

New LESA Test Beam at SLAC's End Station A

14th BTTBW, Mainz

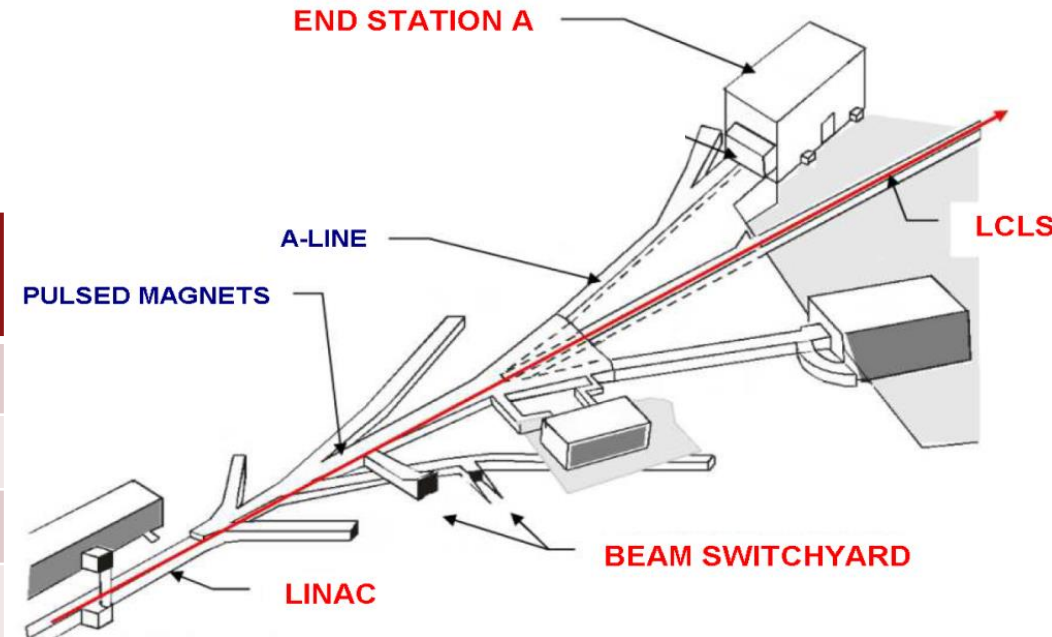
Carsten Hast / Head Test Facilities Department

April 13-17, 2026

End Station Test Beam (ESTB) 2013-2018

- LCLS beam was deflected to ESTB at 5Hz
- LCLS Cu Beam Energy 3-16GeV
- Secondary particle production target in BSY
 - Just kick beam onto 6mm of Cu
 - Secondary electrons up to <15GeV
- Beam is bend by 24.5° into ESA
- Highlights:
 - g-2 calorimeter calibration
 - LANL electron radiography
 - Atlas silicon tracker development
 - Cosmic neutrino/air showers
 - Electron Channeling Studies

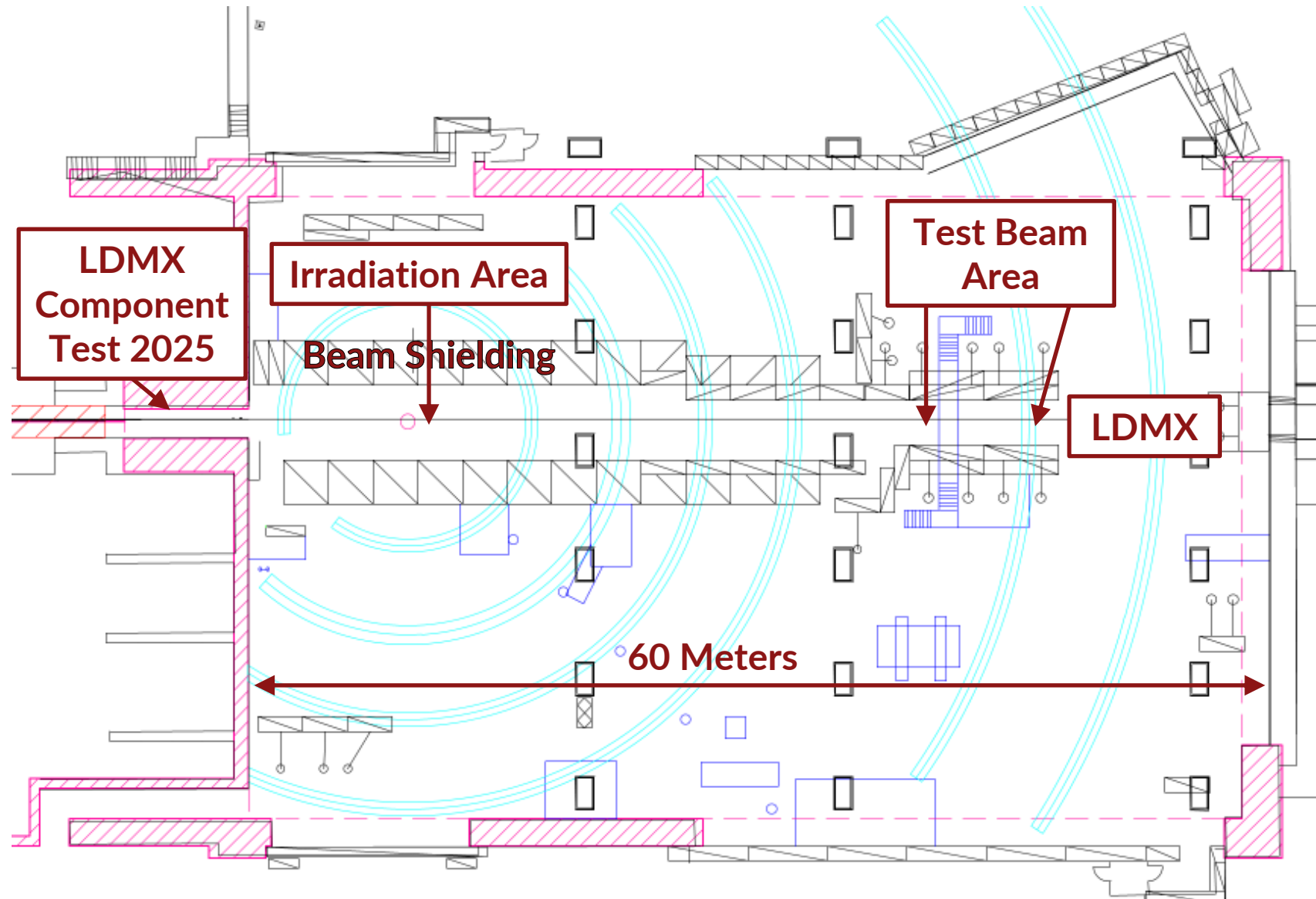
Fiscal Year	# Experiments	# Users
2013	6	91
2014	11	207
2015	6	54
2016	15	140
2017	7	74
2018	6	49
2019	8	86
Total	58	701



