E-320 Progress in FY24 and Plans for FY25

2024 FACET-II PAC & User Meeting

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November 19, 2024

This work was supported by the U.S. Department of Energy under award DE-SC0020076

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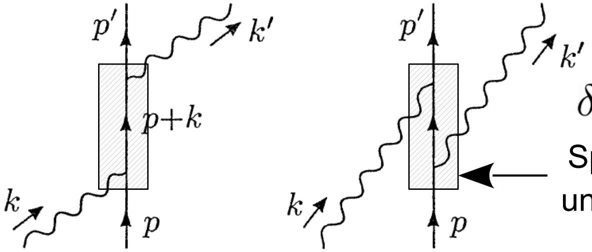
Strong-Field QED: from linear to nonperturbative Compton scattering



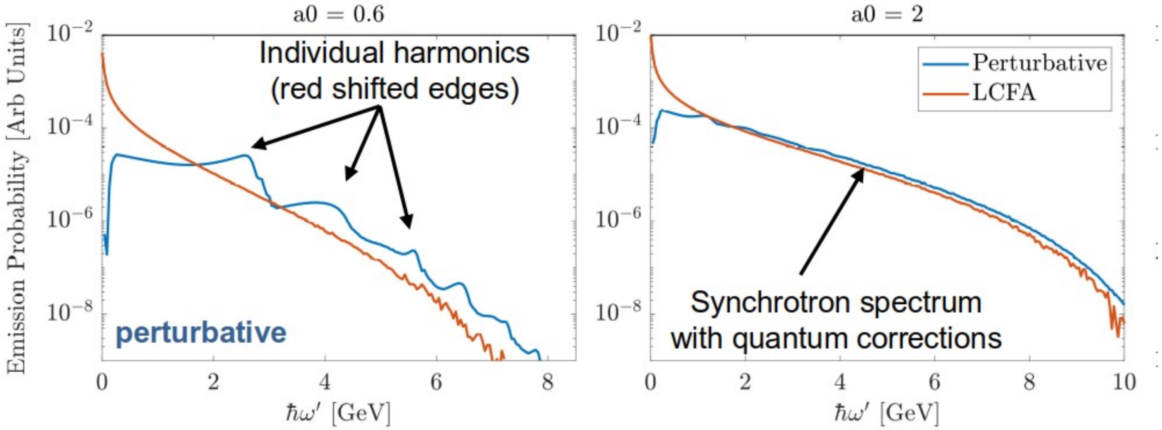
$$\delta V \sim \lambda_c^2 \times \lambda$$

Space-time volume:
uncertainty principle

Electron-photon (Compton) scattering
Klein & Nishina (1929)

$$\rho \sim \frac{I_0}{\hbar\omega c} \qquad \rho\,\delta V \gtrsim \frac{1}{\alpha} \qquad a_0^2 = \left(\frac{eE}{mc\omega}\right)^2 \gtrsim 1$$

Smallness of α ≈ 1/137 can be compensated by the laser photon density ρ ⇨ nonperturbative interaction

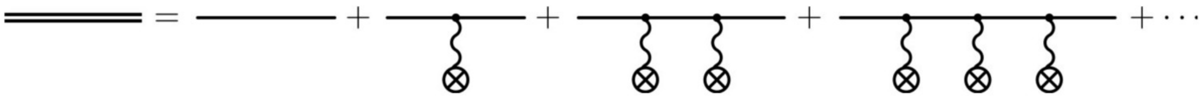


Transition from perturbative to nonperturbative interaction

Simulations: C. Nielsen (Aarhus)

Nikishov & Ritus, JETP 19, 1191 (1964); Brown & Kibble, Phys. Rev. 133, A705 (1964); etc.

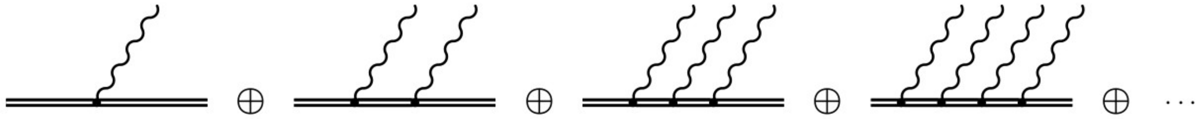
Strong-Field QED: quantum radiation reaction



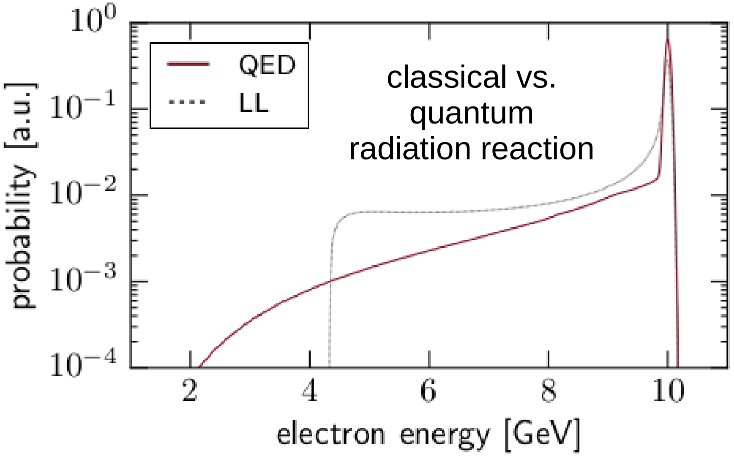
Interaction with ~ a_0^3/χ ~ 100 laser photons

$$a_0 = \frac{eE}{\omega_L mc} \approx 0.6 \frac{\lambda_L}{1\,\mu m}\sqrt{\frac{2I}{10^{18}\,W/cm^2}}$$

$a_0 \gtrsim 1$: laser-electron interaction becomes non-perturbative



Emission of multiple hard photons: quantum radiation reaction



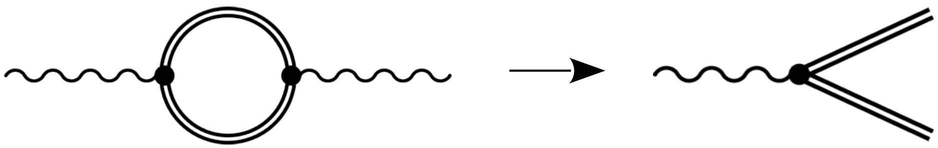
Simulation: M. Tamburini

$$\chi = \frac{E'}{E_{cr}} \approx 0.6 \frac{\mathscr{E}}{10\,GeV}\sqrt{\frac{2I}{10^{20}\,W/cm^2}}$$

$\chi \gtrsim 0.1$: quantum effects induce significant recoil

Fedotov et al.,Phys. Rep. 1010, 1-138 (2023)
Gonoskov et al., RMP 94, 045001 (2022)
Di Piazza et al., RMP 84, 1177 (2012)

Strong-Field QED: observing tunneling electron-positron production

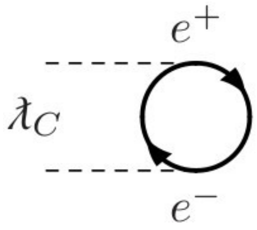


Vacuum polarization

photon transforms temporarily into an electron-positron pair

Pair production

virtual pair is "ionized" by laser at QED critical field



Length: $\lambda\!\!\!^{-}_C = \hbar/(mc)$

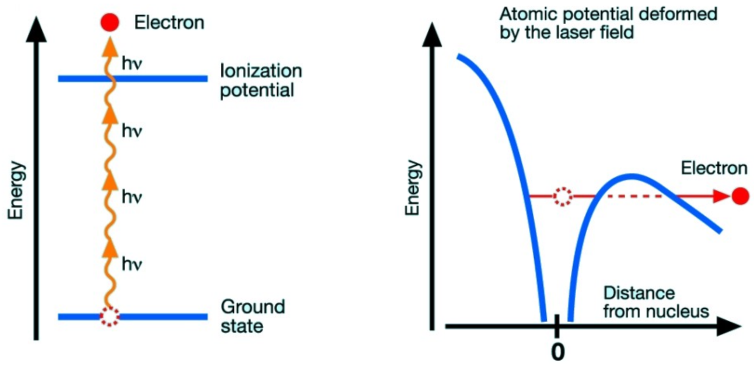
Energy: $\mathcal{E} = mc^2$

Critical field: $eE_{cr} = mc^2/\lambda\!\!\!^{-}_C$

Qualitative changes between E-144 and E-320:
(analogous to strong-field ionization of atoms)

E-144 ($a_0 \lesssim 1$): multi-photon regime

E-320 ($a_0 \gg 1$): tunneling regime



High-level summary

- **We observe physics of nonlinear electron-laser interactions in SFQED regime**
  - ⇨ Shift/change of Compton edges observed (dressed electron mass)
  - ⇨ Transition from perturbative to non-perturbative spectrum observed

- **Plan for FY25: transition from “qualitative” to fully quantitative measurements**
  - ⇨ Need to spend time on measurements rather than commissioning (stable t_0, stable beam or working feedbacks for spatial & temporal drifts, ...)
  - ⇨ Make sure that we preserve the focal-spot quality at the highest intensities
  - ⇨ Proper calibration of all diagnostics (BPMs, BBA of spectrometer quads, …)

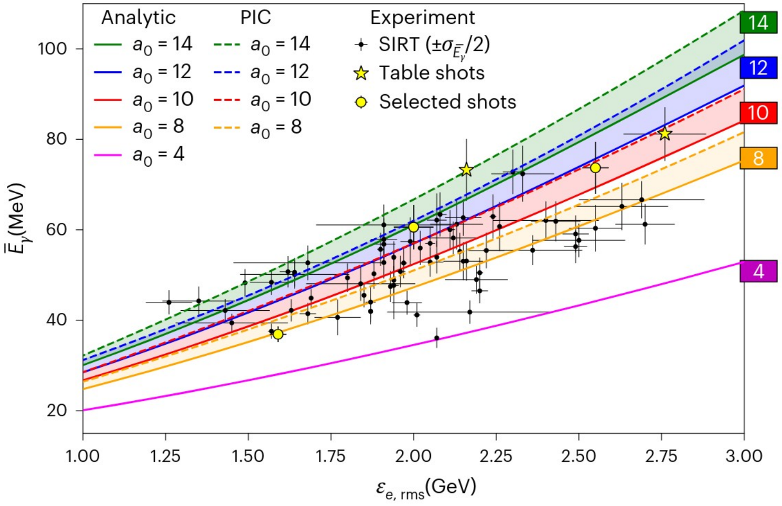
- **Plan for FY25: start the positron program**
  - ⇨ New tracking detector installed (WIS), LYSO imaging system upgraded
  - ⇨ Need stable beam, remove upstream Be window, reduce losses in S20
  - ⇨ Ideally we will be able to send more laser energy to the tunnel

International competition: taking publishable data is timely

nature photonics

Article https://doi.org/10.1038/s41566-024-01550-8

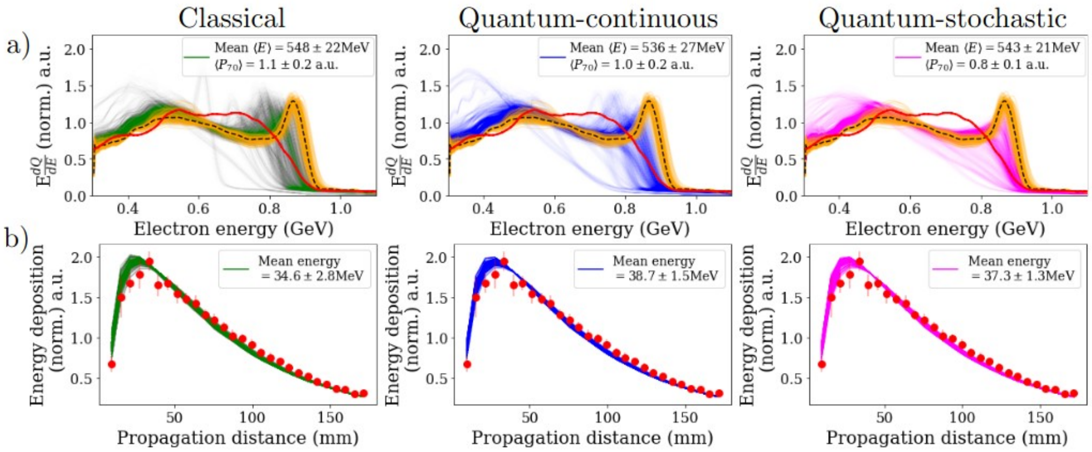
All-optical nonlinear Compton scattering performed with a multi-petawatt laser



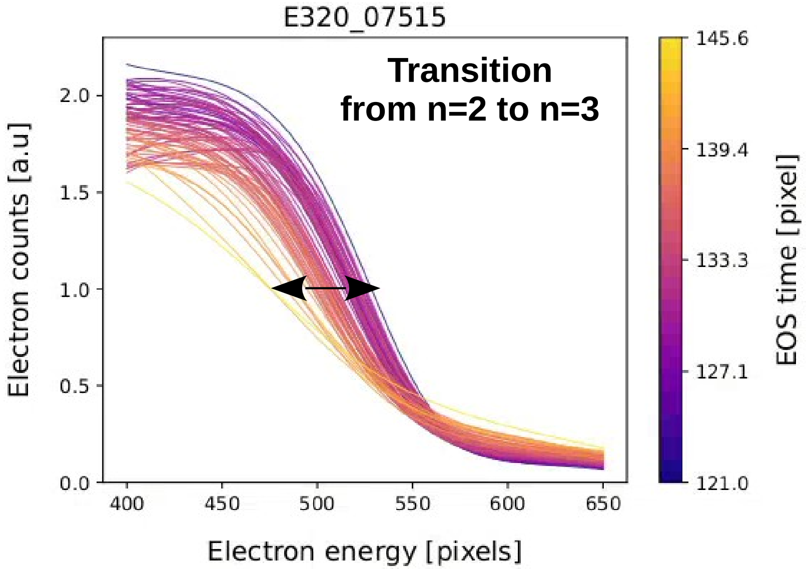
[Submitted on 16 Jul 2024]

Observation of quantum effects on radiation reaction in strong fields

E. E. Los, E. Gerstmayr, C. Arran, M. J. V. Streeter, C. Colgan, C. C. Cobo, B. Kettle, T. G. Blackburn, N. Bourgeois, L. Calvin, J. Carderelli, N. Cavanagh, S.J.D. Dann A. Di Piazza, R. Fitzgarrald, A. Ilderton, C. H. Keitel, M. Marklund, P. McKenna, C. D. Murphy, Z. Najmudin, P. Parsons, P. P. Rajeev, D. R. Symes, M. Tamburini, A. G. R. Thomas, J. C. Wood, M. Zepf, G. Sarri, C. P. Ridgers, S. P. D Mangles

