End Station A Test Beam Facility

ESTB

Carsten Hast

1st ESTB User Meeting

SLAC, August 2012

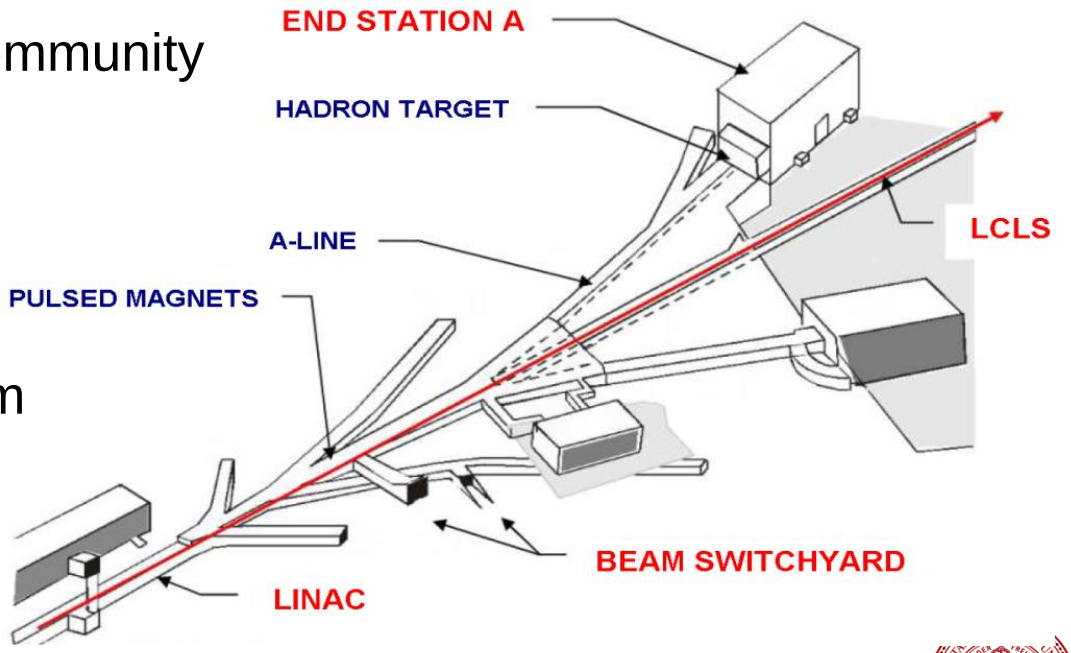
SLAC NATIONAL ACCELERATOR LABORATORY


FACET uses 2/3 of SLAC LINAC
LCLS uses 1/3 of SLAC LINAC
End Station A

ESTB Mission and Layout

- ESTB will be a unique HEP resource
  - » World's only high-energy primary electron beam for large scale Linear Collider MDI and beam instrumentation studies
  - » Exceptionally clean and well-defined primary and secondary electron beams for detector development
  - » Will serve a broad User community

Pulsed magnets in beam switch yard to send LCLS beam to ESA

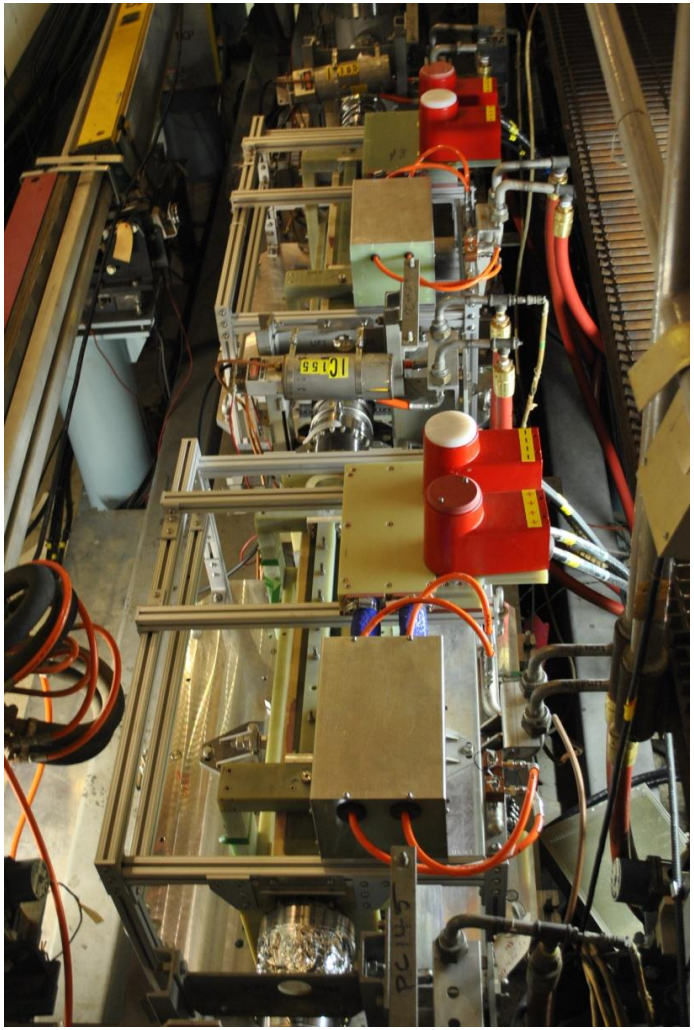


LCLS and ESTB Beams

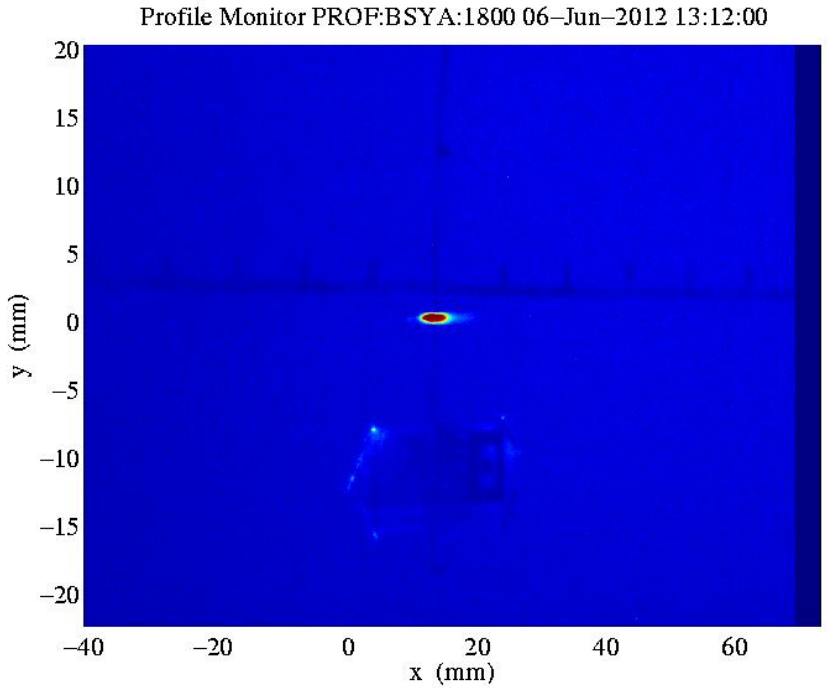
- LCLS beam (min and max parameters)
  - Energy: 2.5 –15.0 GeV; typical around 4 or 13 GeV
  - Repetition rate: 120Hz
  - Beam current: 20 to 350 pC; typical 150pC
  - Beam availability > 95%!

