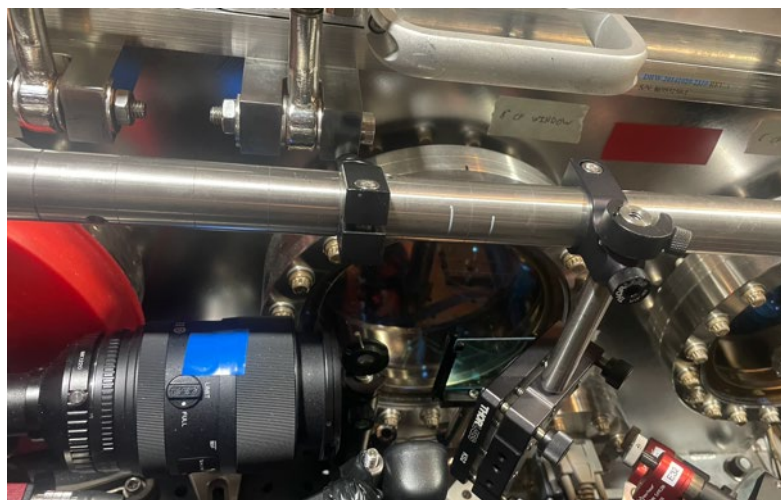
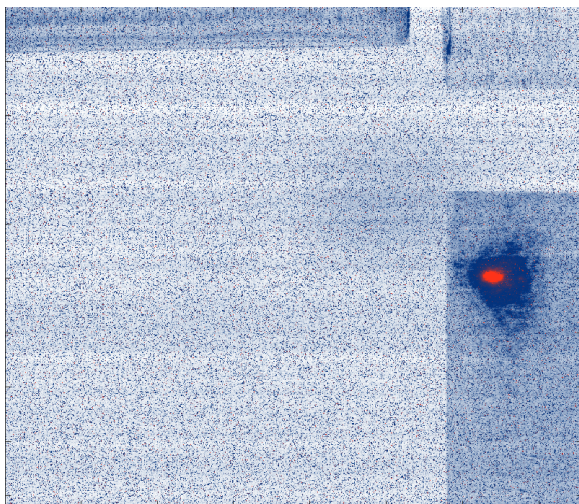


Image from alignment Jan. 2022

# Front-view camera

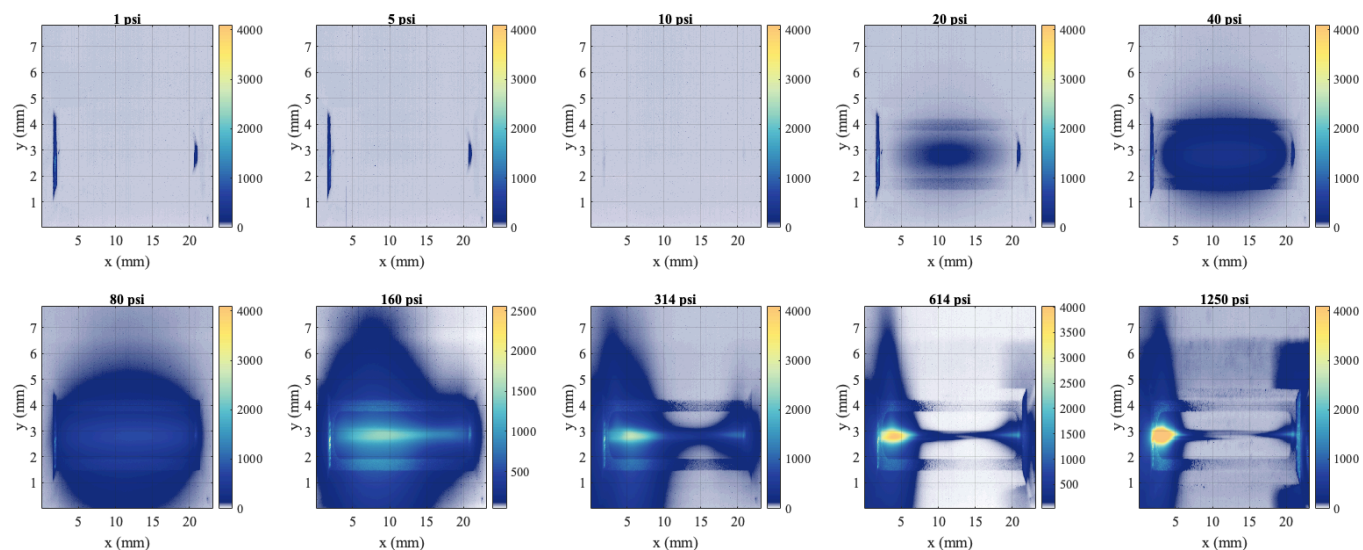
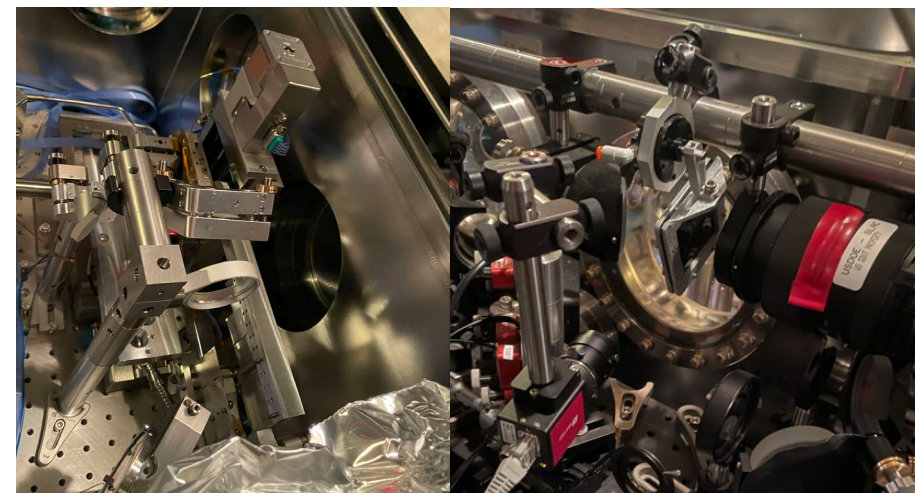
- Collects transition radiation and laser light from E332 foils
- Valuable alignment tool for various experiments
- Blue-glass filter on flip mount to protect camera from laser light