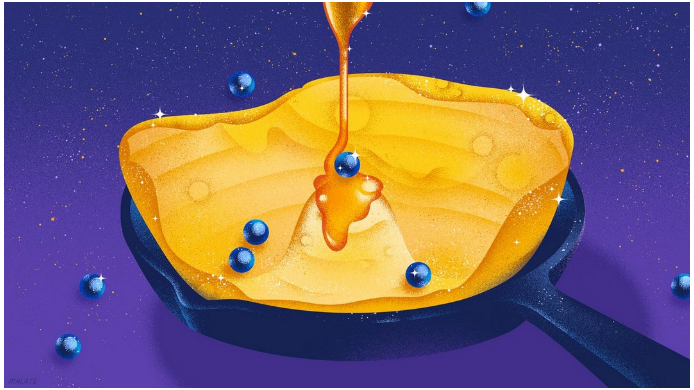


Highlight FY24: Electrons become more massive in strong laser fields



Inside a laser field the electron mass increases, which shifts the position of the Compton edges

symmetrymagazine.org



In the standard model, mass originates from interactions with the Higgs field

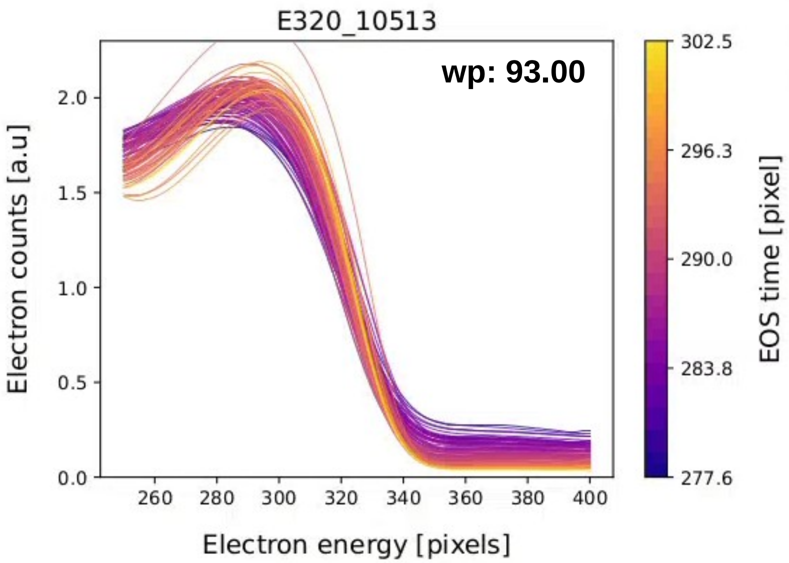
$$q^2 = m_*^2, \qquad m^* = m\sqrt{1 + a_0^2/2}$$

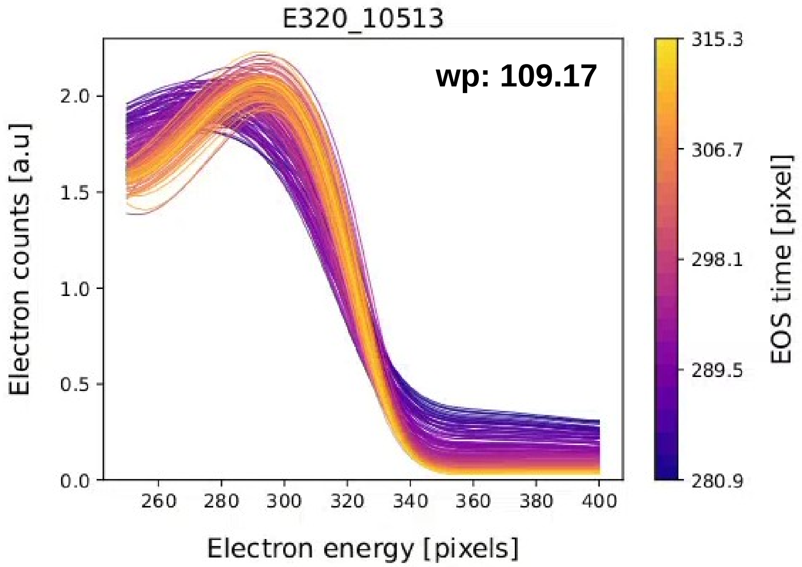
where m_* acts as an "effective mass" of the electron in the field.

Nikishov & Ritus, JETP 19, 1191 (1964); Brown & Kibble, Phys. Rev. 133, A705 (1964); Landau & Lifshitz (vol. 4)

Analysis: T. Smorodnikova

Change of 1st Compton edge: reduced effect due to spatial averaging





Analysis: T. Smorodnikova

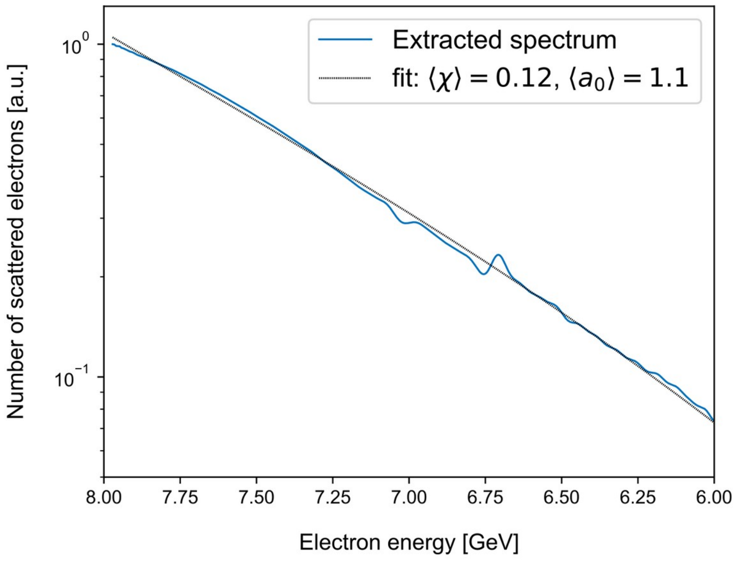
relation between the incident and scattered frequencies,

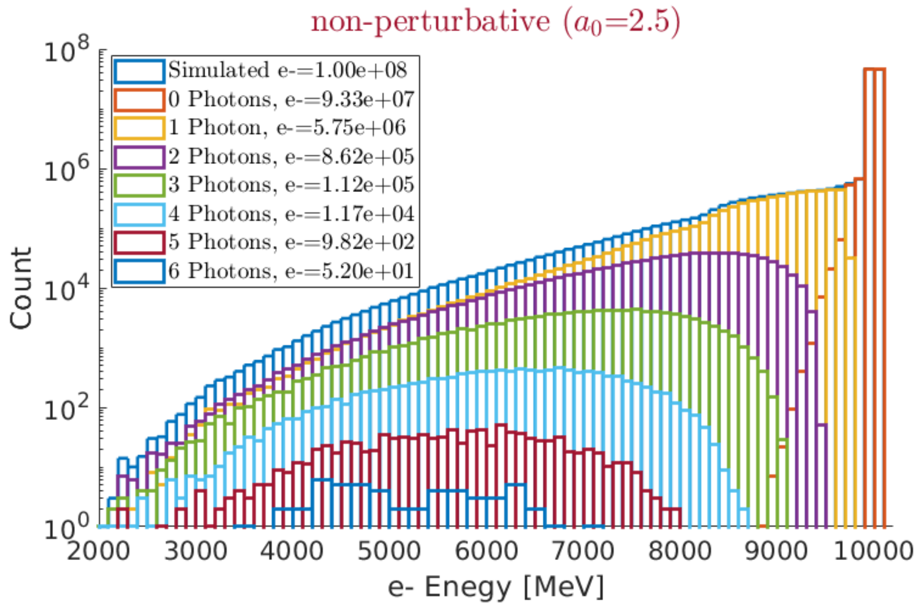
$$\omega' = \omega_r' = \frac{mr\omega}{m + (2r\omega + m\nu^2)\sin^2\tfrac{1}{2}\theta}\,. \qquad (3.34)$$

$$\nu^2 = \frac{\Delta m^2}{m^2} = \frac{e^2}{m^2}\left(-\tfrac{1}{2}\mathfrak{a}\cdot\mathfrak{a}^*\right) > 0. \qquad (3.27)$$

Brown & Kibble, *Interaction of Intense Laser Beams with Electrons*, Phys. Rev. 133, A705 (1964)
Nikishov & Ritus, *Quantum Processes in the Field of a Plane Electromagnetic Wave and in a Constant Field*, JETP 19, 1191 (1964)

Highlight FY24: Transition from perturbative to non-perturbative regime





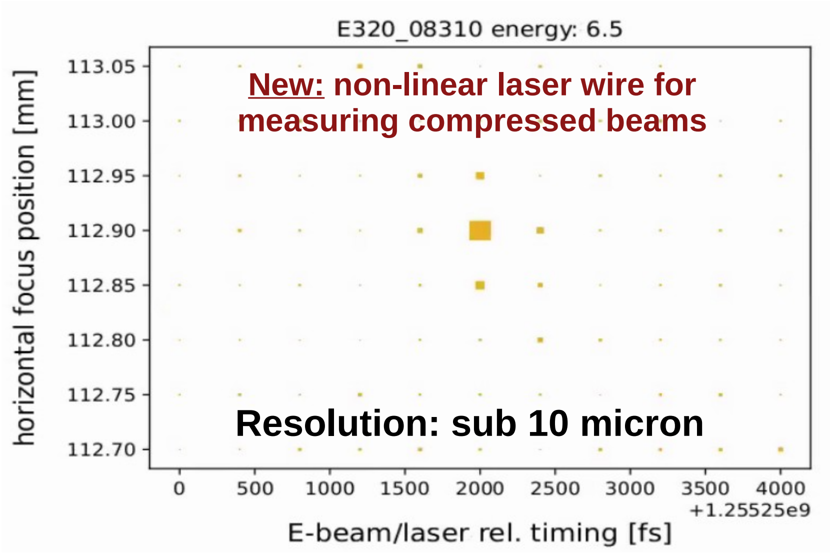
Simulation: R. Holtzapple (CalPoly)

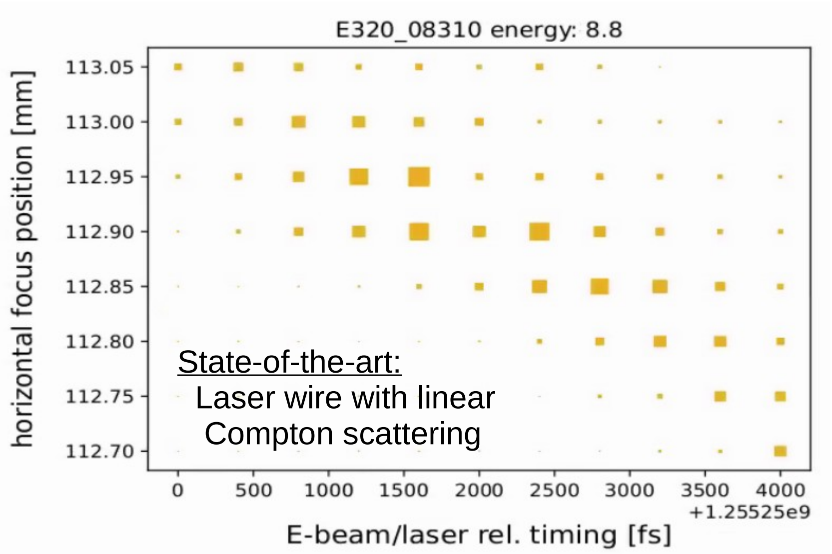
- Highest laser intensities: quasi-continuous spectrum with averaged (!) $\chi \gtrsim 0.1$
- We observe electrons down to at least 6 GeV (40% energy loss in single emission)
- Simulations suggest importance of multiple hard emissions (**quantum radiation reaction**)

Nikishov & Ritus, JETP 19, 1191 (1964); Brown & Kibble, Phys. Rev. 133, A705 (1964); Landau & Lifshitz (vol. 4)

Analysis: T. Smorodnikova

Nonlinear laser wire: measuring compressed electron beams





Analysis: T. Smorodnikova

- Proof-of-principle demonstration during last spring shift (May 21, 20024)
- Repetition during Nov. shift was difficult: DAQ problems & poor beam stability
- Requires new timing stabilization based on EOS delay stage for long-range scans

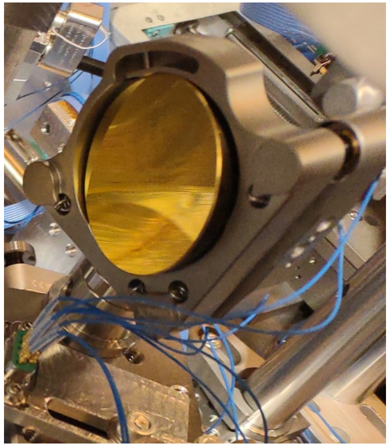
ToDo: repeat with higher spatial resolution and active timing stabilization

the idea was first used by E-144; see, for example, Bamber et al., PRD 60, 092004, 1999

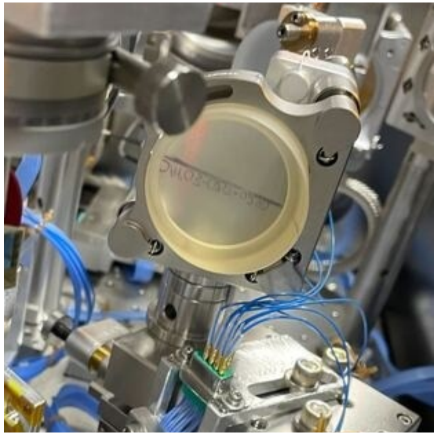
Improvements in FY24

(which made new results possible)

Installation of dielectric λ/10 OAP (Alex & Junzhi, April 24, 2024)



old, gold OAP, λ/4

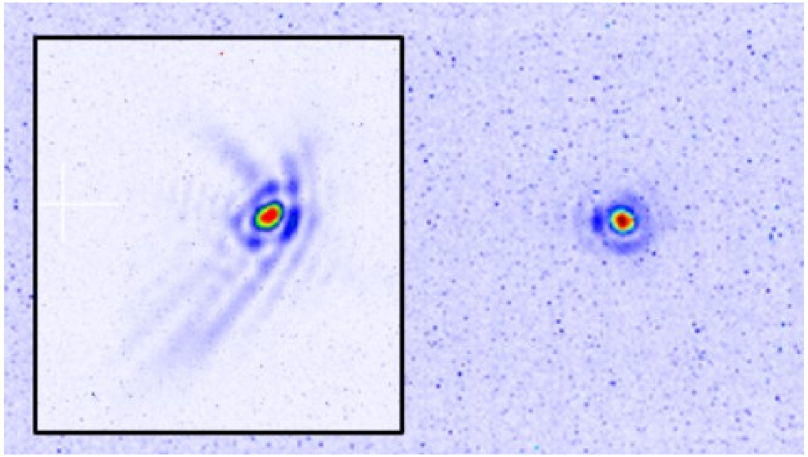


new, dielectric OAP, λ/10

- There is risk of damage by other experiments (solid-target collisions, Li oven, …)
- We purchased backup optics (AlSi substrate, quality seems even better; still requires coating)