- ESTB beam
  - Kick the LCLS beam into ESA @ 5 Hz
    - Potential for higher rates when LCLS doesn't need full rate
  - Primary beam 2.5 -15.0 GeV
    - Determined by LCLS
    - <1.5 x 10^9 e^-/pulse (250 pC)
  - Clean secondary electrons
    - 1 GeV to 14 GeV, 1 e^-/pulse to 10^9 e^-/pulse

Beam Successfully Extracted into A-line



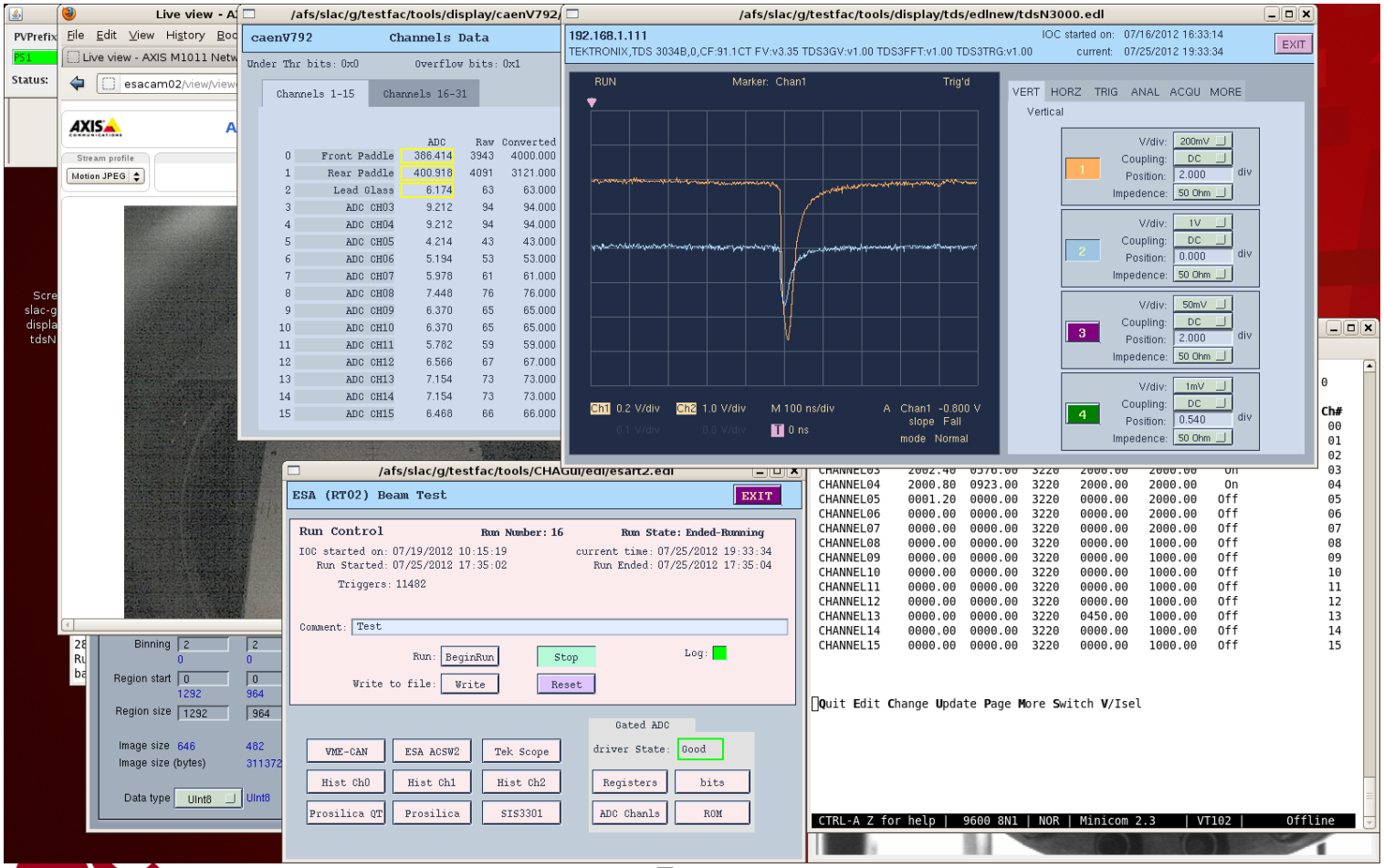
- June 6th:
  - 3.5 GeV LCLS beam to middle of A-line