I gave an overview talk @ BTTB4 Orsay 2016

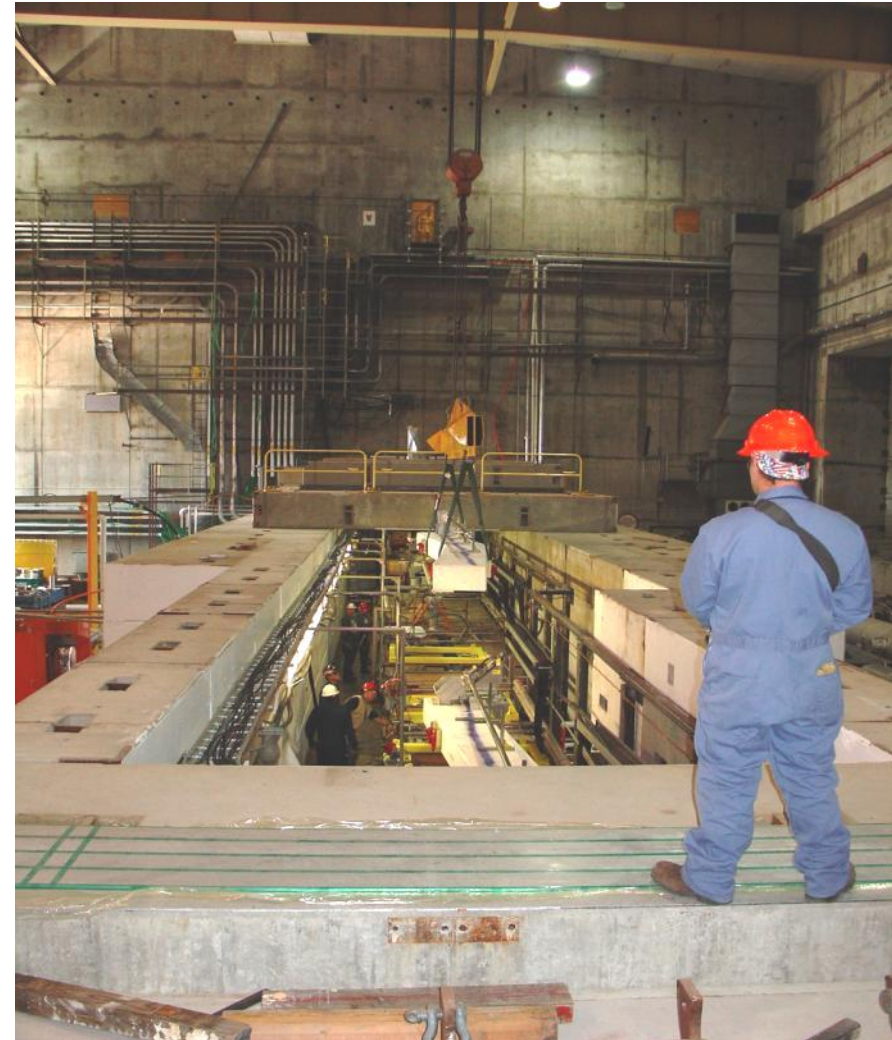
Widely Successful

Building 61: End Station A (ESA)