f# ≲ 2: ~2 μm spot (FWHM)
collision angle: 25°-30°

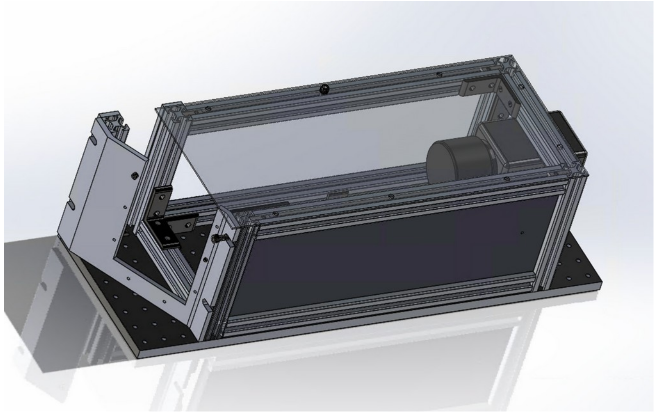
Improvement of the focal-spot quality

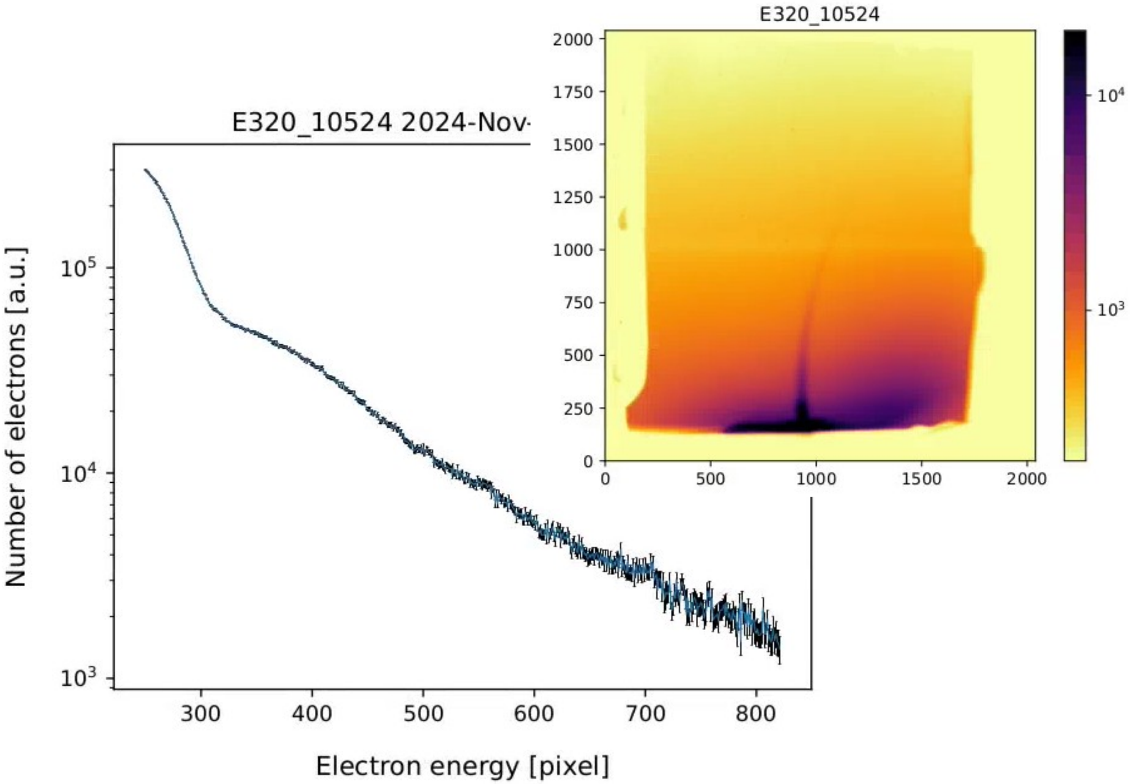


Low-Background LFOV (Alex)

Current setup

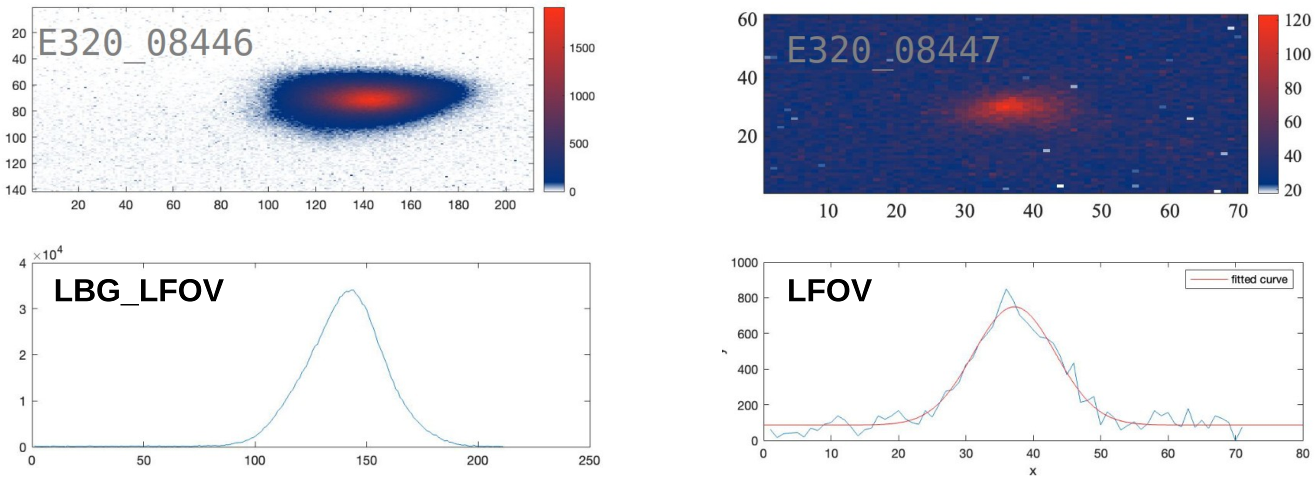
FY25 upgrade





- Main diagnostic for the scattered electron spectrum
- Much more sensitive than LFOV, further improvements ongoing

Low-Background LFOV (Alex)



Analysis & plots: A. Knetsch

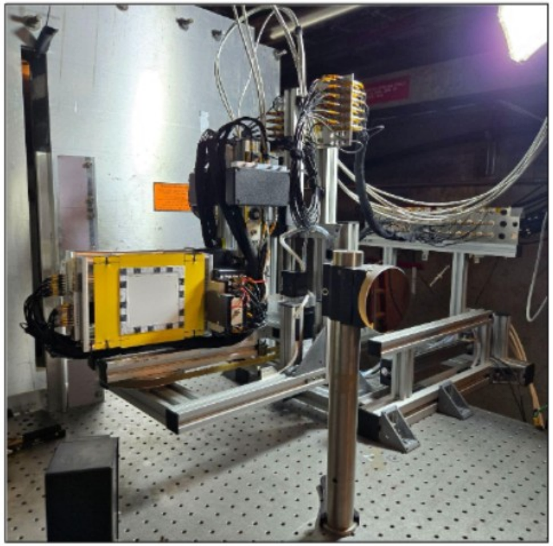
Same amount of dark current: LBG_LFOV has much higher sensitivity

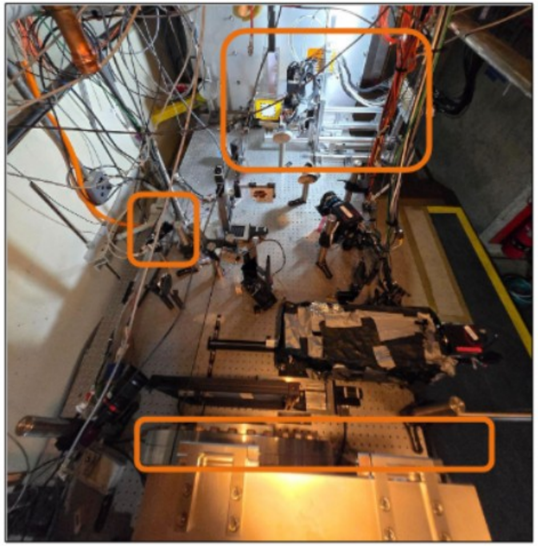
ToDo FY25: better image quality, better background management

- have entire screen in focus using Scheimpflug optics (suggestion: D. Storey)
- Improve flatness of screen, possibility to add filters (reduce backgrounds)
- Add more sensitive scintillator (CsI, LYSO; single-electron sensitivity?)
- **Highly desirable**: test direct detection using ePix detector

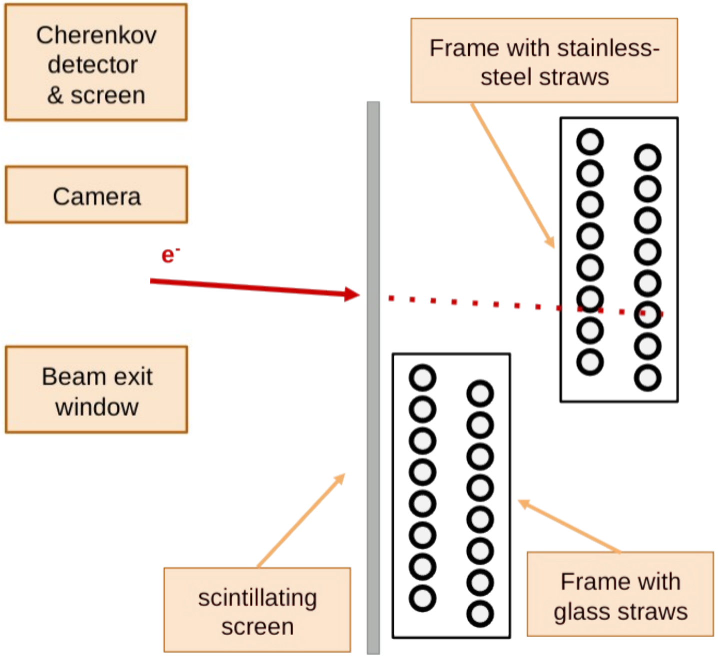
ePix module provided by the SLAC detector group

LUXE Electron Detection System (T-618, DESY)





Installation at the FACET-II dump table



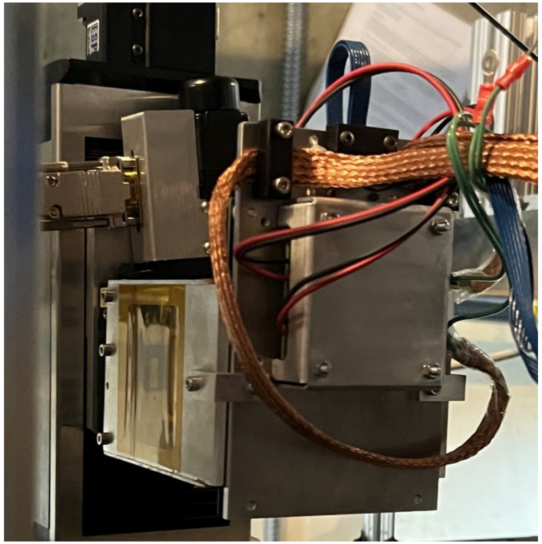
DESY team: A. Athanassiadis, L. Hendriks, L. Helary, R. M. Jacobs, J. List, E. Ranken, I. Schulthess, M. Wing

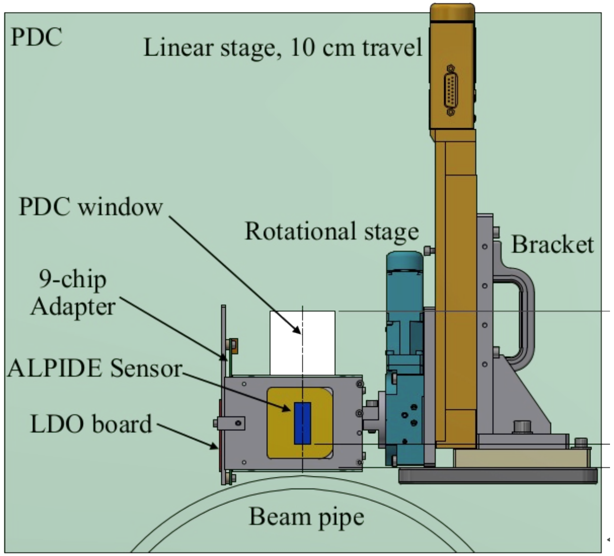
LUXE TDR: https://arxiv.org/pdf/2308.00515.pdf
EPS talk: https://indico.desy.de/event/34916/

Commissioning has been successful; detailed data analysis is ongoing

Positron tracker prototype (T-619, Weizmann Institute)

Installation in the FACET tunnel behind PDC





Hardware survives and is producing data

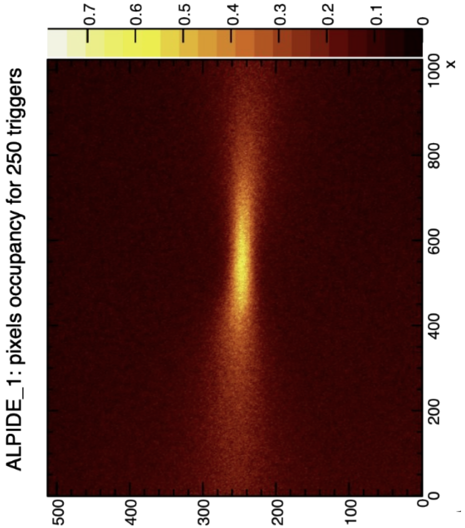
- Thin monolithic active pixel sensors "ALPIDEs" (ALice PIxel Detector)
- Radiation hardness: technology is used in the ALICE experiment at the LHC

Noam Tal Hod's group, WIS: Sasha Borysov, Alon Levi, Nathaly Nofech-Mozes, Arka Santra (now in SINP, Kolkata), Roman Urmanov

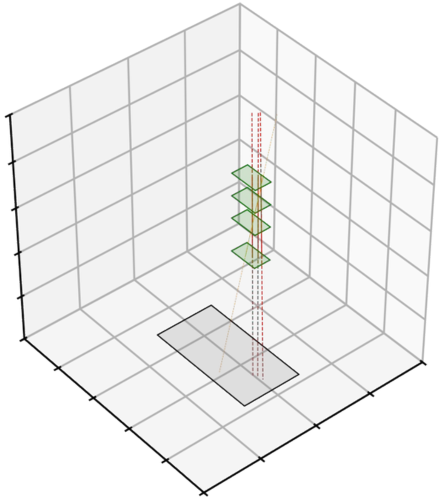
Details: LUXE TDR (arXiv 2308.00515); Alpides (26.9 μm x 29.2 μm): NIM A 824 (2016) 434-438 and NIM A 845 (2017) 583–587

Positron tracker prototype (T-619, Weizmann Institute)

“Butterfly”
(quad focusing)

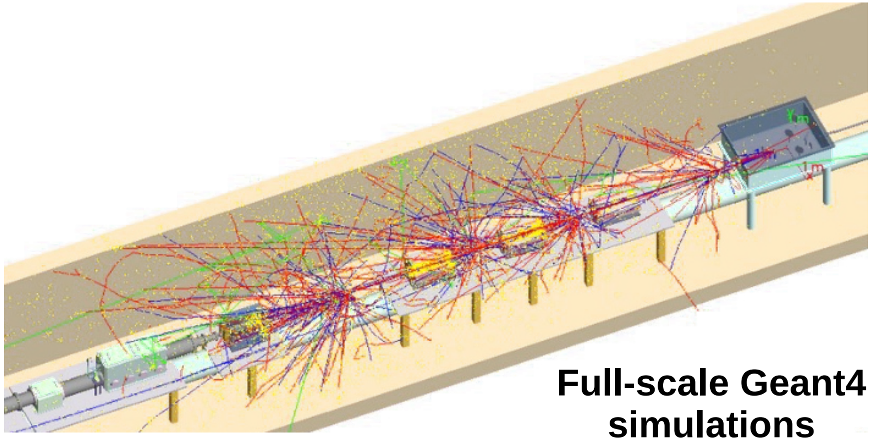


Positron tracking
(preliminary result)