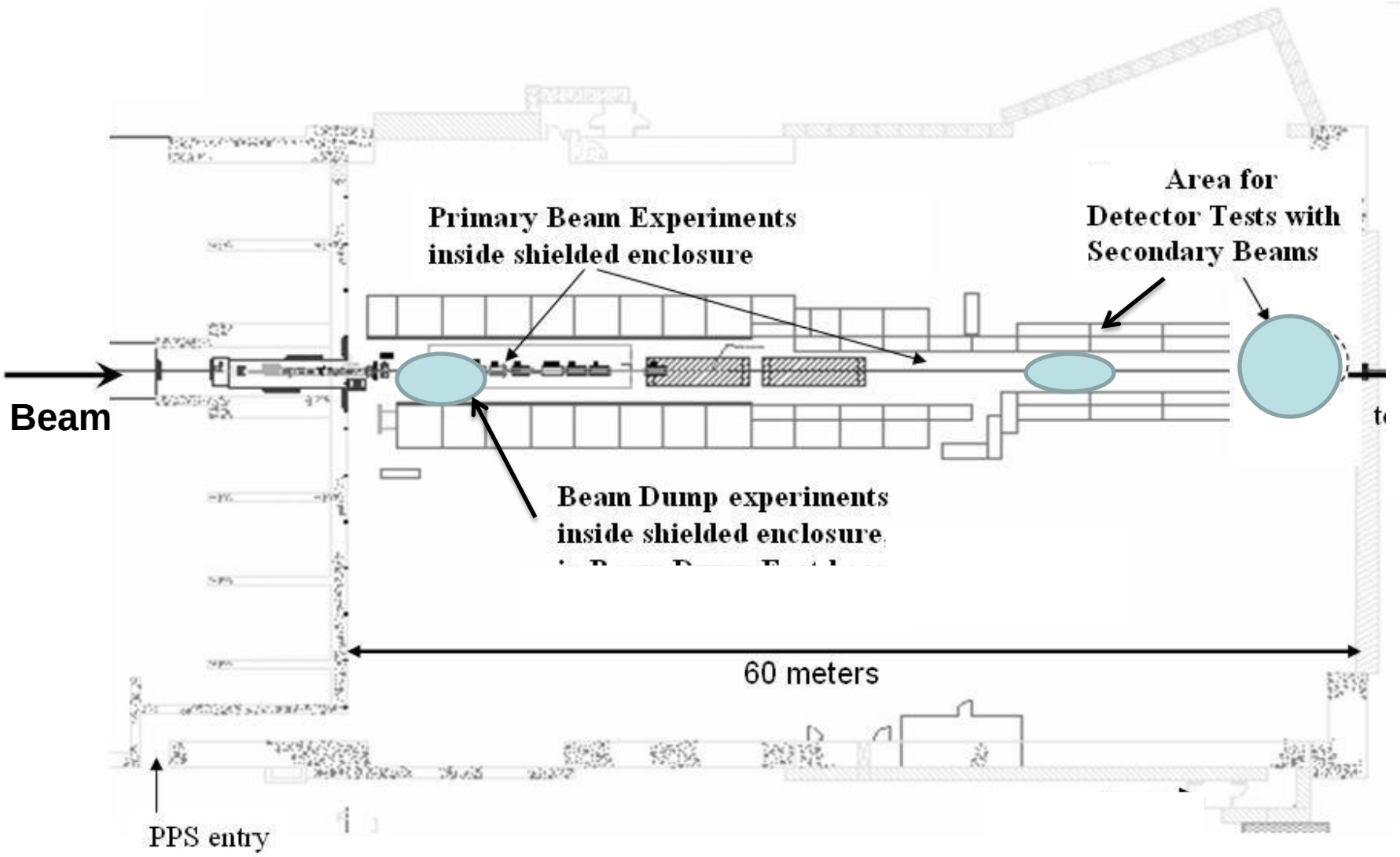

Accelerator Area Access State
No Access
Controlled Access
Permitted Access
CAUTION
RADIATION WARNING LIGHTS
YELLOW - SAFE
Residual Radiation May Exist
STEADY MAGENTA
Potential Radiation Hazard
FLASHING MAGENTA
Radiation Hazard On
CAUTION
AN4
NOTICE
NO OPEN-TOED SHOES
NO HEELS >3cm
IN THE END STATION

ESTB Primary Beam Operation July 25th

- With PMT voltages as low as 500V (nominal 1700) we saw huge signal at the ESA dump
- That means 100000+ particles out of 10^9 made it to the dump



Building 61: ESA



ESTB Proposals Submission and Review Process

- For detector R&D or radiation tests user submits a comprehensive proposal which includes:
  - PI, members and institutions involved
  - Short description of the overall physics goals
  - Detailed description of the experimental apparatus
    - Sketch of the planned layout with dimensions
    - Description of the DAQ system coming with the experiment and what additional DAQ will be needed from SLAC
    - Other electronics components (HV supplies, scopes, etc.)
    - Cooling or gas supply needs
    - Computing infrastructure needs
    - Any other aspect which might be of importance
    - Support needed from SLAC: riggers, technicians, DAQ systems, cooling, gas lines, etc.
  - Preferred beam parameters and acceptable beam parameters
  - Estimated installation time
  - Run plan (e.g. how many data points, how many modifications of the apparatus, etc.)
  - Preferred running time
  - Any other aspects of importance

ESTB Proposals Submission and Review Process

- Proposal (2-5 pages) is submitted to C. Hast (hast@slac.stanford.edu)
- Proposal is reviewed by ESTB Scientific Committee
  - » C. Field, P. Grenier, C. Hast, B. Ratcliff + additional members (as needed)
  - » Accelerator physics proposal are send to SAREC for review
  - » Criteria for proposal evaluation:
    - scientific value
    - feasibility
    - evaluation of resources
    - scheduling and prioritization
- SAREC will provide a prioritized list of their reviewed proposals to ESTB SC
- Proposal will be reviewed by SLAC Safety Committees as appropriate (ESTB Operations Manager directs this process)
    - Electrical
    - Earthquake
    - Hazardous Experimental Equipment Committee
    - Radiation Physics
    - etc.
- ESTB Scientific Committee will provide a prioritized list of experiments to the ESTB Operations Manager who will schedule the experiments
- Typical turn around for detector R&D proposals between 1 and 3 months

Becoming a User

- Users will register with the SLAC Users Organization
  - **SLUO** http://www-group.slac.stanford.edu/sluo/
  - SLUO will work with the PI on a generic MoU between Stanford University and your home institution (mainly about intellectual property rights…)
  - Each individual user needs to agree to that MoU
  - SLUO will get users a SLAC systems ID and a computer account

- We might change to the SSRL/LCLS style user organization, but that will be transparent to ESTB users

- A SLAC Contact will be assigned to each experiment and user
  - This SLAC Contact functions as your supervisor here at SLAC
  - Carsten Hast will be the Operations Manager for ESTB in FY13

- SLAC Contact defines the training requirements
  - Most training can be done remotely via web training (after you have a SLAC system ID)
  - Couple of things on first day of arrival

- We will setup a web page which will lay out what you need to do

Resources @ SLAC

- Your experimental setup should arrive as “ready to go” as possible
- Test Facilities Department will help you installing your experiment
  - Vacuum work
  - Crane operation
  - Small modifications
  - Hook up of gases, water cooling, electricity, etc.
- Alignment group is available on short notice

➔All above covered in ESTB operations budget

- Basic DAQ will provide beam parameters on a per shot basis
- You provide the DAQ for your setup
- We have 64 HV channels, many general purpose ADC (12bit) channels
- Some web cameras
- If you need things which don’t exist yet (special gases, cables, lasers, DAQ, etc.) we need time (and money) to provide those
- Contact us early and we discuss about

Preparation of Your Setup

SLAC

- ESA “Counting House” situated above in the same building and other locations in the Research Yard have some space for experimental setup
  - You can assemble your experiment and test DAQ
  - Limited hardware modifications possible