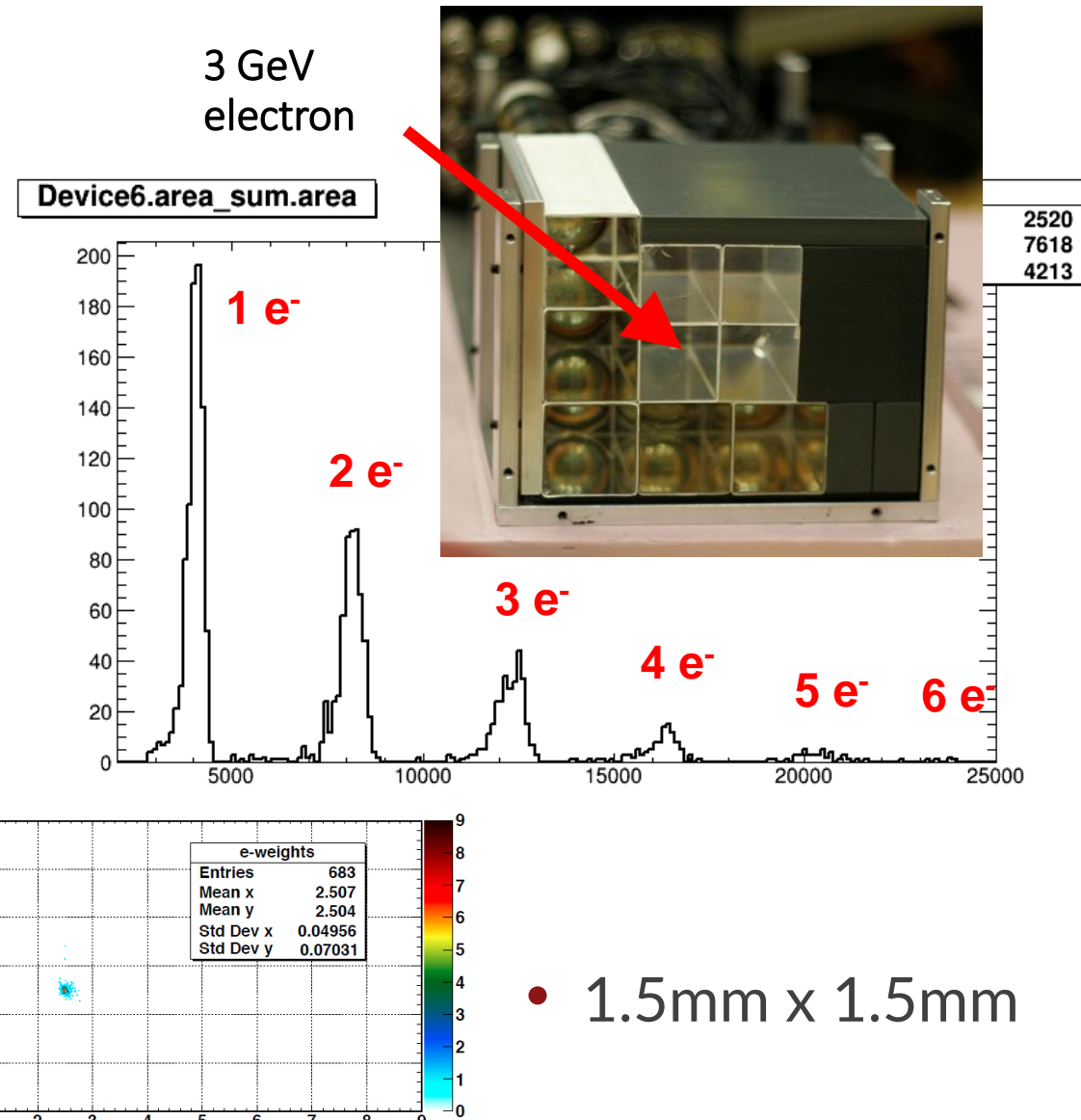
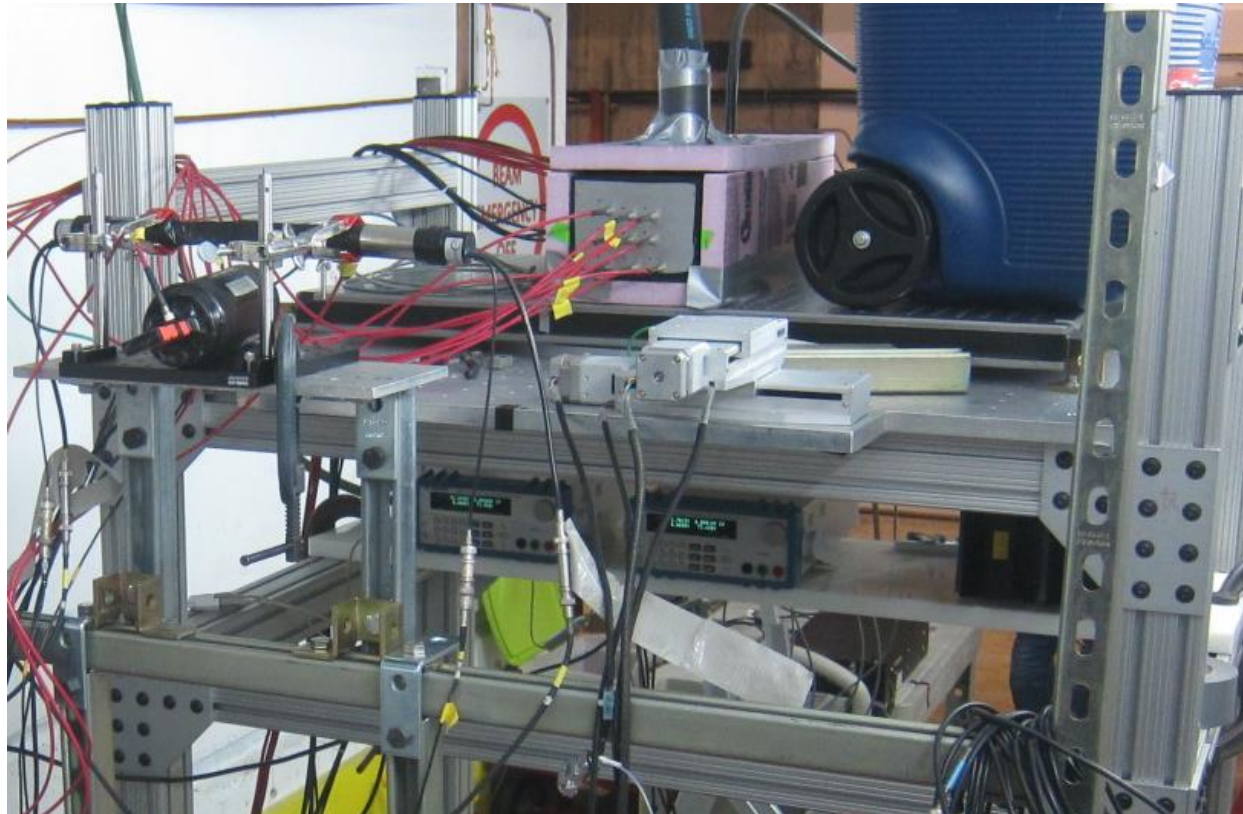
End Station A (ESA)