Upstream Be window must be retractable

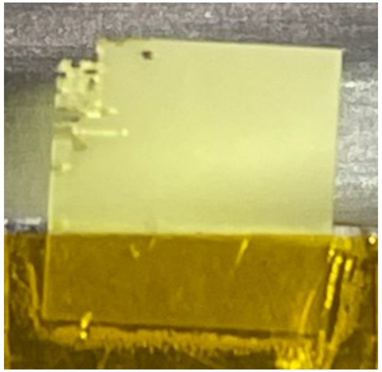
We are ready to measure Breit-Wheeler positrons



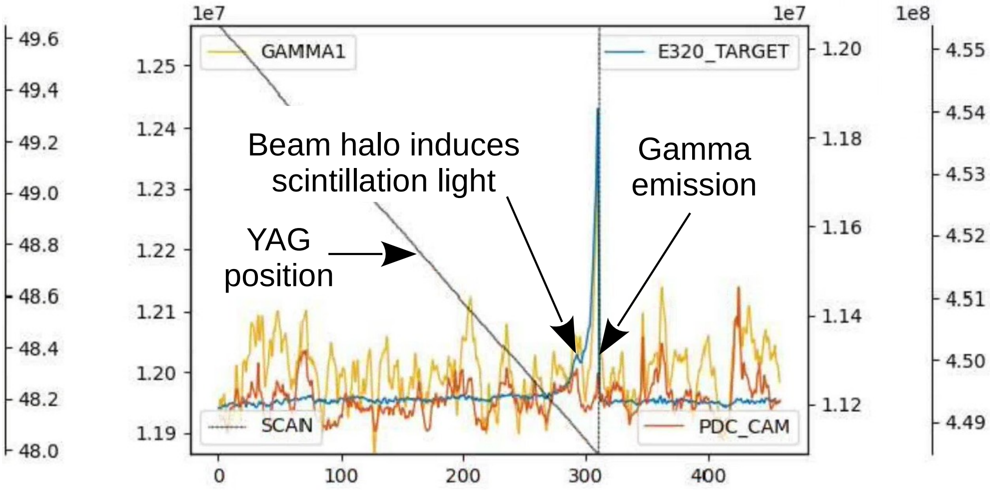
Full-scale Geant4 simulations

- For the first time we can measure single positrons
- Upstream Be window: major source for positrons via emission of gamma rays that hit pipes etc.
- Current installation: 4 layers, 1 chip each (one additional layer in hand, up to 9 feasible)

New spatial-alignment procedure: can handle compressed electron beam



2023 YAG crystal

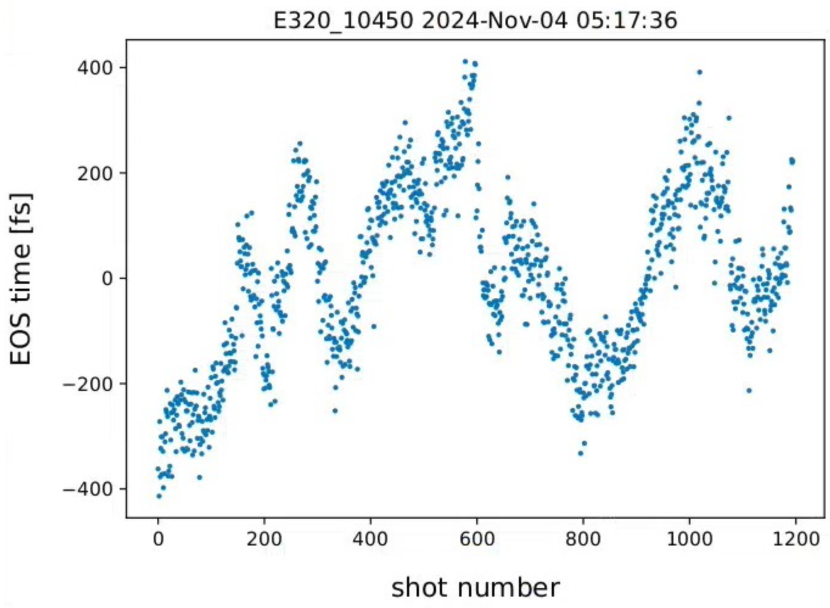


YAG is retracted when gamma emission is detected

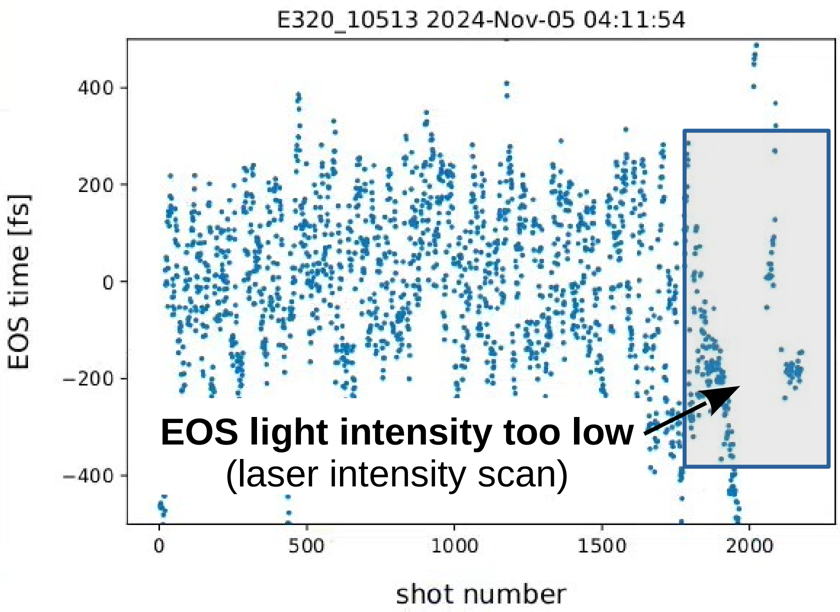
- **Main challenge in 2023**: compressed electron beam destroys YAG crystal
- **Mitigated by peripheral knife-edge scan**: move YAG towards beam and monitor diagnostics
  - Scintillation light (E320_TARGET camera) is early indicator that e-beam is near (beam halo)
  - Beam is detected by enhanced production of gamma photons / positrons

Drift compensation for laser-electron timing (Alex)

EOS time without active stabilization



EOS time with active stabilization

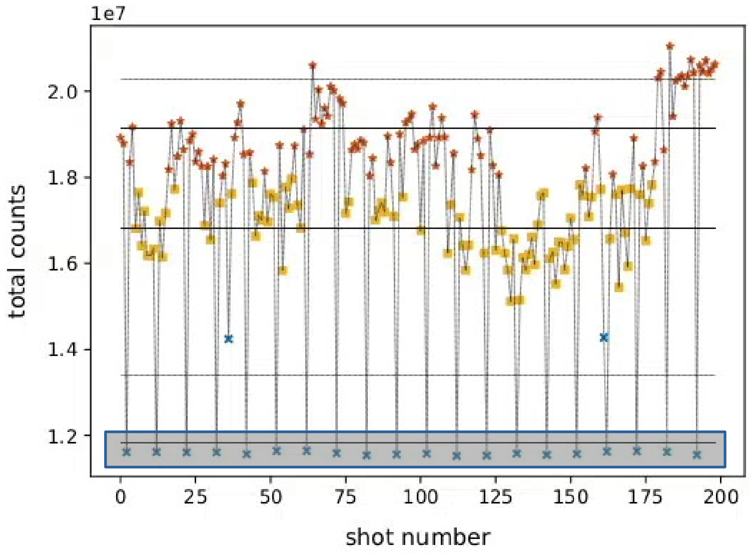


PID controller: A. Knetsch

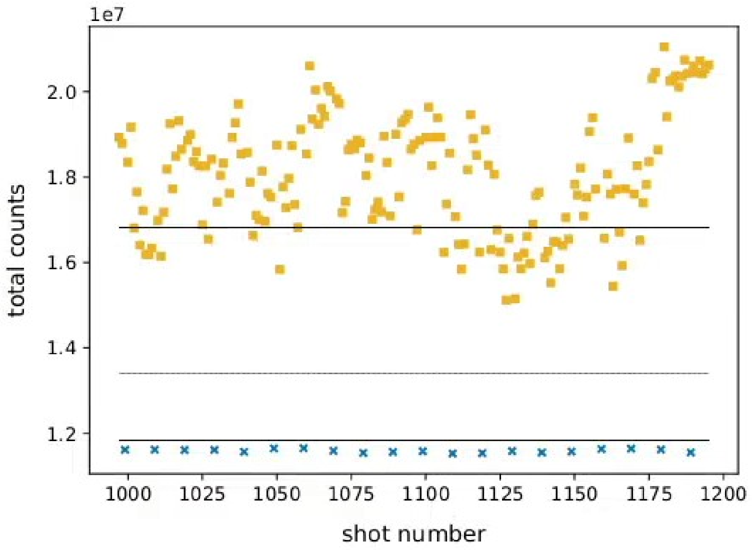
- Time drifts ~1ps (without stabilization); EOS range is only ~2 ps
- **ToDo (high priority): use EOS delay-stage to track laser delay for long-range scans**

Goose trigger

Initial clustering
(two signal cluster to account for drifts)



Final decision
(after cluster merging and outlier rejection)



Analysis: T. Smorodnikova

- Currently: every 10th shot is goosed (prone to systematic errors; need more background data)

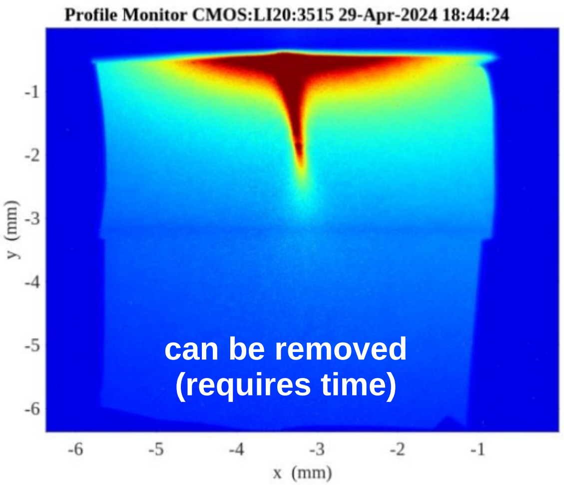
⇨ **ToDo: programmable pseudo-random goose trigger + ~50/50 on/off (high priority)**

⇨ **ToDo: record event code and which shots are goosed as PV**

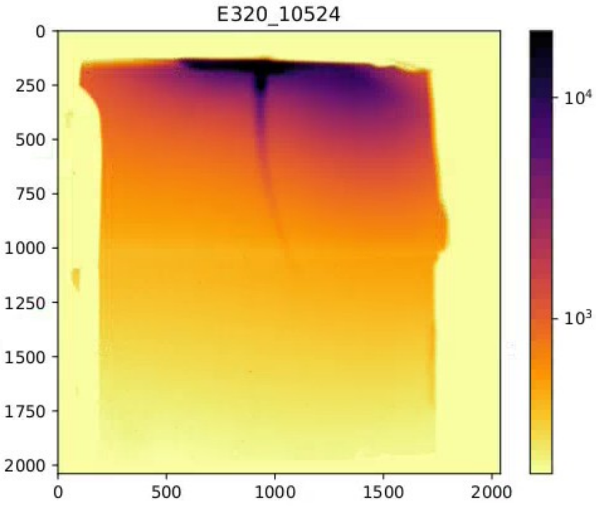
Challenges

Scattering on upstream Be window: renders experiment impossible

Beam-induced background
(beam colliding with Be window)



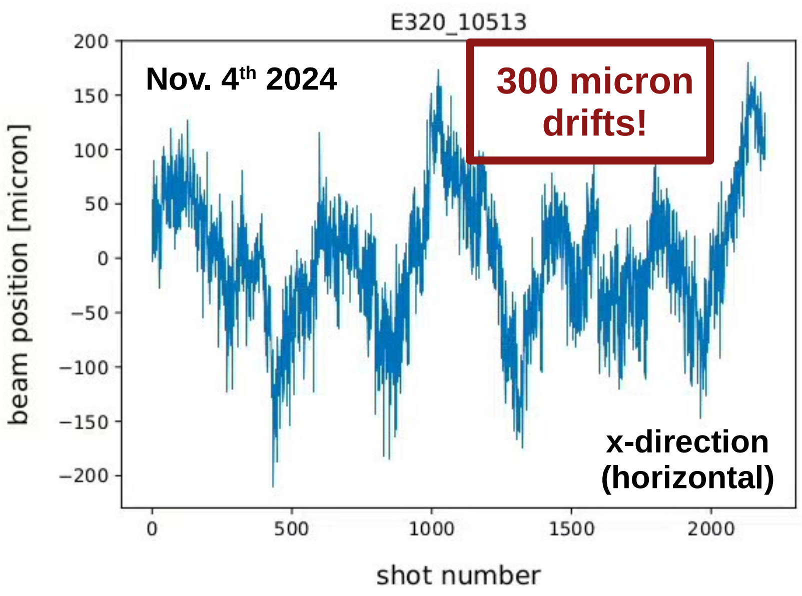
Laser-electron scattering
(laser-produced low-energy tail)

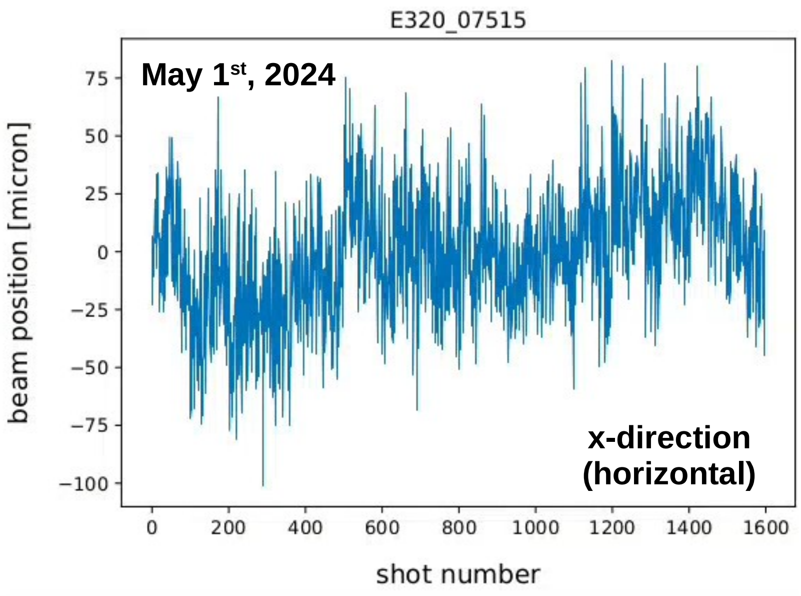


Upstream Be window must be retractable

- **Major challenge: low-energy electrons from Be window are undistinguishable from our signal**
- Significant effort for OPs to thread e-beam through the hole in the Be window (takes away time)
  ⇨ beam orbit through the IP is often angled, leading to position-angle correlations in the data
  ⇨ it is difficult to fully compensate the dispersion in the chicane, resulting in large beam drifts

Beam position drift/jitter at the E-320 IP (spring vs. fall)