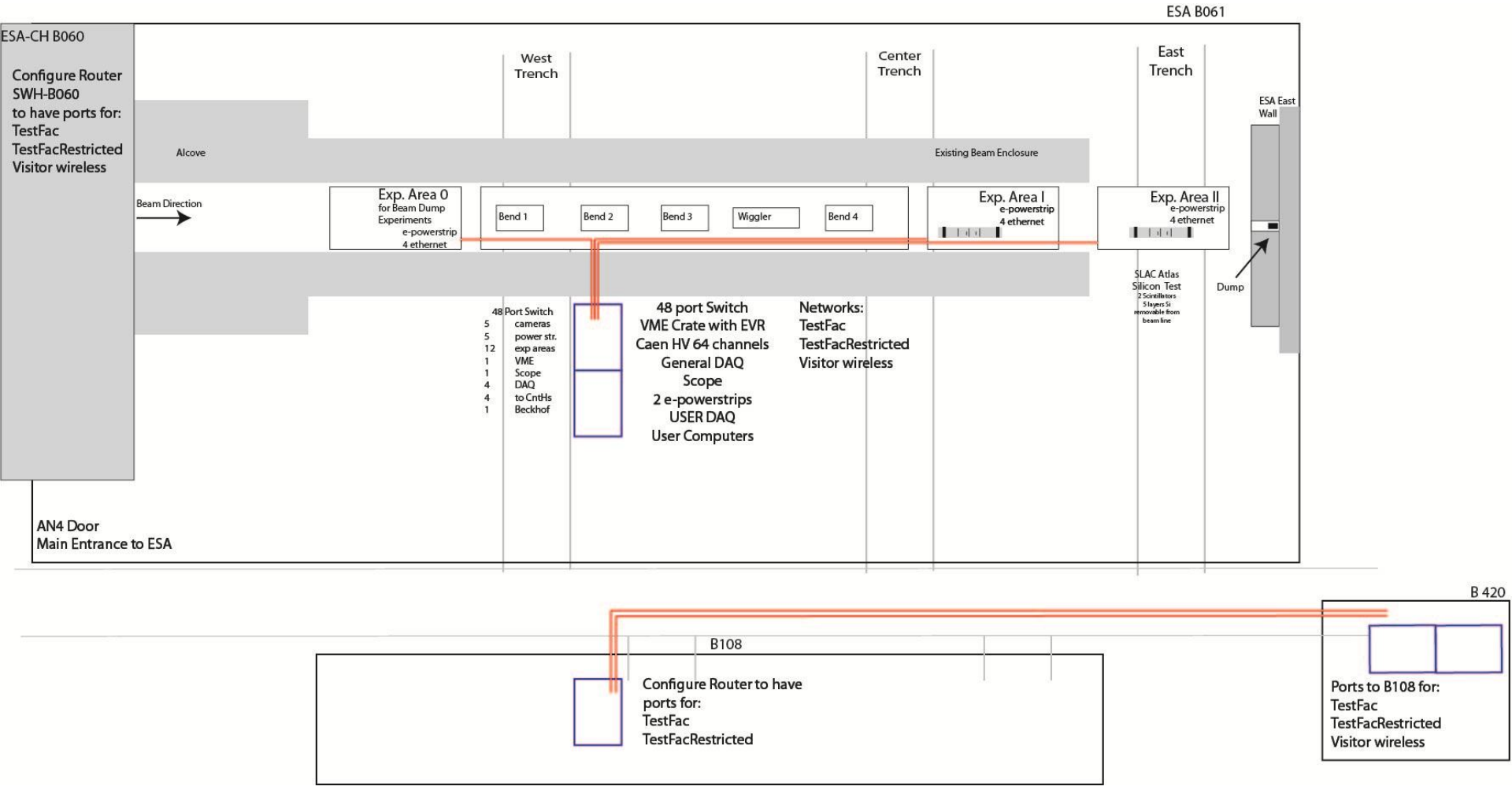
➔ ESA is meant for beam operation so we will try to minimize the idle time during allocated beam time

- Controlled access to ESA is time consuming
  - In-and-out >10 minutes
  - 73 stairs from Counting House to ESA ➔ free “fitness program”

- Loosing the search is an absolute no-no!
  - Takes 5 operators about 2 hours
  - Can only happen during shift change on 2 days in the week

➔ Good preparation is key for efficient operation

Setup in ESA


ESA B061
ESA-CH B060
Configure Router SWH-B060 to have ports for:
TestFac
TestFacRestricted
Visitor wireless
West Trench
Center Trench
East Trench
ESA East Wall
Alcove
Existing Beam Enclosure
Beam Direction
Exp. Area 0
for Beam Dump Experiments
e-powerstrip
4 ethernet
Bend 1
Bend 2
Bend 3
Wiggler
Bend 4
Exp. Area I
e-powerstrip
4 ethernet
Exp. Area II
e-powerstrip
4 ethernet
SLAC Atlas Silicon Test
Dump
48 Port Switch
5 cameras
5 power str.
12 exp areas
1 VME
1 Scope
4 DAQ
4 to CntHs
1 Beckhof
48 port Switch
VME Crate with EVR
Caen HV 64 channels
General DAQ
Scope
2 e-powerstrips
USER DAQ
User Computers
Networks:
TestFac
TestFacRestricted
Visitor wireless
AN4 Door
Main Entrance to ESA
B 420
B108
Configure Router to have ports for:
TestFac
TestFacRestricted
Ports to B108 for:
TestFac
TestFacRestricted
Visitor wireless

Operations of ESTB

ESTB is mainly operated from ESA-Counting House, with visits to Main Control Center (MCC) and in some cases operated directly from MCC