- ESA has massive shielding
- Crane coverage
- Pretty good temperature stability
- Test-Beam Beam line is at 4'10"=150cm height above ground (inside bunker)
- Vacuum up to your experiment
- Beam path is straight for about 150m after the last bend magnet in A-line
 - We will have some quads in ESA to make the beam larger for LDMX, can be turned off
 - Very effective collimator system in A-Line
- Divergence is $< 0.1\text{mrad}$
- Energy resolution is in the per mill range



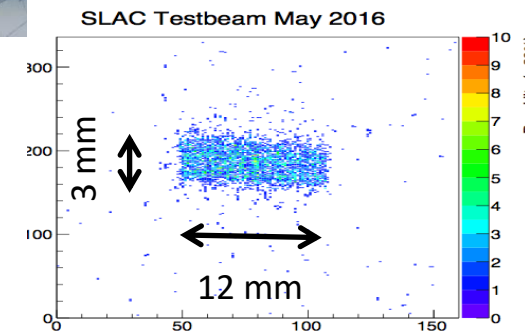
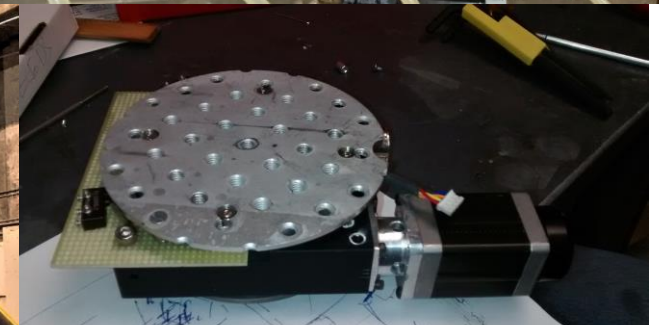
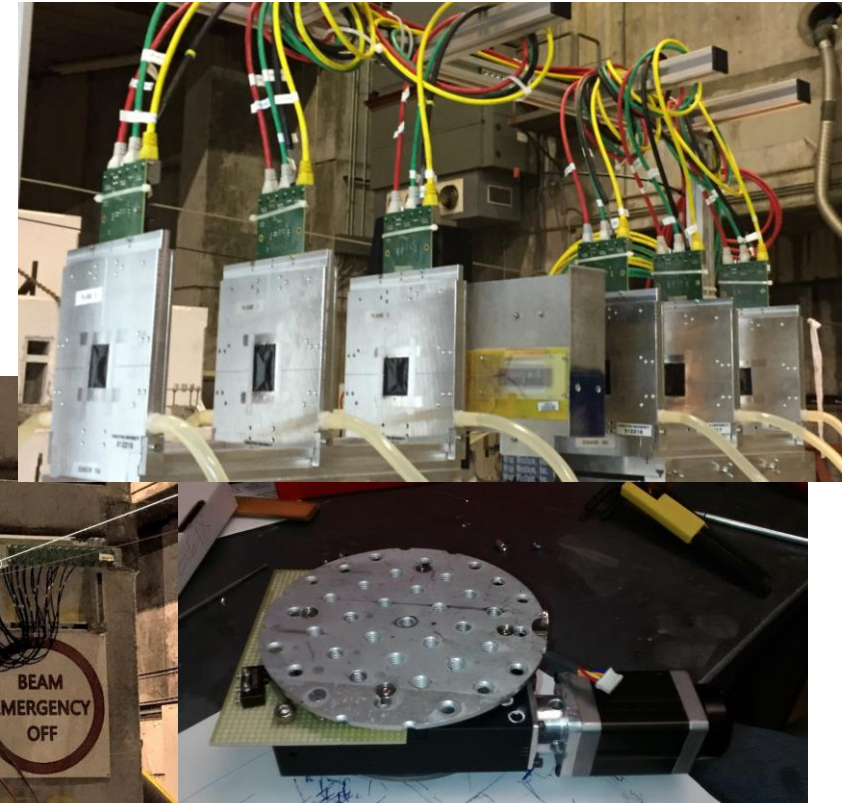
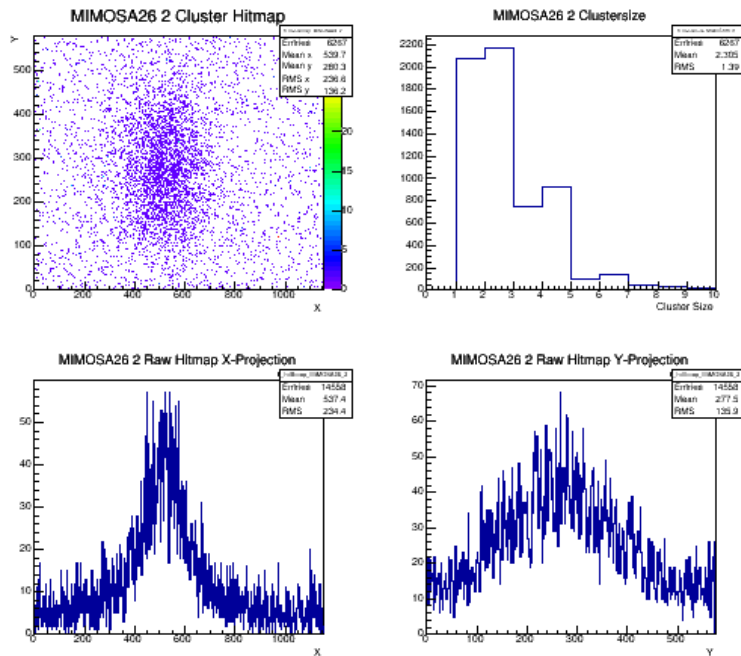
Typical Experimental Setup (g-2 Calorimeter)