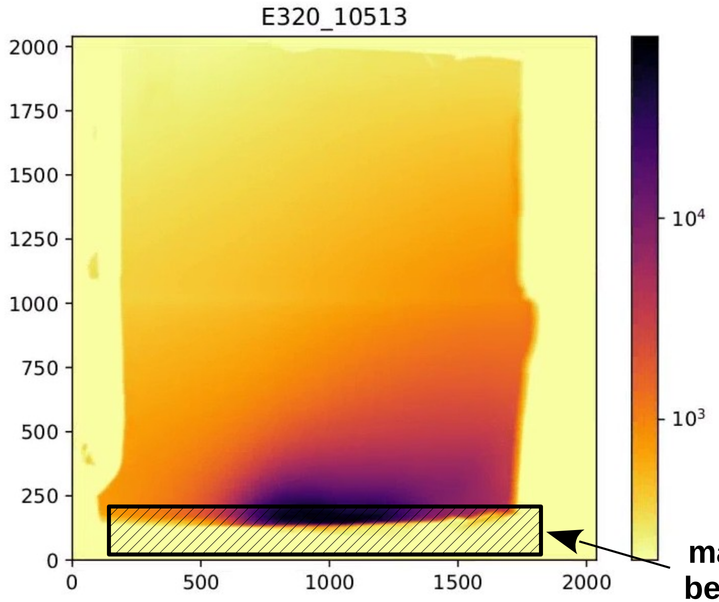




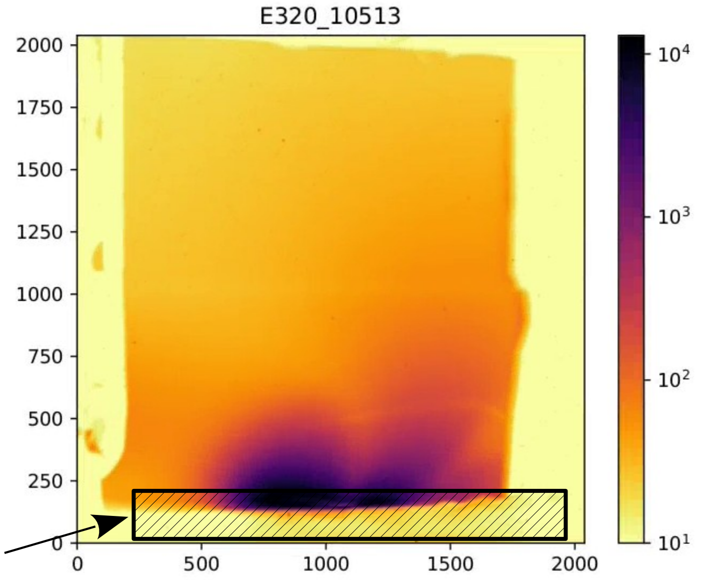
- BPM before picnic basket (3156) was defect during all our shifts in 2024
  ⇨ **Todo: make sure that all BPMs (in Sector 20) are working and calibrated**
- Not all BPMs in Sector 20 are in EPICS (valuable data are not being recorded)
  ⇨ **Todo: include existing BPMs (in Sector 20) into EPICS**
- **Goal: remove upstream Be window, optimize for zero dispersion (active stabilization?)**

Beam stability fall 2024: significant fluctuations/changes in background

All goosed images
(pixel-by-pixel mean value)



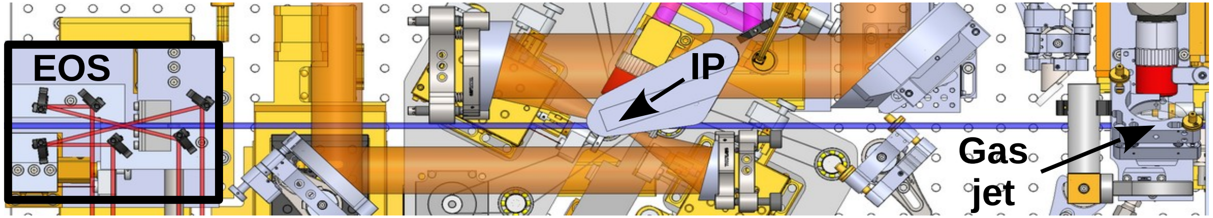
All goosed images
(pixel-by-pixel standard deviation)

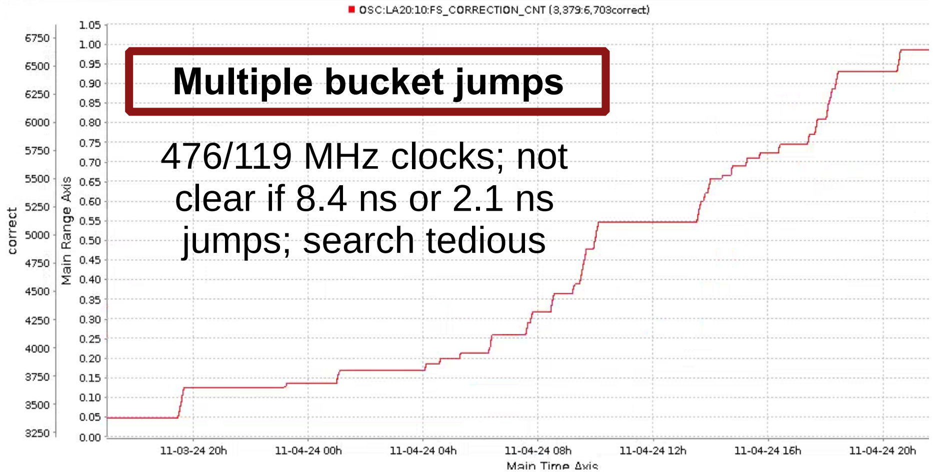


main beam

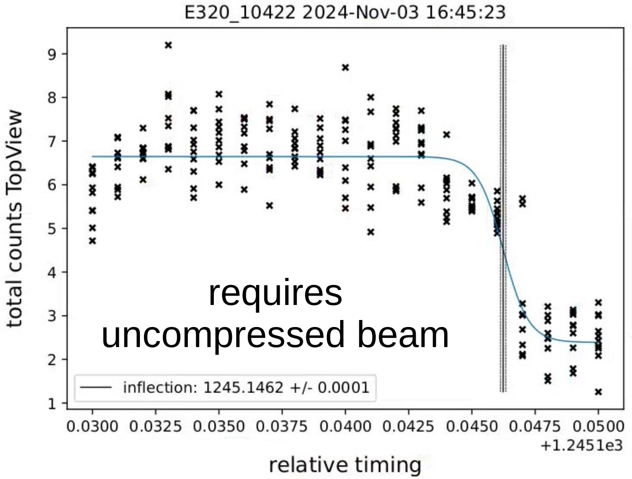
- We saw strong fluctuations in the beam-induced background (beam-position drifts/jitter?)
- **ToDo: pseudo-random goose trigger + ~50/50 on/off** (more background data)

Instability of t_0: significant time spent on plasma afterglow procedure





Plasma afterglow signal
(if recovery on EOS is impossible)

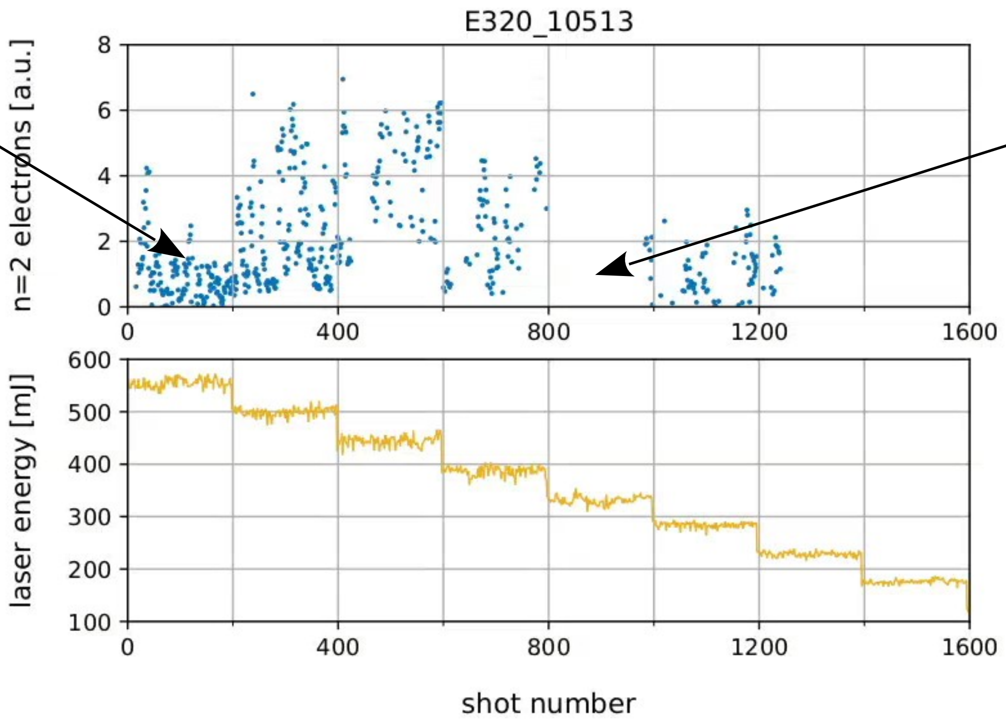


- Stable t_0 reduces setup time by several hours
- Bucket jumps and unstable FS-script sabotaged our fall beamtime
- **Highly desirable**: robust diode/pickup for sub-ns timing diagnostic

Anomaly at highest laser intensity

highest intensity: non-linear signal breakdown

Can be explained by spatial drifts



- Theory: we are heating the gratings and/or OAP, this leads to phase-front deformations
- **ToDo: more laser diagnostics in tunnel** (phase-front sensor, focal-spot diagnostics)

Goal: shot-to-shot high-intensity diagnostic

MO focal imaging: only possible at low intensities

beam splitter
(≲1:≳99)

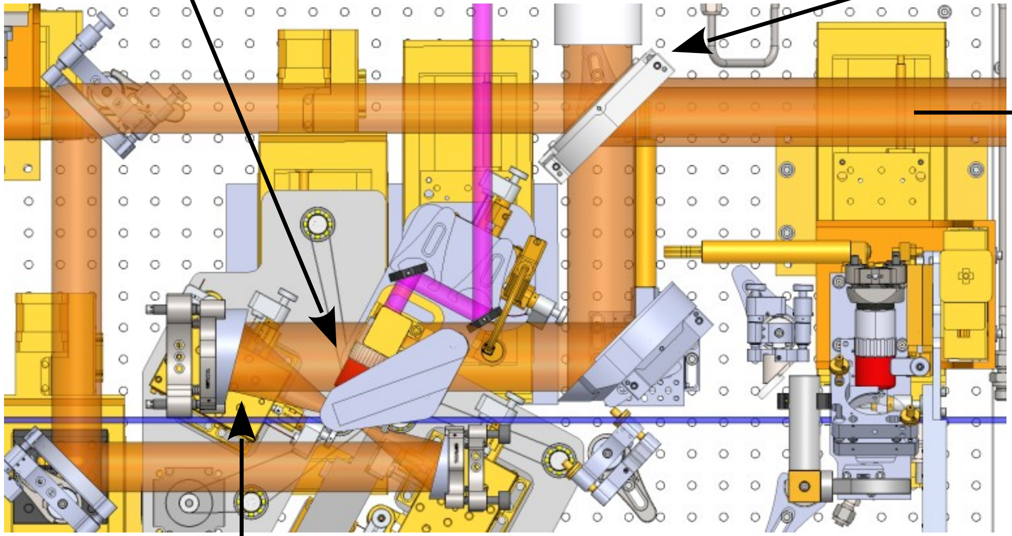


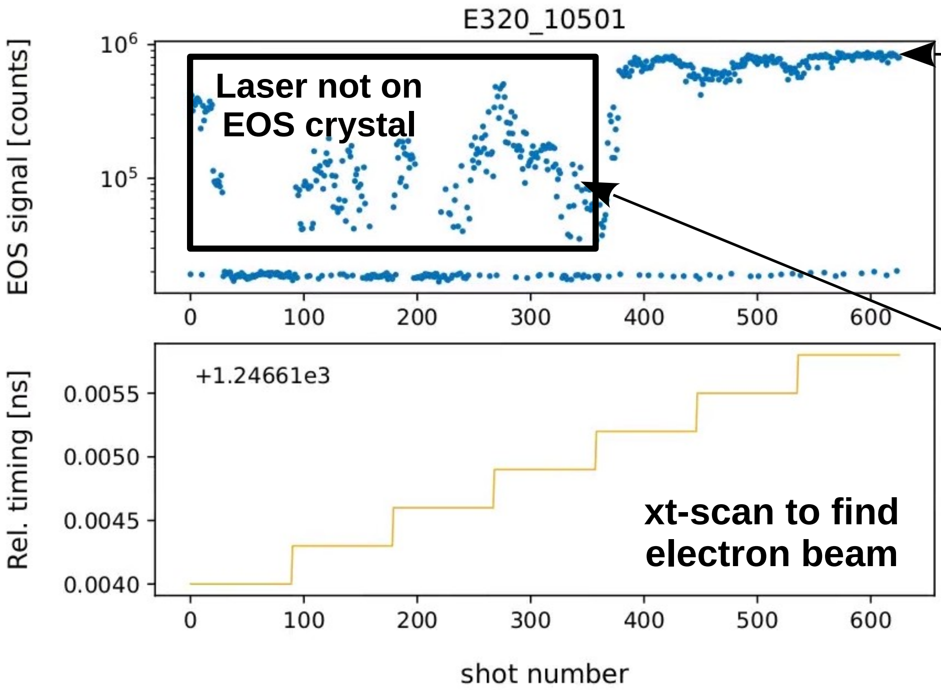
image of focal spot
is formed outside
the PB with a lens

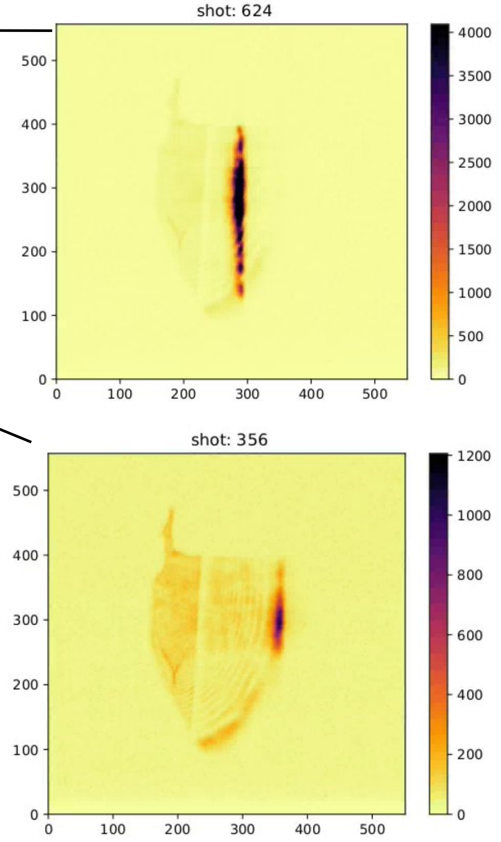
- Aim: re-image focal spot for each shot
  → alignment of the 2nd OAP becomes critical
- Use interferometry to align OAP pair
  → we know that “errors” are due to the actual focus and not the mis-alignment of OAP2