Basic operation

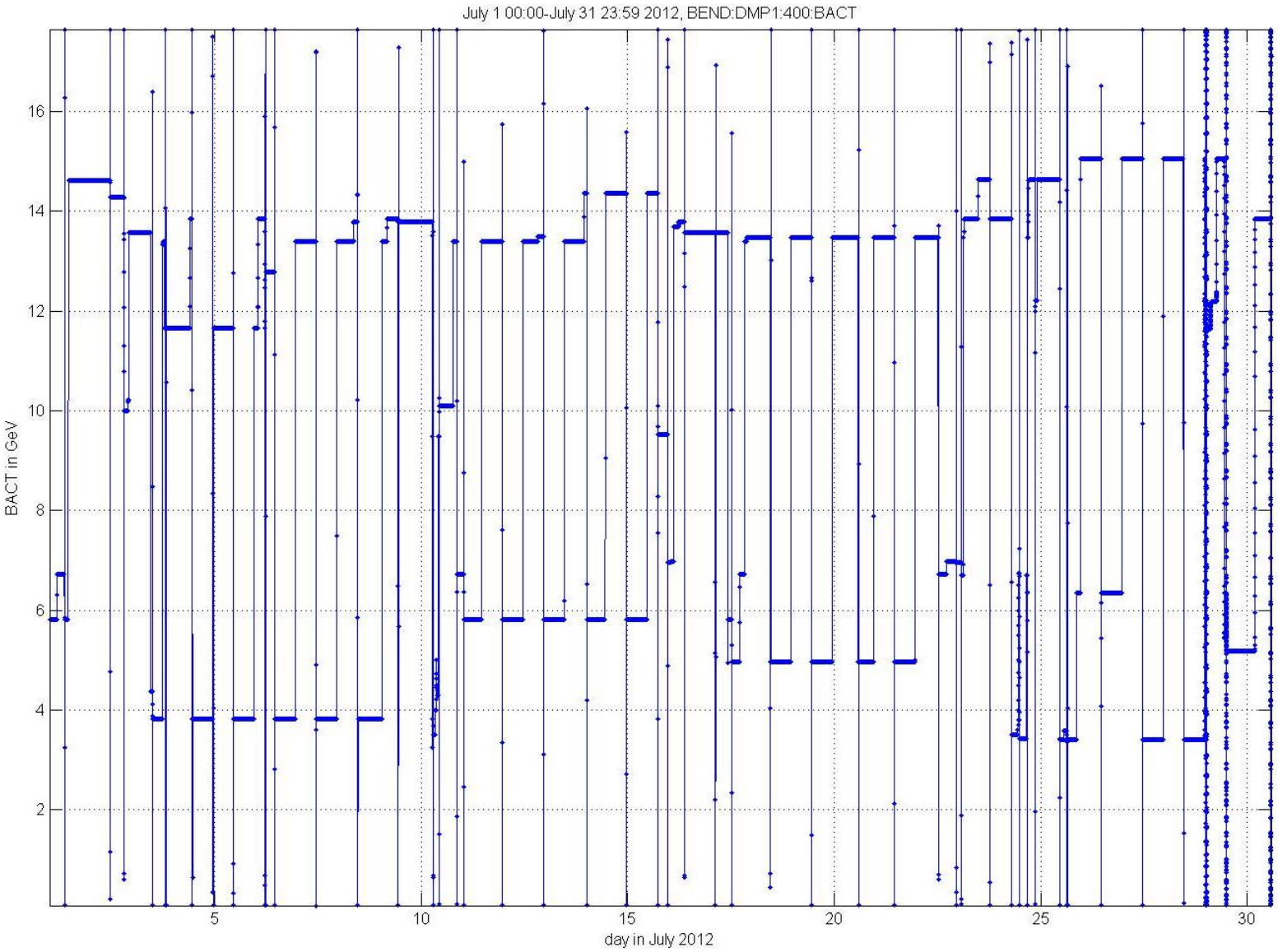
- Beam energy and bunch charge is defined by LCLS
- LCLS experiments runs for 5 days from Thursday morning to Tuesday morning
  - Time is split between a day and night time LCLS experiment (change of beam parameters likely)
- LINAC maintenance on Wednesday day (PAMM) ➔ no beam to ESA
- 5Hz of LCLS beam to ESA 24/7 (see caveats above)
- Rate may increase when LCLS experiments don't need full rate or have short access

- We will try to stage multiple experiments in ESA to run simultaneously
  - For example: Silicon first followed by some calorimeter

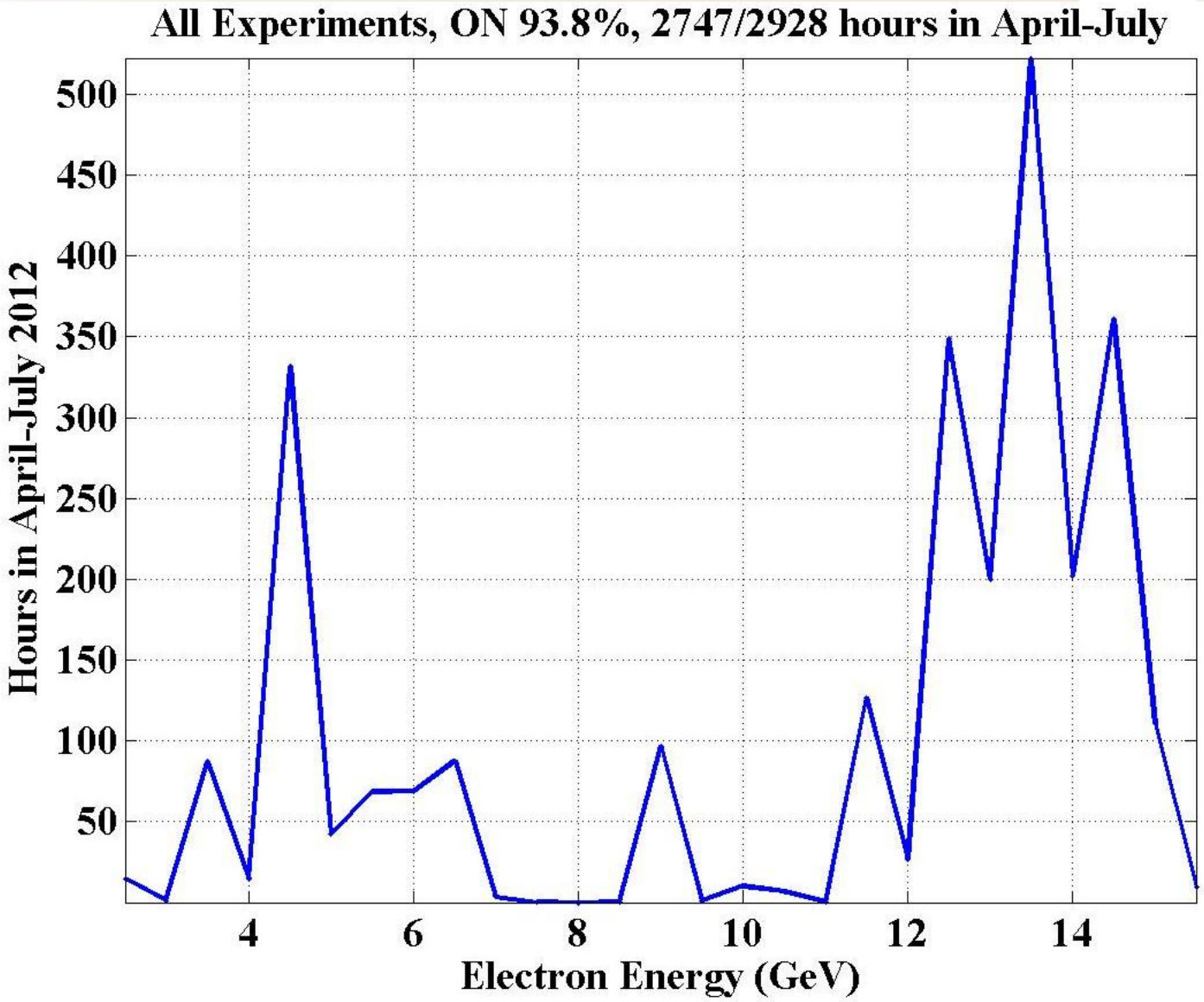
➔DAQ should be flexible to cope with changes