- Single electrons 2-6Gev @ 5Hz
- Used our large movable stage to position calorimeter



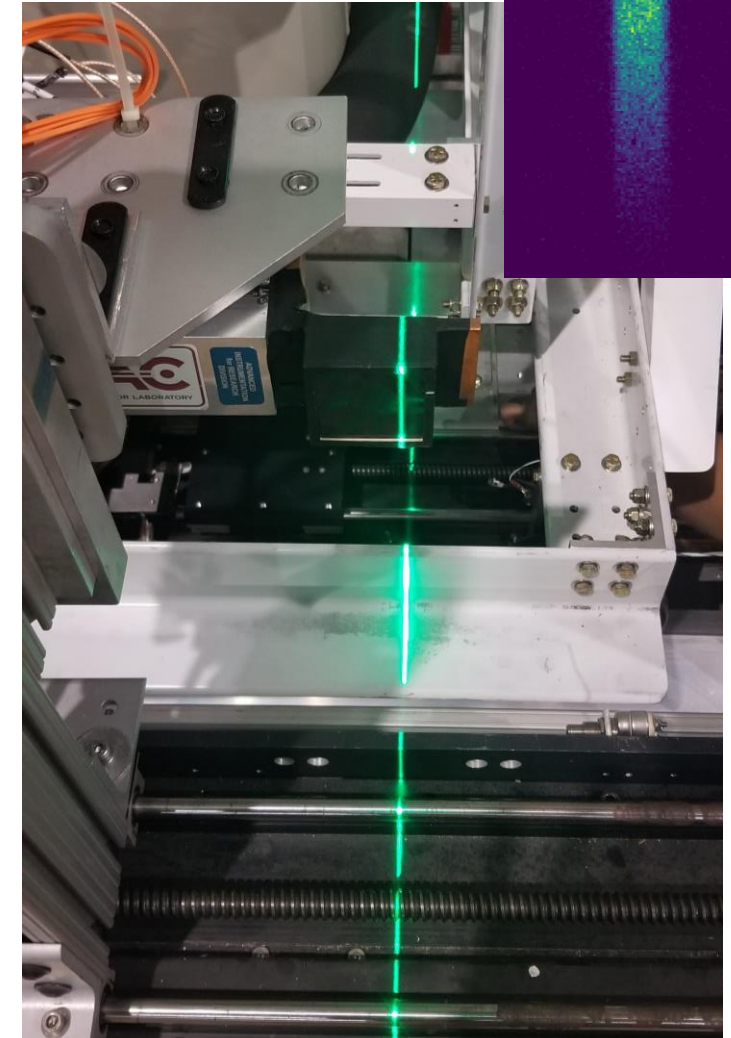
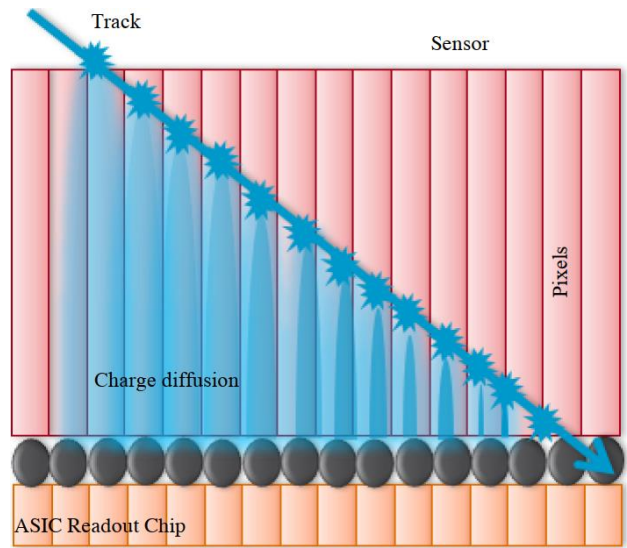
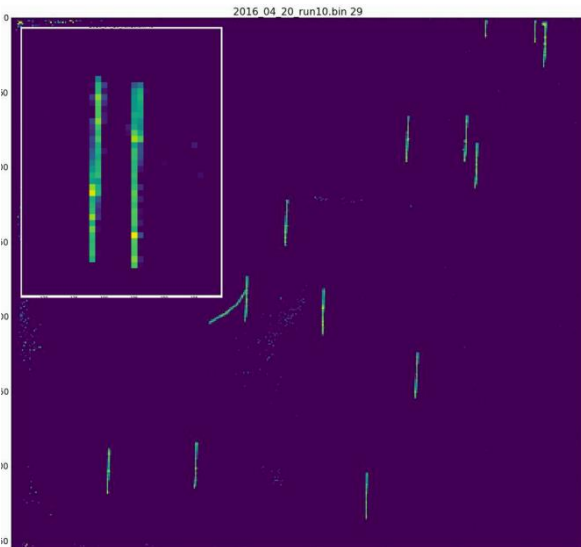
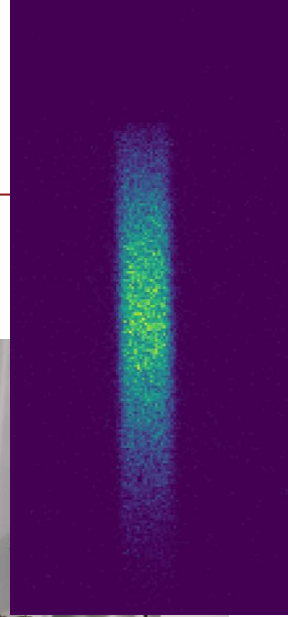
Typical Experimental Setup (Caladium)