High-intensity diagnostics: 2nd OAP re-images the focal spot

Interferometric alignment of both OAPs

Timing drift stabilization: currently incompatible with long scans

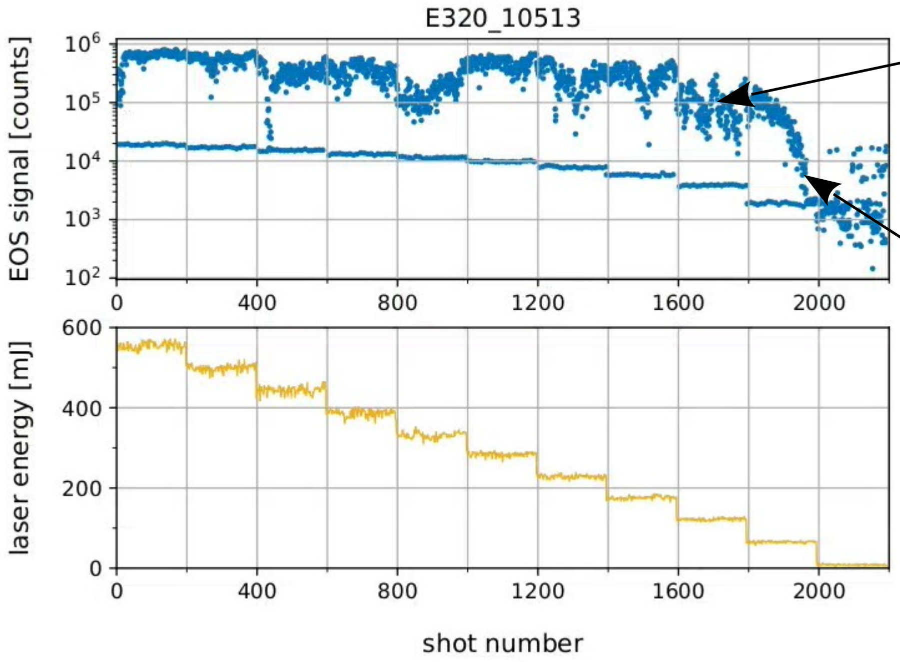


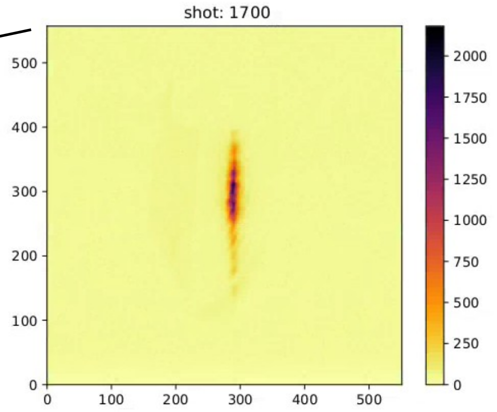


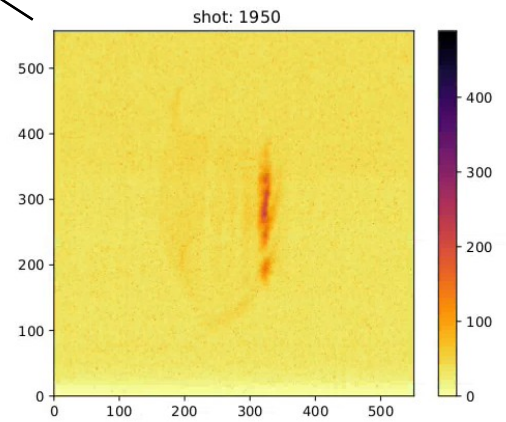
- Time drifts ~1ps (without stabilization); EOS range is only ~2 ps
- **ToDo: use EOS delay-stage movement for long-range scans**

  (similar fix should also be used for the grating scans)

Challenge: EOS becomes invisible at low intensities

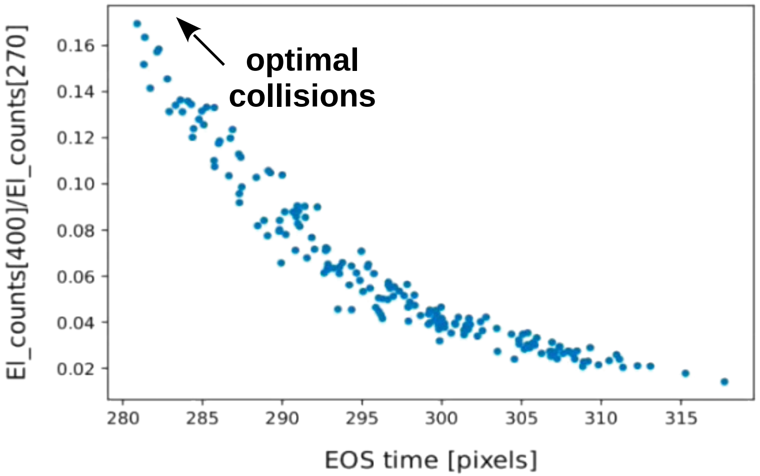


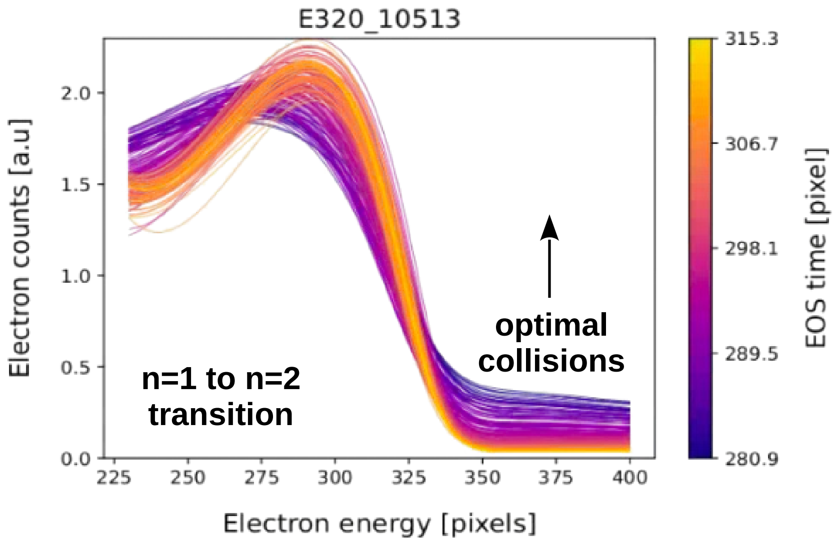




- EOS signal becomes too weak during intensity scans
- **ToDo: increase probe intensity when main laser is attenuated**

We didn't collide at optimal timing: effective laser intensity is reduced





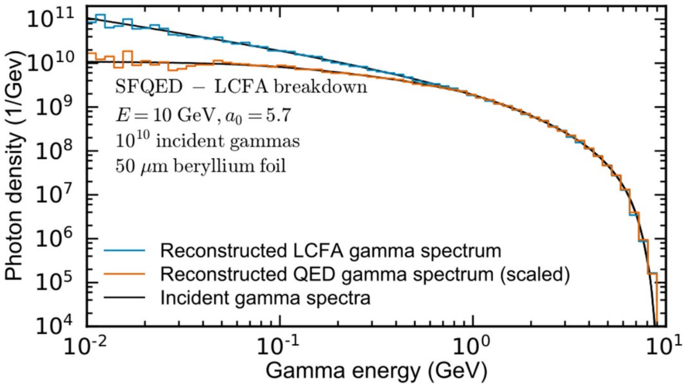
Analysis: T. Smorodnikova

- If we properly collided with the laser, we would observe an optimal collision time
- For non-optimal alignment it is very difficult to determine (effective) laser intensity
- **ToDo: run this analysis in real time and correct relative timing** (possible in the future)

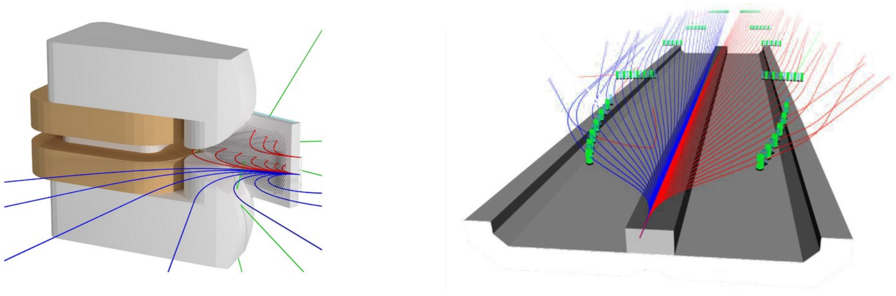
Future plans

Mid-term goal: upgrade gamma diagnostics

Measure photon formation length

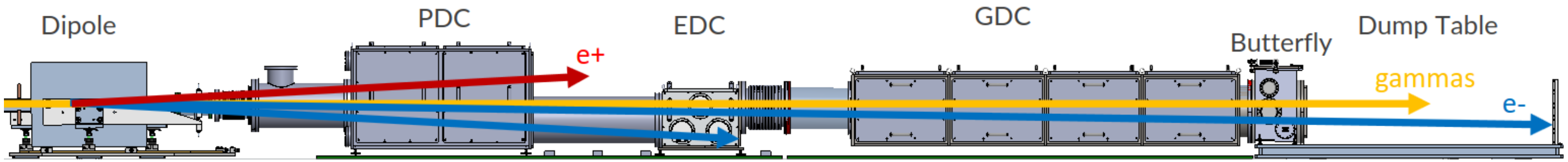


UCLA group



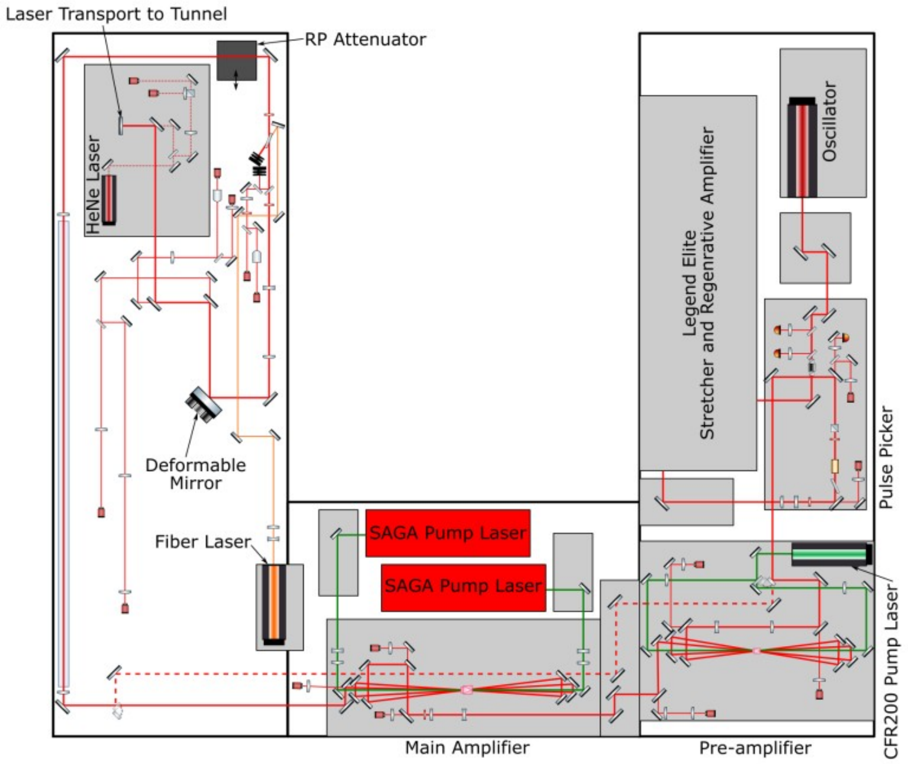
Compton (MeV) + gamma pair spectrometer (GeV)

B. Naranjo et al., IPAC2021 THPAB269, THPAB270 (2021)



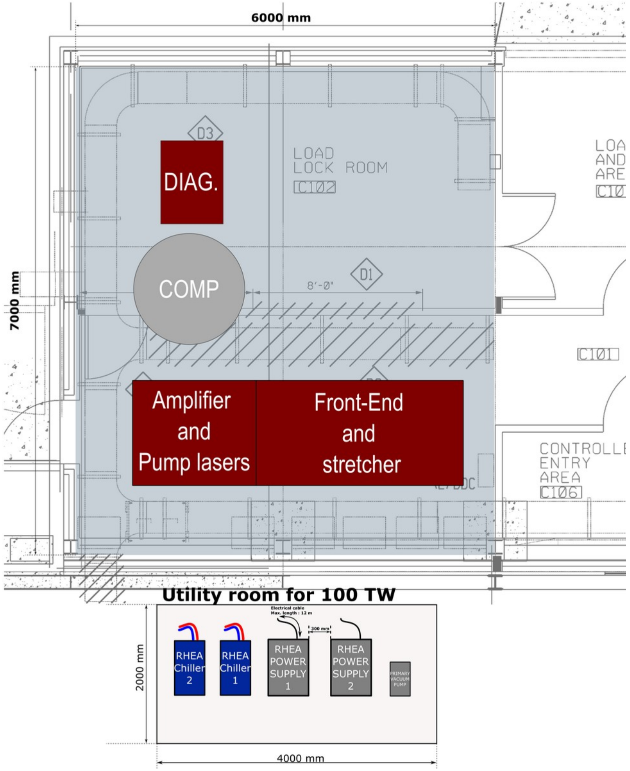
B. Naranjo: Gamma Detection: Compton and Pair Spectrometers
D. Storey: Experimental area (e- and gamma diagnostics, DPS, Li oven)

Mid-term goal: ≳ 100 TW laser: FES expressed interest



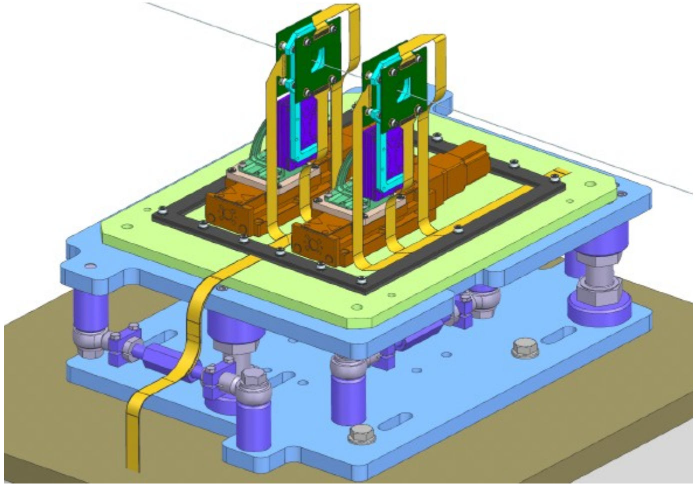
Current laser system: 10 TW
(~60 fs, 0.6 J in laser room)

Thales 100 TW proposal



Mid-term goal: install gamma-ray profiler with high resolution

Sapphire-strip detector

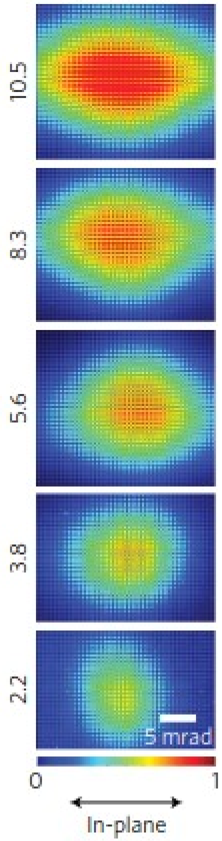


2x2cm^2 field of view, 5-10 µm resolution,
High radiation resistance (Sapphire)