- Our DAQ will give you a trigger signal
- Automatically take advantage of higher beam rates
- Beam energies might change
- If parameters become unacceptable for your experiment ➔ turn beam off (BSY kickers off)

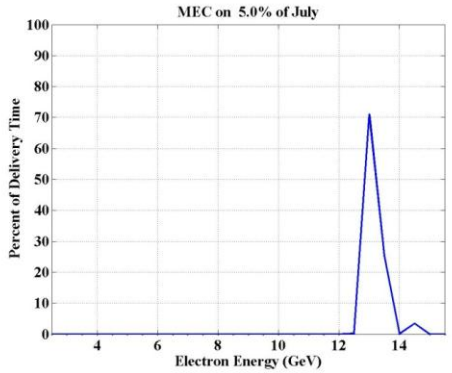
LCLS Beam Energies July 2012

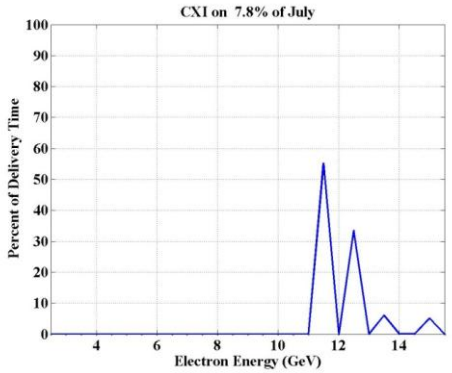


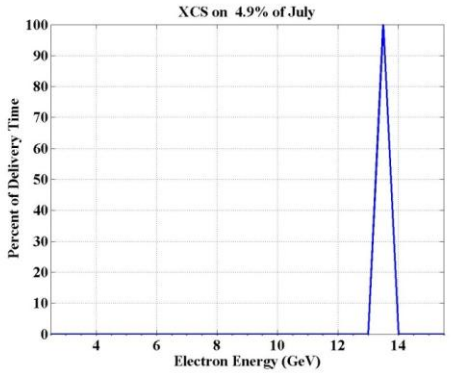
LCLS Beam Energies April-July 2012

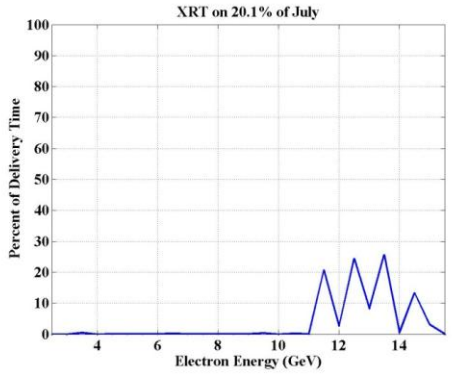


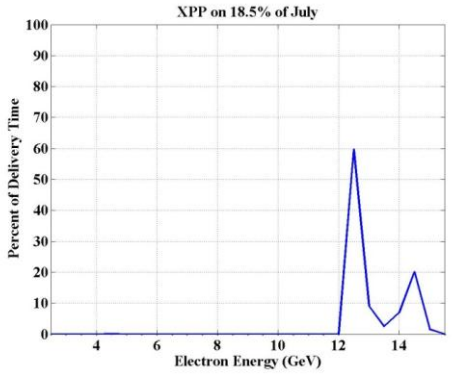
LCLS Beam Energies by Experiment July 2012

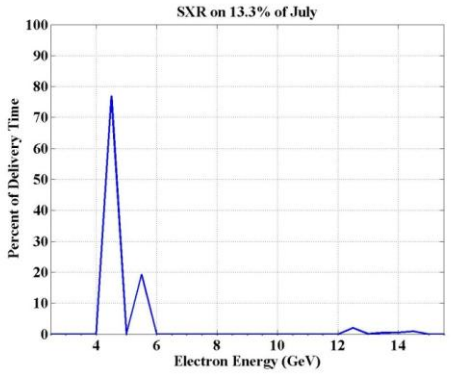


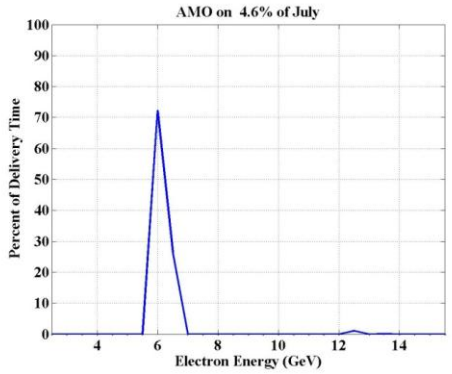


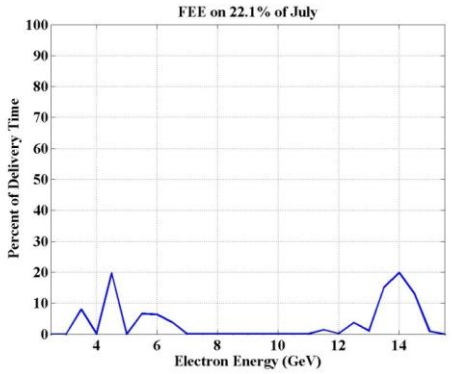


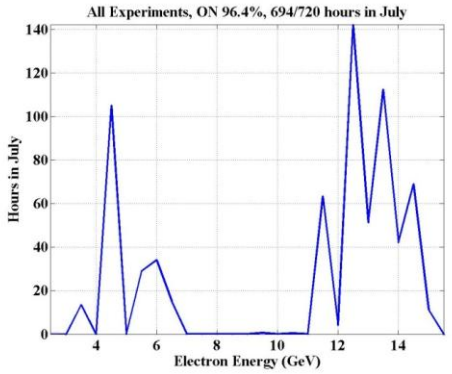












LCLS Beam Energy and Operation of ESTB

SLAC

- LCLS experiments are scheduled months in advance
- Direct correlation between LCLS hutch and beam energy range
- ESTB experiments will be scheduled as compatible with the LCLS boundary conditions as possible