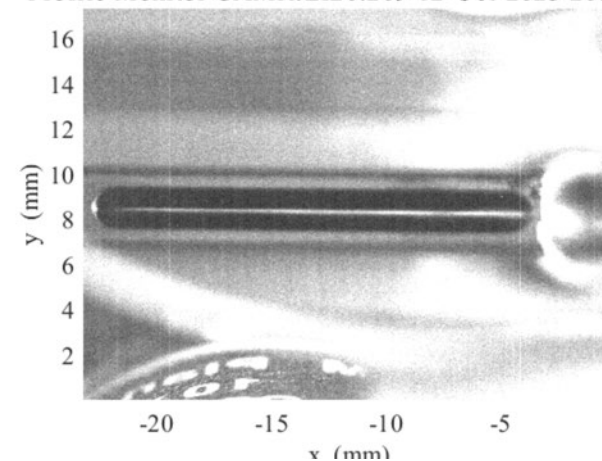


# Top view

- Collects plasma afterglow light from gas jet
- Great tool to find synchronous time-of-arrival with electron beam
- Can detect inhomogeneities in axilens ionization

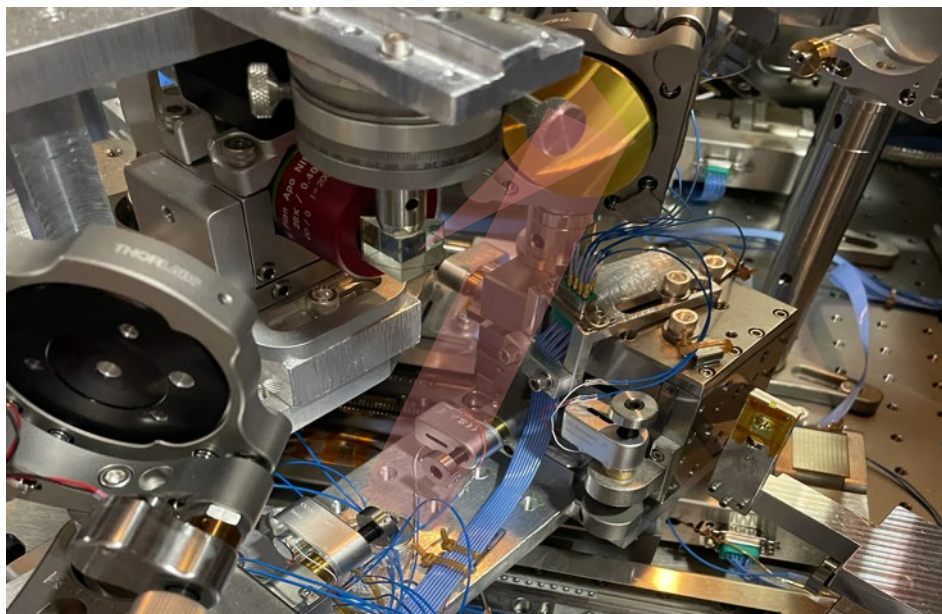


Profile Monitor CAMR:LI20:209 12-Oct-2023 20:45:36



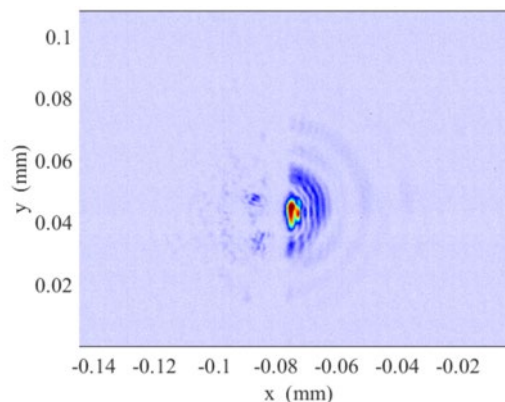
Gas jet pressure scan

# E-320 diagnostics

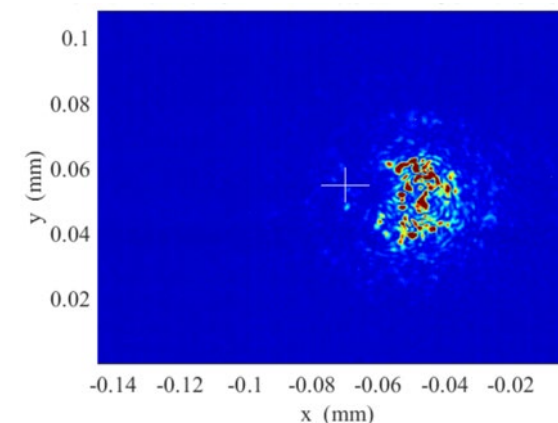


- Diagnostic for spatio-temporal alignment of E320 experiment
- Find  $t_0$  on femtosecond time-frame
- Align to um precision