The gamma-profile ellipticity is related to a_0 in the interaction region

High-order multiphoton Thomson scattering
Yan et al., Nature Photon. 11, 514 (2017)

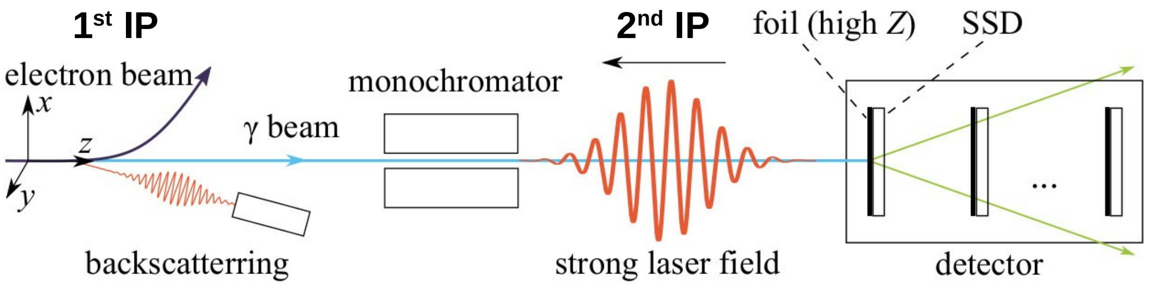
Har-Shemesh & Di Piazza
Opt. Lett. 37, 1352–1354 (2012)



INFN, U. Bologna, & U. Padova: P. Grutta, M. Bruschi, M. Morandin, F. Lasagni, S. Vasiukov, U. Dossell
QUB: K. Fleck, N. Cavanagh, E. Gerstmayr, M. Streeter

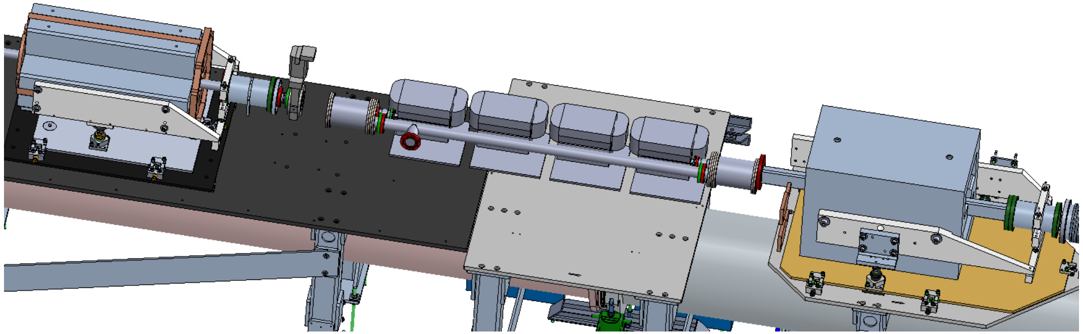
Long-term goal: 2nd IP to realize gamma-laser collisions

Measuring vacuum birefringence beyond Euler-Heisenberg



Bragin et al., PRL 119, 250403 (2017)

Gamma pair spectrometer



New chicane between quads and dipole

D. Storey

Summary and timeline

Short & mid-term goals:

Upgrade electron detectors

LBG_LFOV v2
direct detection (ePix)
Pseudo-random
Goose trigger

Spring 2025

Increase laser intensity

reach $a_0 \gtrsim 5$,
(eventually $a_0 \gtrsim 10$)

Sometime 2025

Measure tunneling pair production

requires:
clean beam transmission;
retracted Be window;
more laser energy

Sometime 2025

Install pair spectrometer (gamma photons)

carried out by UCLA

Upgrade to 13 GeV?

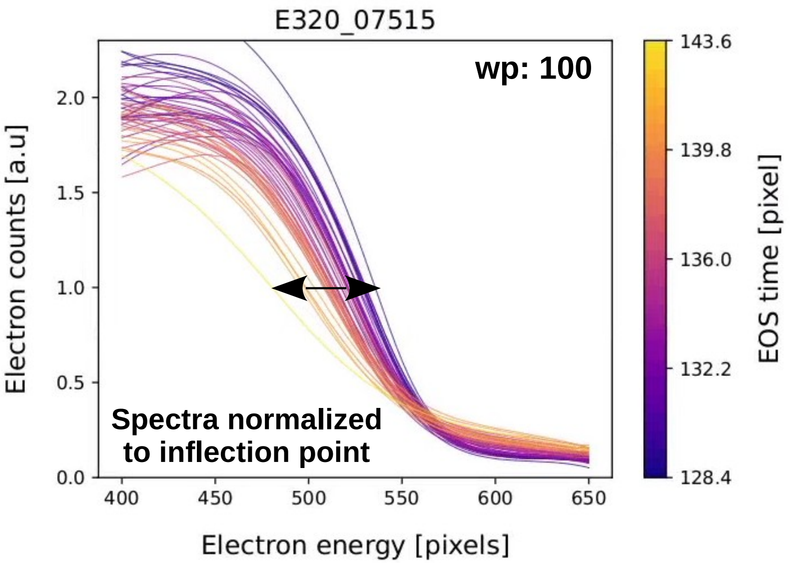
2025-26?

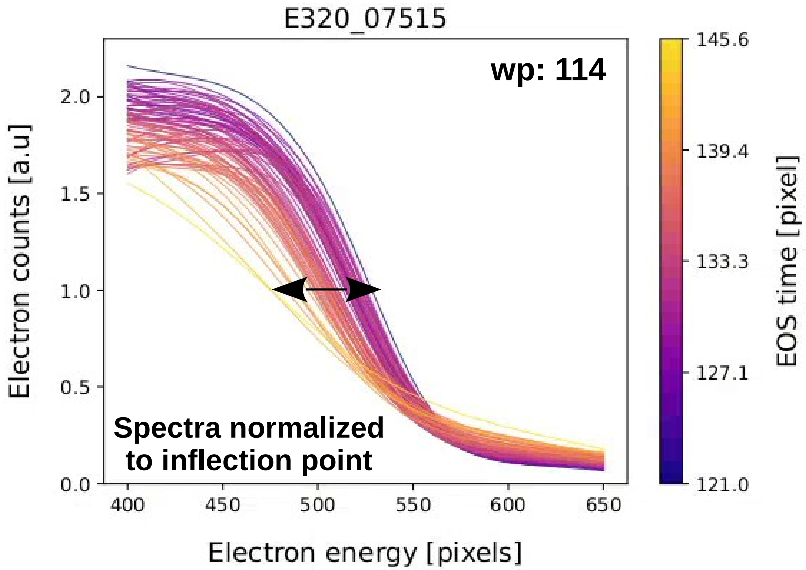
Long-term goals:

- 100-500 TW laser upgrade for FACET-II
- 2nd IP: light-by-light scattering experiments, (pair production & vacuum birefringence)
- Polarization-sensitive detectors: vacuum birefringence, radiative spin polarization
- Observe signatures of high-energy electron-positron coherent recollisions, waveform synthesis
- …

Thank you for your attention

Shift of 2^{nd} Compton edge (electron mass dressing)





Analysis: T. Smorodnikova

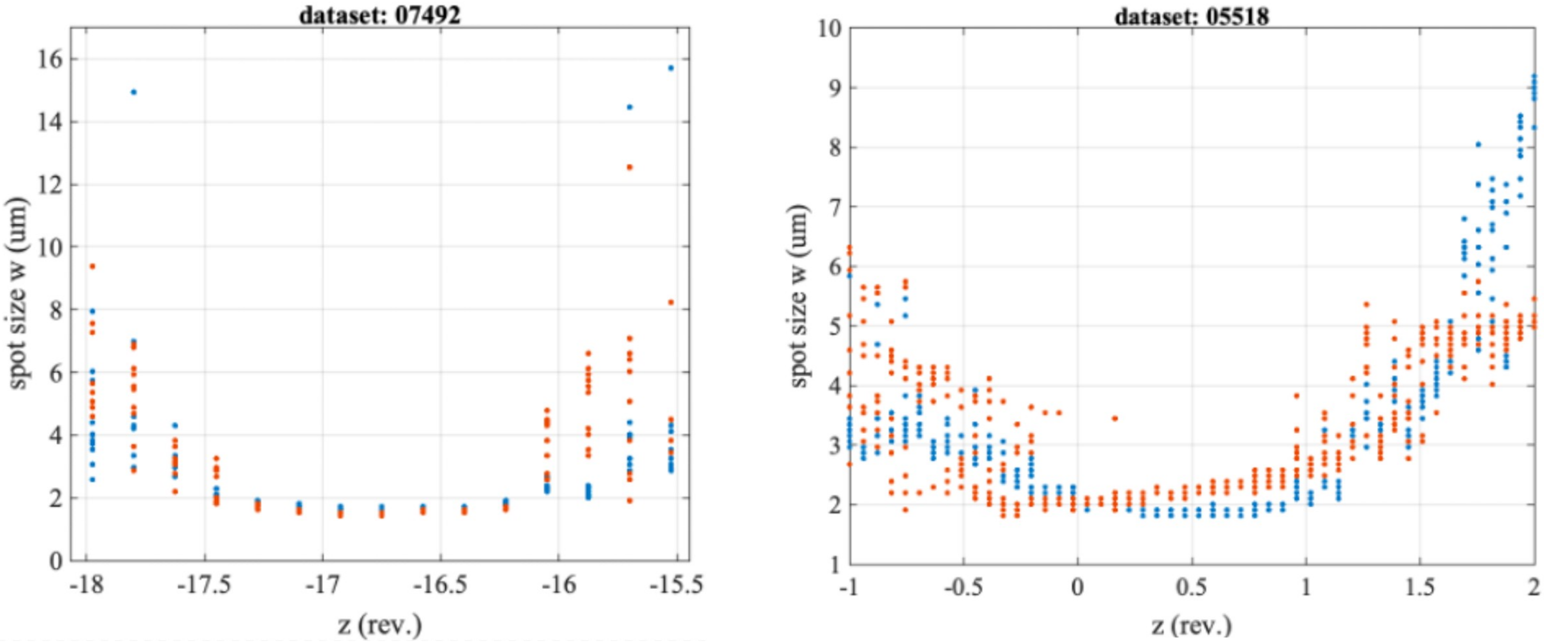
relation between the incident and scattered frequencies,

$$\omega' = \omega_r' = \frac{mr\omega}{m + (2r\omega + m\nu^2)\sin^2\frac{1}{2}\theta}. \qquad (3.34)$$

$$\nu^2 = \frac{\Delta m^2}{m^2} = \frac{e^2}{m^2}\left(-\tfrac{1}{2}\mathfrak{a}\cdot\mathfrak{a}^*\right) > 0. \qquad (3.27)$$

Brown & Kibble, *Interaction of Intense Laser Beams with Electrons*, Phys. Rev. 133, A705 (1964)
Nikishov & Ritus, *Quantum Processes in the Field of a Plane Electromagnetic Wave and in a Constant Field*, JETP 19, 1191 (1964)

Dielectric λ/10 OAP: improved focal quality

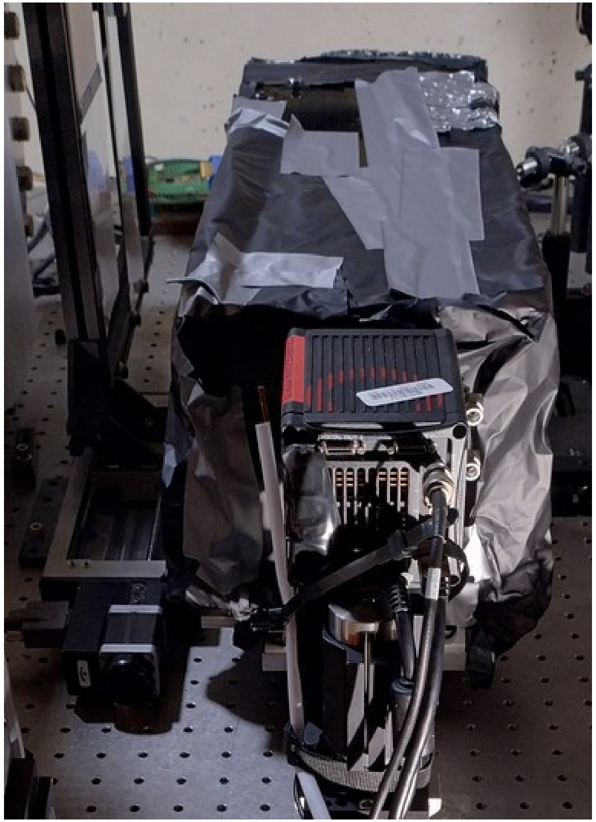


new, dielectric OAP, λ/10 old, gold OAP, λ/4

Analysis & plots: A. Knetsch

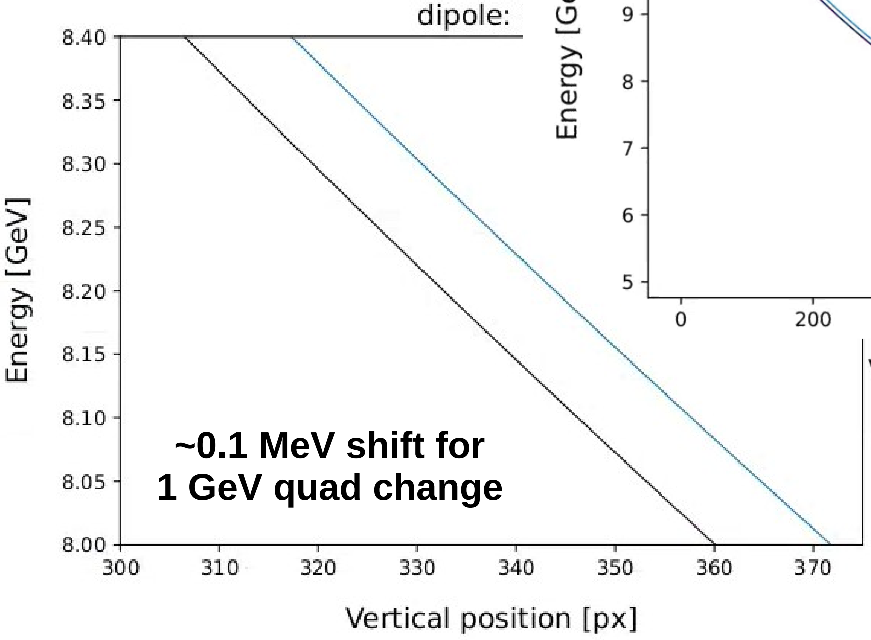
Better spot quality, higher Strehl, much improved focal scans

Low-Background LFOV (Alex)