- Caladium (EUDET) telescope on loan from Carleton Uni.
- Did plenty of ATLAS and other Silicon beam tests
- Mounted on movers for easy positioning in beam
- Rotation stage for DUT
- Worked quite well

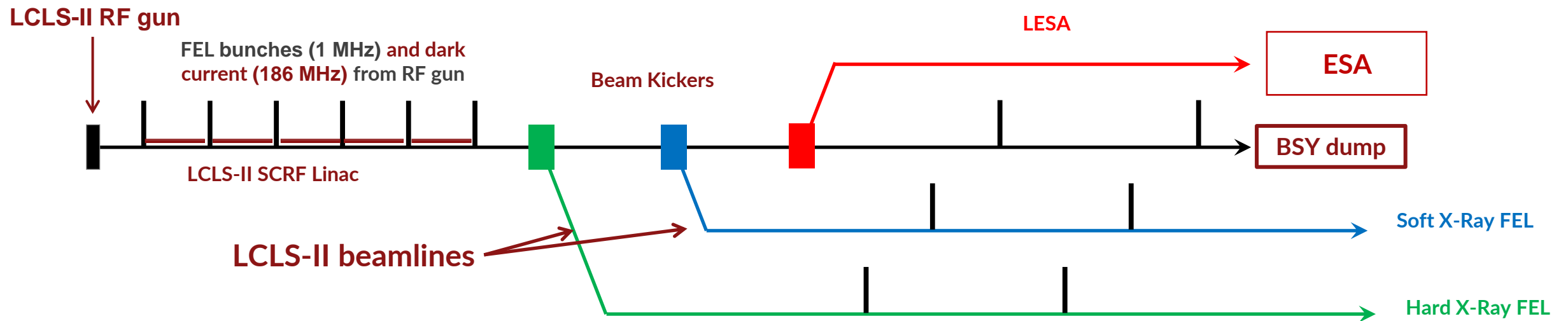


Typical Experimental Setup (ePix 100a)

- We built a modified version of an ePix camera
 - Moved electronics by 90 degrees to reduce material after sensor
- Mounted on x/y movers, incorporated into experimental setup for T-530: Microwave Cherenkov Calorimeters for Ultra-high Intensity Beams, Peter Gorham (Univ. of Hawaii)
- Did some 45° measurements
 - “3D Electron Tracking and Vertexing in Single Plane Pixel Detectors”, G.Blaj et.al. (*NSS/MIC/RTSD*), Strasbourg, France, 2016, pp. 1-6, doi: 10.1109/NSSMIC.2016.8069688.