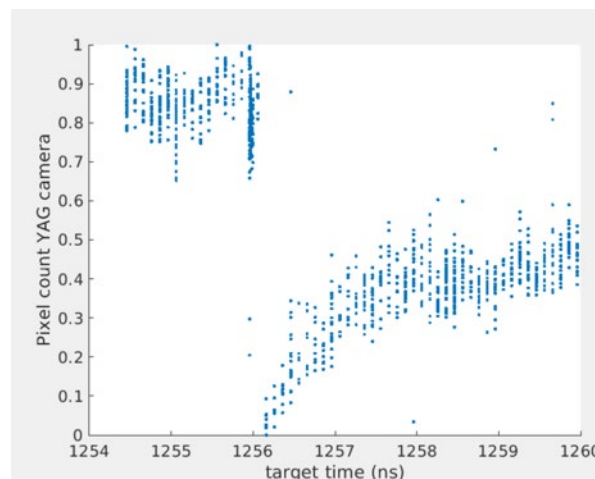
Laser-alignment



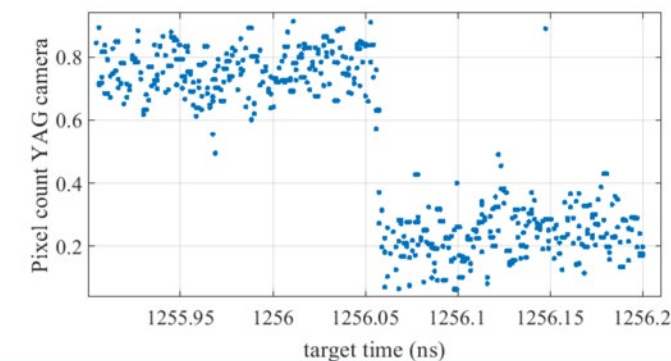
Wide spot on YAG



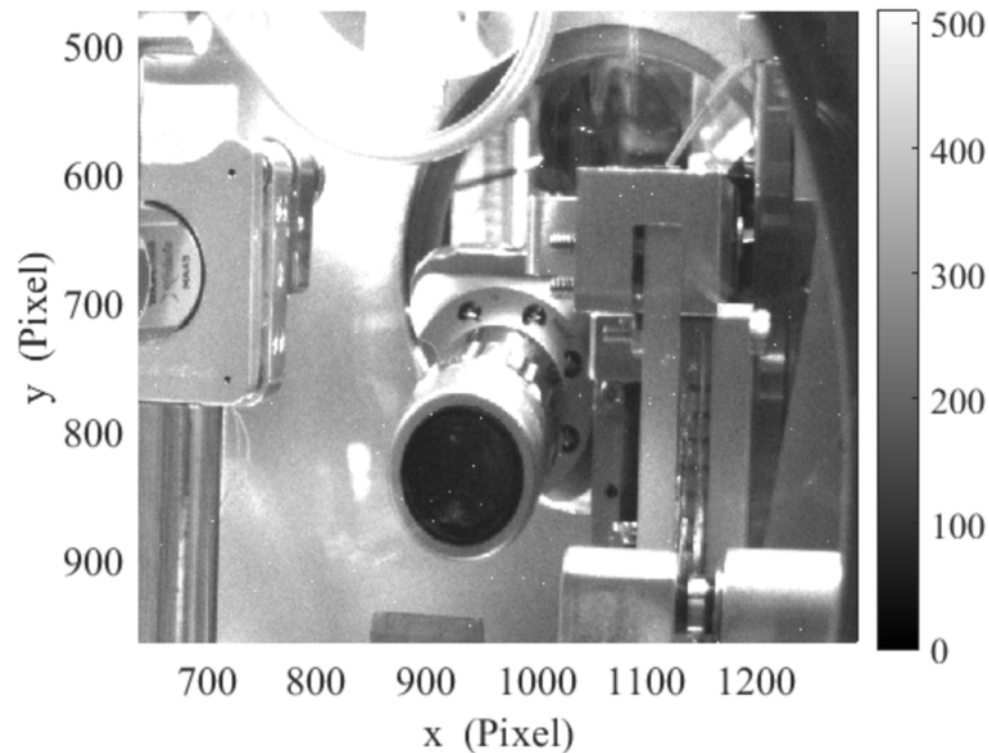
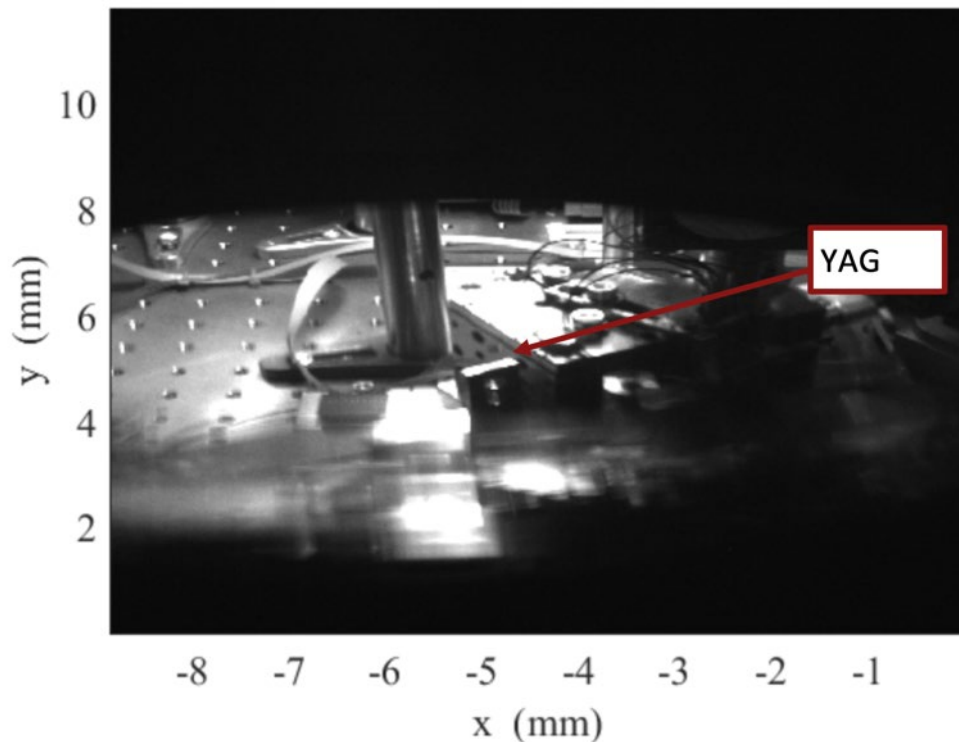
E-beam Synchronization



Fine timing scan



# General overview cameras



- Helper cameras to avoid crashes and for bugfixes during alignment
- Observation of Gas jet IP, E-320 IP, and laser beam dump

# Future plans (not a complete list)

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## Upcoming goals:

- Wavefront measurements
- Functionality of all probe line
- Ionize with ionizer
- EOS BPM
  
- 400 nm upgrade
- Downstream ionizer / injector
- Darkfield shadowgraphy
- Motorized air compressor
- ...

## Long term goals:

- Improve probe quality, maintainability and stability
  
- Process similar to main-laser improvement
  
- Planing phase starts soon

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Thank you for your attention !