➔ You'll need to be flexible

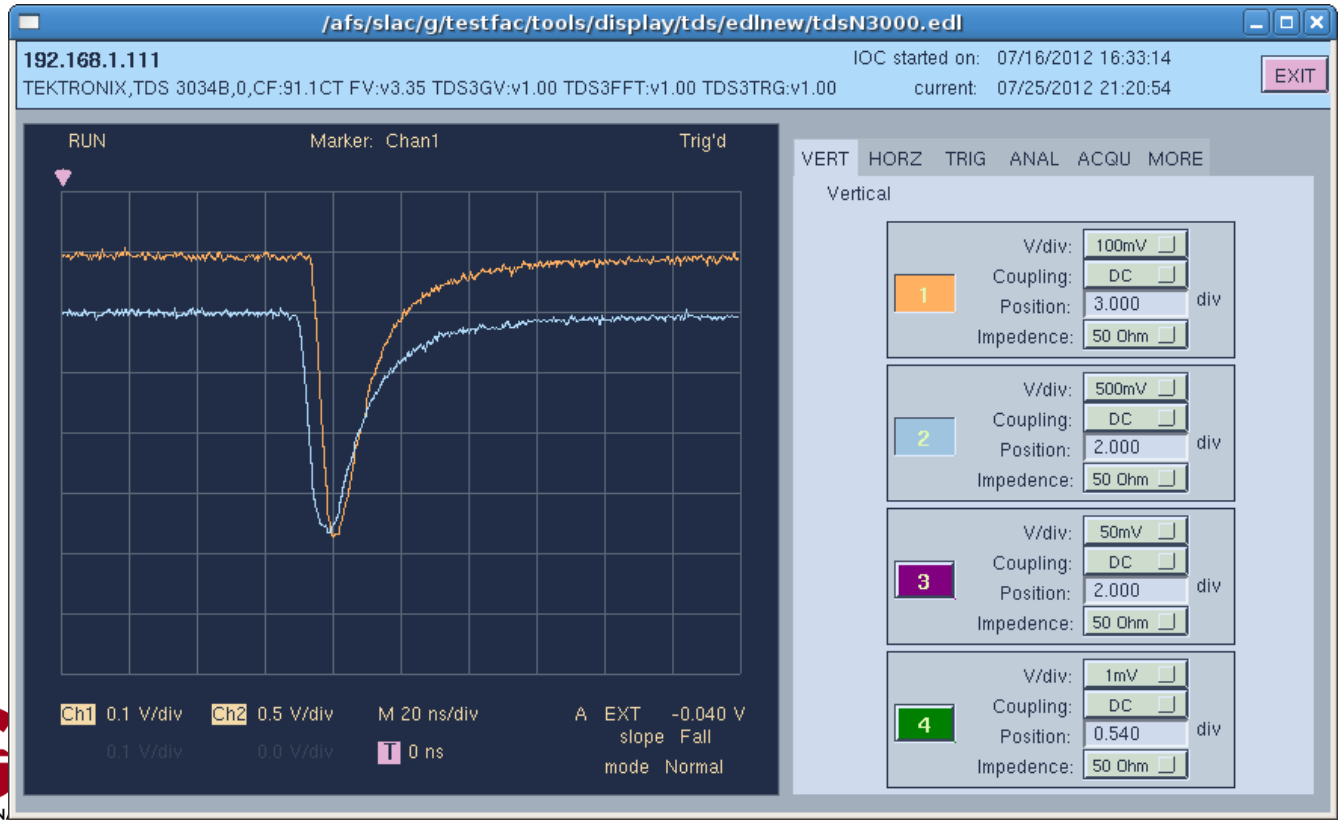
Schedule

- Currently SLAC summer down until September 20th
- LCLS starts up September 25th
- LCLS Users October 11th
- Commissioning of ESTB with primary beam between Sep. 25th and October
- Commissioning of secondary particles November and December
  - Would like to have some help from SLAC Atlas Silicon Group
- Christmas break from December 21st to January 3rd
- LCLS runs
  - January to early August 2013
  - October 2013 to March 2014 (tentatively)
  - January 2015 to June 2015 (tentatively)
  - October 2015 to June 2016 (tentatively)