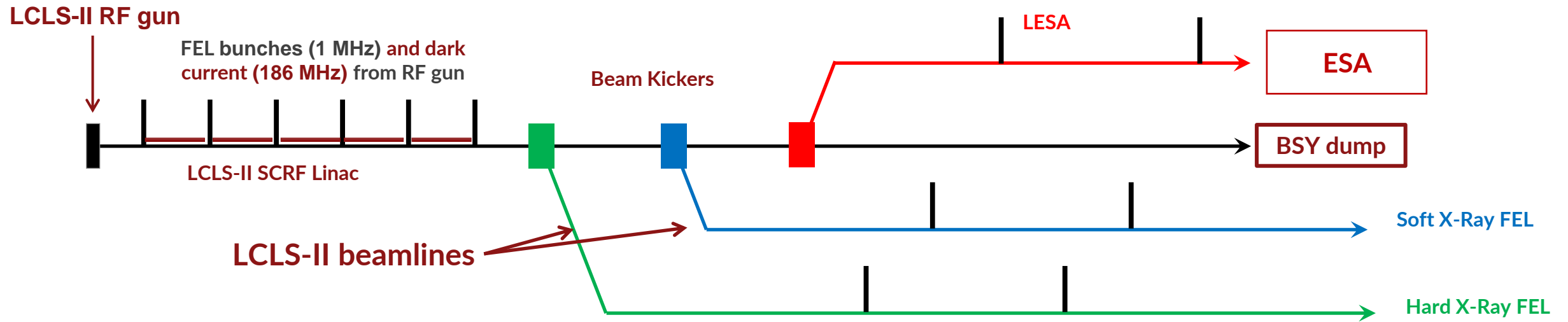


Linac to End Station A (LESA) Beam Generation



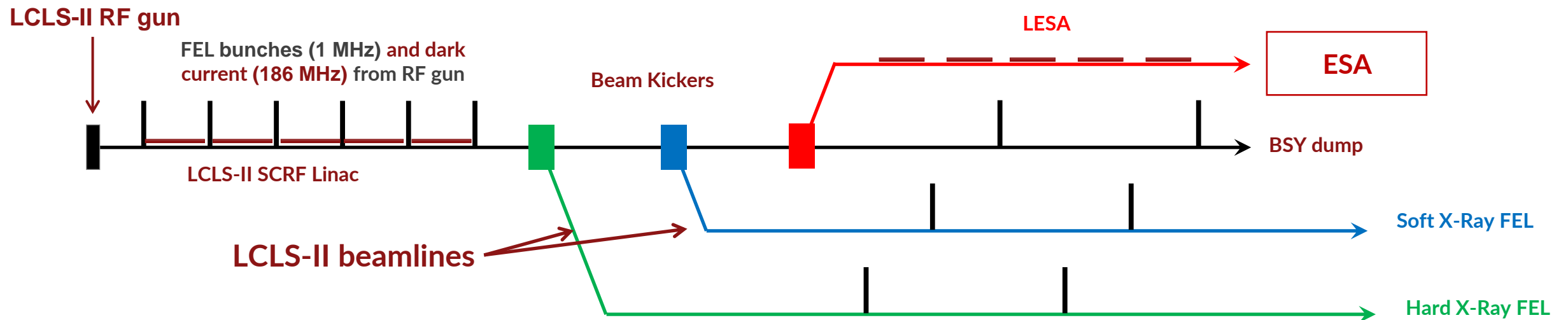
- LESA uses beam otherwise going to dump

Linac to End Station A (LESA) Beam Generation

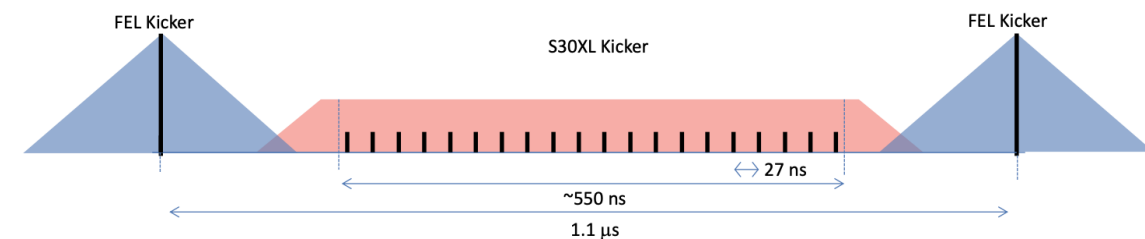


- LESA uses beam otherwise going to dump
- Primary beam pulsed to LESA
- Bunch Length
 - LCLS-II-HE: 10um equivalent to 33fs with a momentum spread of ~0.1%
 - A-Line's 24-degree bend has large dispersion
33fs → 2ps, need to measure that next year

Linac to End Station A (LESA) Beam Generation

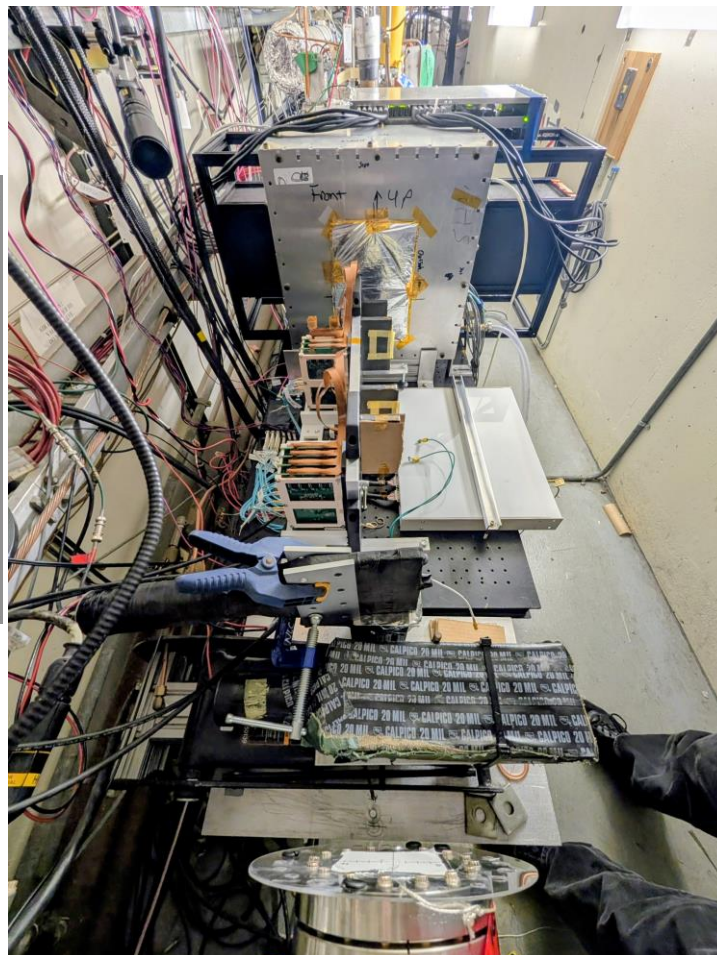


- LESA uses beam otherwise going to dump
- Dark Current is nearly nonexistent
- Plan to install 37MHz laser later to fill dark current buckets
- Expect every pulse (every 27ns) to have a timing jitter of ~ 2 ps (maybe less because the momentum spread is smaller)