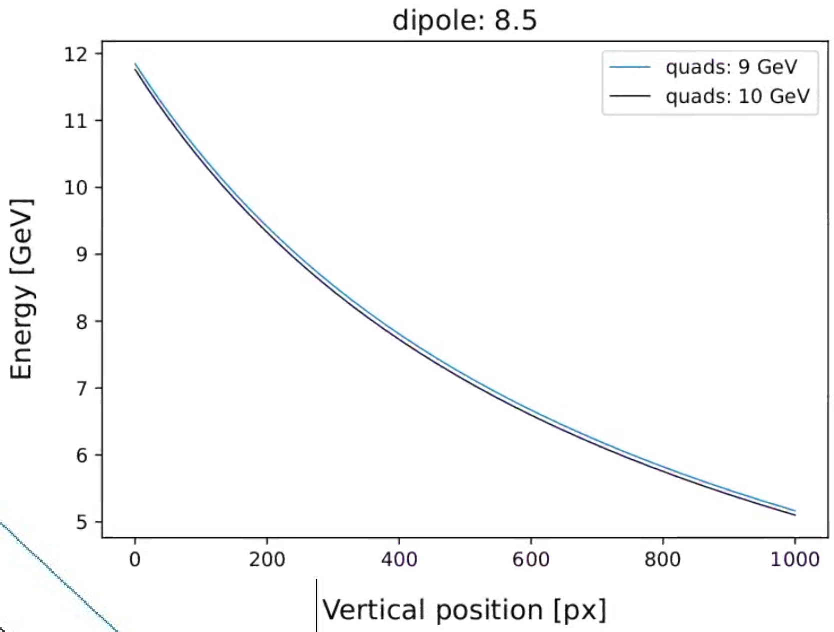


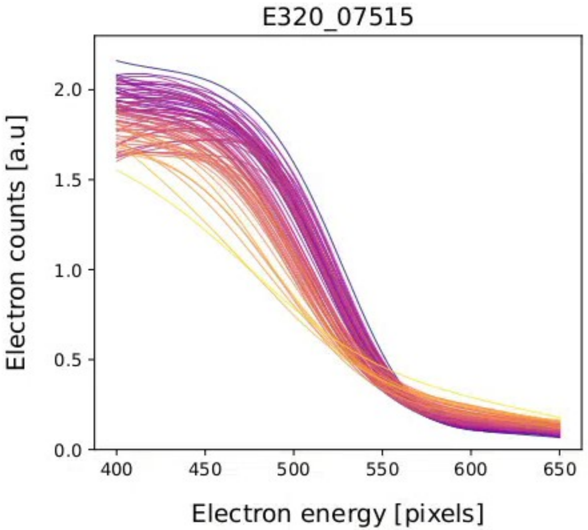
- ORCA FLASH 4.0 + Nikkor 50mm f/1.2 + DRZ fine
- Sees up to 24.4 cm over the table surface
- Detection of low-energy scattered electrons
- Much more sensitive than LFOV

Low-Background LFOV: energy calibration



~0.1 MeV shift for 1 GeV quad change



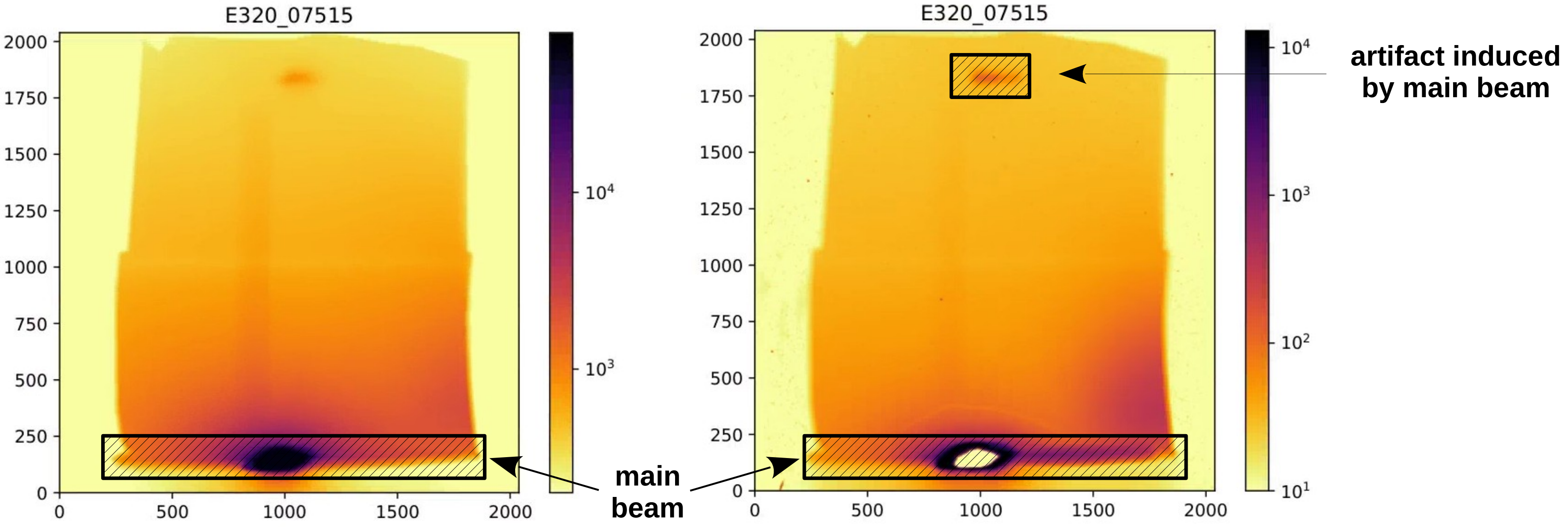


- Dark current defocuses too much for quads ≲ 8 GeV
  ⇨ we don't have an energy calibration for 8 GeV
- **ToDo: BBA of quads** (steering is too large)

Beam stability spring 2024: much better beam-induced backgrounds

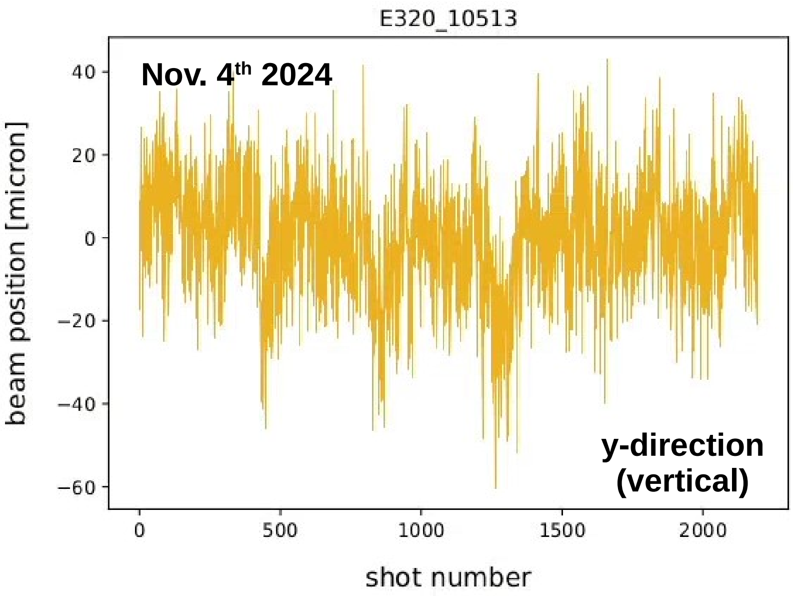
All goosed images
(pixel-by-pixel mean value)

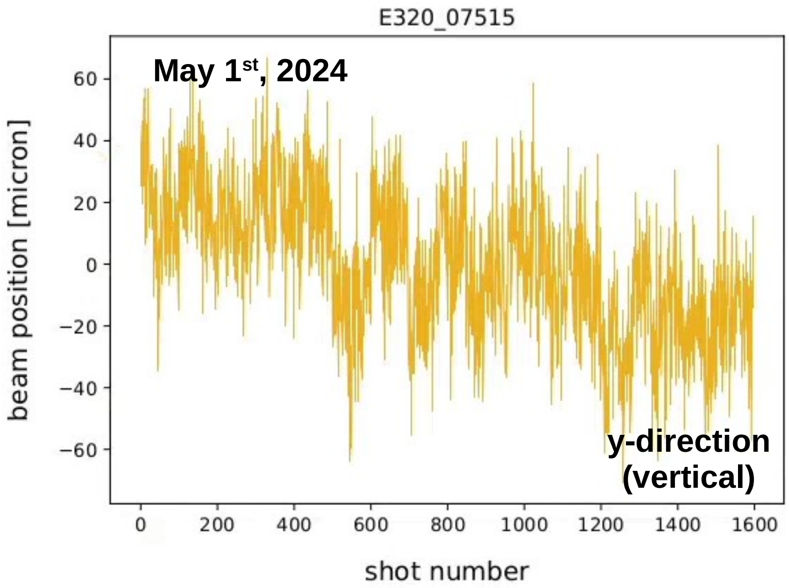
All goosed images
(pixel-by-pixel standard deviation)



- Even though we put the main beam fully on LBG_LFOV, the background is much more stable
- Enhanced beam-tuning time in spring significantly improved the beam quality

Beam position drift/jitter at the E-320 IP (spring vs. fall)





- BPM before picnic basket (3156) was defect during all our shifts in 2024
  ⇨ negative impact on the precision that we can achieve
  ⇨ **Todo: make sure that all BPMs (in Sector 20) are working and calibrated**
- Not all BPMs in Sector 20 are in EPICS (valuable data are not being recorded)
  ⇨ **Todo: include existing BPMs (in Sector 20) into EPICS**

We can recover collisions in ≲ 4 hours (Spring 2024)

```
09:00 pm:  Starting alignment to E320 setup
09:19 pm:  Compressor window out  now
09:45 pm:  Focal scan before beam shaping
http://physics-elog.slac.stanford.edu/facetelog/show.jsp?dir=/2024/18/29.04&pos=2024-04-29T21:4
22:00 pm: Beam shaping with deformable mirror
Dataset after beam shaping
http://physics-elog.slac.stanford.edu/facetelog/show.jsp?dir=/2024/18/29.04&pos=2024-04-29T22:1

11:00 pm: vertical beam edge at 48.3175 mm http://physics-elog.slac.stanford.edu/facetelog/show

11:25 pm: drilled a hole accidentally: http://physics-elog.slac.stanford.edu/facetelog/show.jsp

11:30 pm: darkened YAG on the edge: http://physics-elog.slac.stanford.edu/facetelog/show.jsp?di

11:45 pm: found horizontal overlap: ht

01:00 am: found EOS timing (EOS 2) at

01:10 am: beam was at 5 Hz for a while
          http://physics-elog.slac.sta

02:09 am: collisions! http://physics-
          t0: 1255.2675
          EOS delay stage: -19
```

1st day: 5-6 hours

2nd day: 4 hours

04/30/2024 23:59 Team E320 **E320 running log**

```
18:00 pm   Laser in tunnel. EOS2 signal found. Moved compressor grating separation back to 26.6
 and EOS delay back to -21, matching previous conditions for optimal pulse duration: http://physi

19:00 pm   Focus recovered on MO_MAG, still looks nice: http://physics-elog.slac.stanford.edu/fac

20:20 pm   beam intercepted with YAG in vertical direction at position 48.55 mm

20:37 pm   Laser vertically aligned

21:15 pm   Laser spatially aligned, going for collisions

22:00 pm   recovered collisions
```

- **Importance of multi-day shifts**: 2nd/3rd day was always much more productive
- Requires that t_0 doesn't change and that the e-beam doesn't scrape the Be window

Spatial alignment requires now ≲ 2 hours

Elog Nov 4, 2024

found e-beam in vertical dimension

```
20:40 vertical peripheral knife-edge scan http://physics-elog.slac.stan
      motor position where the beam was intercepted: 47.985 http://phys
      moved e-beam off the YAG in horizontal dim http://physics-elog.sl
```

found e-beam in horizontal position

```
      done at 47.0000 YAG height
      motor at 65.6 rev (pico horizontal YAG)

22:00 found collisions. Laser timing jumped again by 2.1 ns to 1246.618
```

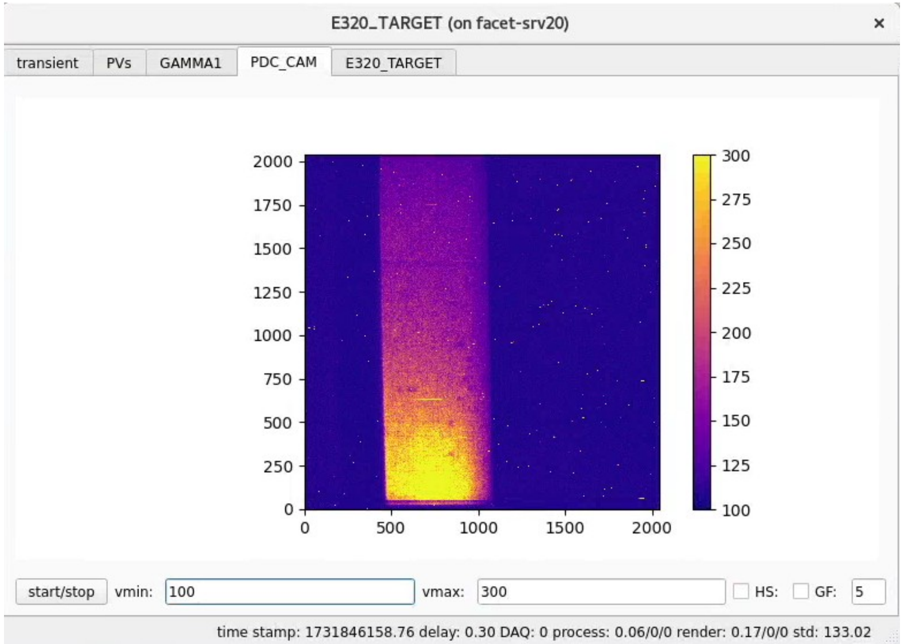
Elog Nov 3, 2024

Found e-beam at 47.8480 mm YAG height

```
19:45 vertical knife-edge finding http://physics-elog.slac.stanford.edu
20:25 moved laser to e-beam (vertical)
```

Found e-beam at 74.2 (horizontal)

```
20:53 http://physics-elog.slac.stanford.edu/facetelog/show.jsp?dir=/202
21:15 lost auto aligner, trying to fix laser transport
22:10 moved laser to e-beam (horizontal); doing wavefront optimization
22:24 focal scans http://physics-elog.slac.stanford.edu/facetelog/show.
22:28 MO tower retracted; going to full laser energy
22:30 Laser 642.5 mJ +- 12.65 mJ
```



PyQt5 GUI for spatial alignment
(10 Hz camera readout)

Recovering t_0 via plasma afterglow: 2-3 hours

Elog Nov 2, 2024: ≳ 3 hours

```
22:50 can't recover timing on EOS
23:45 gas jet is being prepared for timing via afterglow
00:15 Ar bottle connected to gas jet and at 100 psi packing pressure
01:15 Plasma after glow is finally working; searching for t0 by hand
01:35 t0 found with axilens at ~ 1247.261 ns
02:05 found t0 with EOS! http://physics-elog.slac.stanford.edu/facetelog
      t0: 1246.6450 ('OSC:LA20:10:FS_TGT_TIME)
```

Elog Nov 3, 2024: ≳ 2 hours

```
Finding t0 (yesterday t0: 1246.6450)

15:30 - still trying to recover t0 on EOS
        DAQ failed http://physics-elog.slac.stanford.edu/facetelog/show
15:40 scanned target time 1255.0 - 1255.5 ns

Gas jet / afterglow t0 finding

15:45 can't run gas jet due to pump issues: http://physics-elog.slac.st
16:00 Doug / Alex fixed the pump issues http://physics-elog.slac.stanfo
16:40 found t0 via plasma afterglow: http://physics-elog.slac.stanford.
      gamma1 and topview correlation with timing: http://physics-elog.s
16:58 found t0 on EOS: http://physics-elog.slac.stanford.edu/facetelog/

Recovered timing on EOS: 1244.5350
```