➔ Lot's of running for ESTB

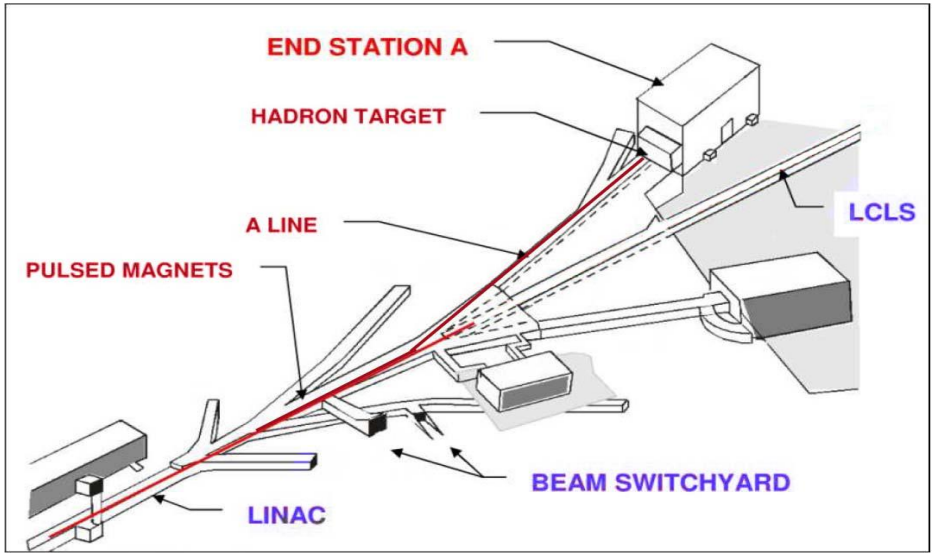
ESTB Secondary Beam Operation July 25th

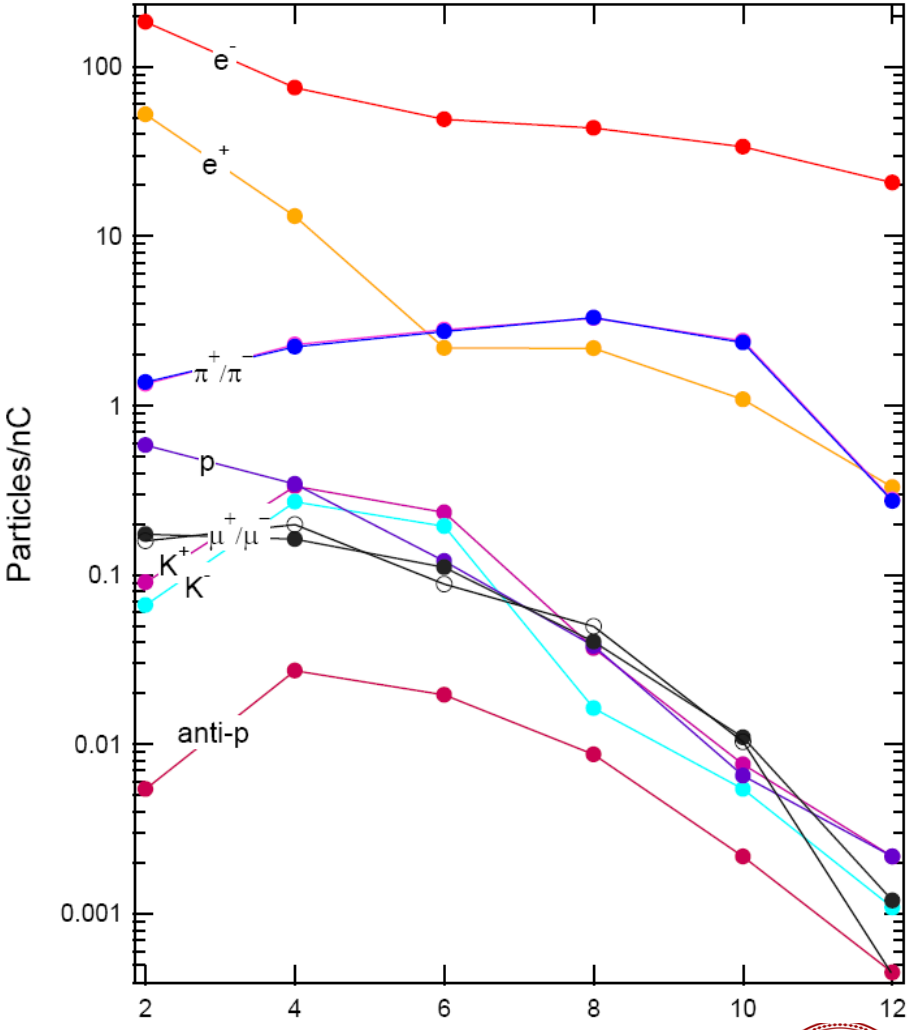
- We operated the LCLS beam between 3.5 GeV and 6.75 GeV leaving A-line at 3.5 GeV
- Inserting a thin screen before the A-line bend we scattered primary LCLS beam
- We saw very nice signals of secondary electrons at the ESA dump
- With PMT voltages as low as 1400V (nominal 1700V) we again saw huge signal at the ESA dump
- That means 1000+ particles made it to the dump



Electrons/Hadrons up to 15 GeV from single particles to full beam intensity

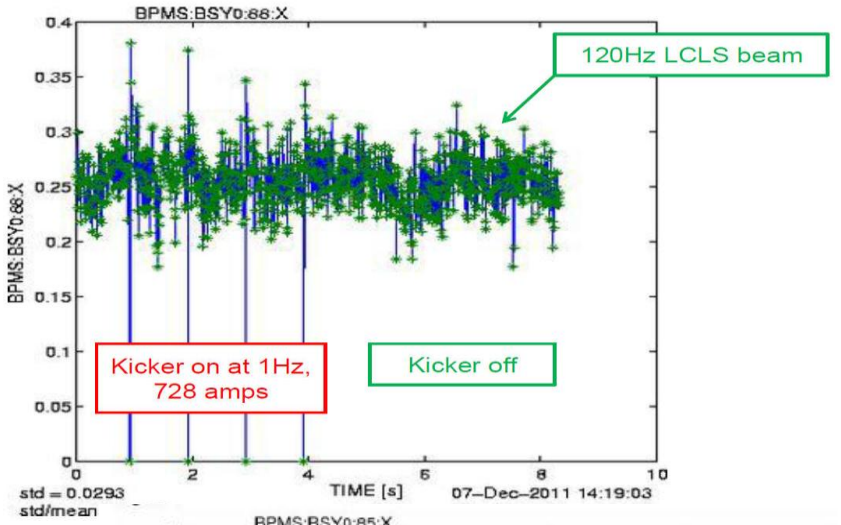
- **Clean secondary electrons**
  - » p<14 GeV, 1/pulse to 2 x 10^9 e^-/p
- **Secondary hadrons (later stage)**
  - » ~0.25 π / pulse < 14 GeV/c (@250pC)

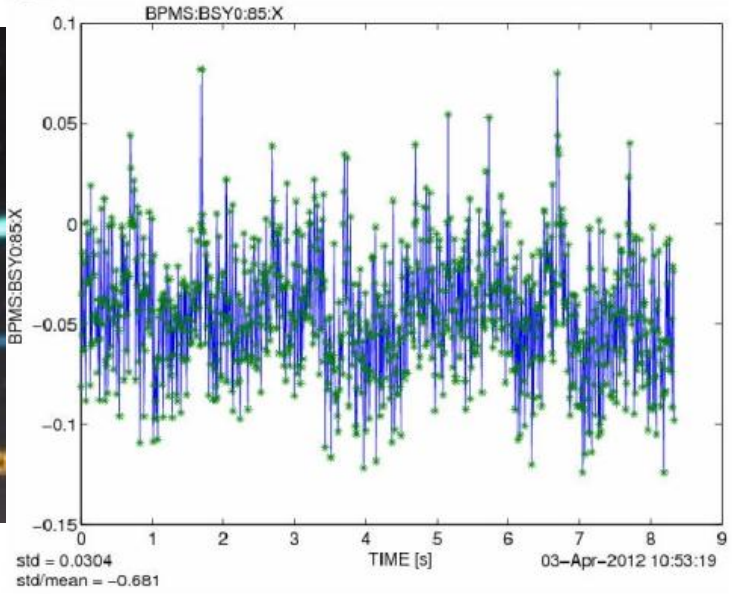




Beam Extraction

- April 3rd:
  - One kicker at 728A
  - Measure beam position far down beam





Puls compensation in kicker reverses Eddy currents in vacuum chamber

➔ Next LCLS beam pulse is not disturbed

Jerry Va'vra's Focusing DIRC Tests 2006-8

- PEP II 10 GeV electron beam
- Beam enters bar at 90º angle
- Prototype is movable to 7 positions
- Time start from LINAC RF, but correctable with a local START counter