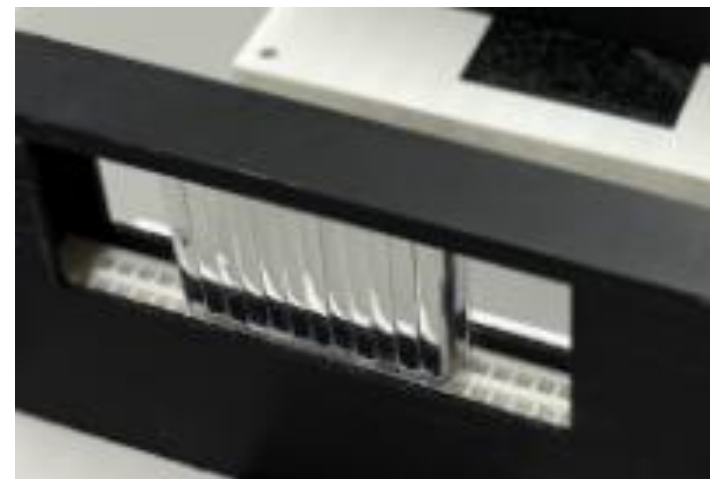


First LESA Beam in ESA in Nov/Dec 2025

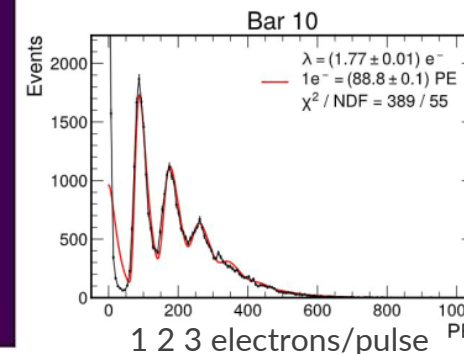
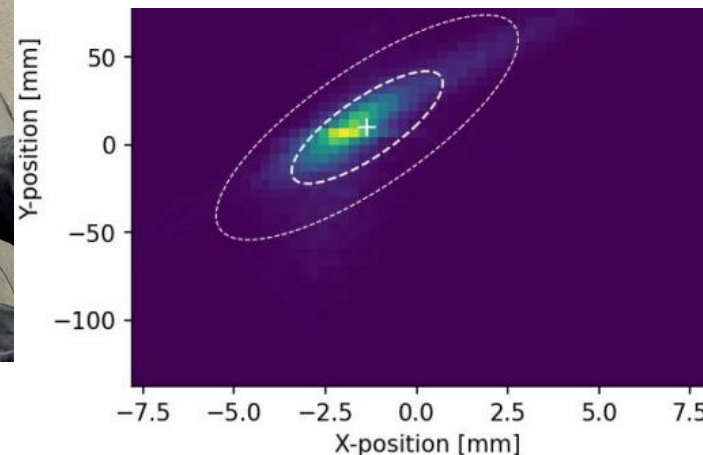
75pC/bunch - 3.75 GeV
 Primary Beam on
 Phosphor Screen in Alcove



~ few electrons/bunch - 3.00 GeV
 Secondary Beam LDMX Fiber Tracker



scintillator bars
 2mm x 3 mm x
 30 mm



- ~~Elizabeth Berzin (Poster)~~
~~Beam Tests of an LDMX Trigger Scintillator Prototype in the Linac to End Station A (LESA) Beamline at SLAC~~
- Erik Wallin (Calorimeter Talk)
 The Light Dark Matter eXperiment Slice Test and HCal Test Beam
 Many more details and much nicer pictures of the setup and ESA

LESA Works at Least as Good as ESTB

What to Expect in Summer 2027

- Primary Beam for beam physics or limited irradiation studies
 - 8GeV
 - Up to 100Hz
 - Beam power max. 80W
 - 10nA current == $6.2 * 10^{08} e^-$ per pulse
- YAG and other screens to see beam profiles
- Beam synchronous timing/trigger system
- Timing/Trigger can be integrated into your DAQ (inquire about details)
- Multiple x/y and rotation stages
- HV for PMTs
- Secondary Beam for experimental hardware tests (6mm Cu-Target in BSY)
 - 2GeV to 8GeV
 - Up to 100Hz
 - Beam power small to nothing
 - 0, 1 to few or 100^{th} - $1000^{th} e^-$ per pulse
- Everything from “Primary Beam”
- Caladium EUDET Telescope
- Lead-glass calorimeter blocks
- Maybe 1 layer of LDMX fiber tracker for particle position
- Maybe acquiring ALPIDE Beam Telescope for faster data rate

Basically, the Same as During ESTB Operation but at 100Hz

Summary

- Successful initial test with 4GeV (actual 3.75GeV) beam into ESA late 2025
- LESA commissioning with 8GeV (most likely 7.5GeV) beam to start later mid-2027
- LESA beam delivery is concurrent with normal LCLS-II-HE operations
 - High beam availability ~250+ days/year is anticipated (after 2027)
 - This will be shared between test beams and other HEP applications (Dark Matter Searches)
 - All ESTB experimental infrastructure will be available
- Beam has
 - 8 GeV primary beam energy, or smaller if making secondaries in A-Line
 - 100Hz repetition rate
 - When we install the 37MHz laser
 - High repetition rate of max. 37MHz @ 50% duty cycle
 - Flexible bunch charge structure with max. ~4000 electrons per pulse on average
- We had a LESA workshop September 2025 at SLAC, more info there
 - <https://indico.slac.stanford.edu/event/9874/>

Expect Test Beams to Start Summer 2027

Questions?

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