

SLAC ESTB

End Station A Test Beam

Other Test Beams

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ALCPG11 Eugene, Oregon

March 22nd, 2011



Other Test Beams

2nd Linear Collider Test Beam Workshop (LCTW 09)

- **IHEP Protvino** electron/hadron beams 1 and 45 GeV. Two months in winter
- **Other sites** beam test facilities in Europe: PSI Villingen (CH), GSI Darmstadt (D), the ELSA beam at Bonn (D), FZD at Dresden-Rossendorf (D).
- **FTBL KEK** (Fuji Test Beam Line) synchrotron photons from KEKB
 - electron beams with momentum 0.4 - 3.4 GeV
 - FTBL shutdown (2010-2012) for the upgrade of KEKB
- **JPARK** hadrons with momentum 0.5-1.5 GeV
- **IHEP Beijing** BTF (Beijing Testbeam Facility) primary (secondary) electron beam with momentum 1.1-1.5 (0.4-1.2) GeV. BTF is under a long shut down(2008-2010) for its upgrade. I have not managed to get a reliable update for of its state
- **Tohoku University**, Japan has a beam test facility providing electrons with momentum 0.3 - 1.2 GeV

Has anybody here engaged with any of these?

SLAC End Station A Test Beam (ESTB)

- Test beam activities have been interrupted by ending PEP II operation and start of LCLS
- 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 secondary electron beams for detector development
 - Huge experimental area, good existing conventional facilities, and historically broad user base
 - Secondary hadron beam available as an upgrade

ESTB Proposal

R.Erickson, T.Fieguth, C.Hast, J.Jaros, D.MacFarlane, T.Maruyama, Y.Nosochkov, T.Raubenheimer, J.Sheppard, D.Walz, and M.Woods,

“ESTB proposal” July 2009

L.Keller, M.Pivi joined 2010

1st ESTB User Workshop on Thursday March 17th 2011

- 50 participants from 16 institutions and 5 countries
- 13 short presentations for proposed test beam uses
- 6 formal requests (already before the workshop)

**Underlines the broad
community needs**



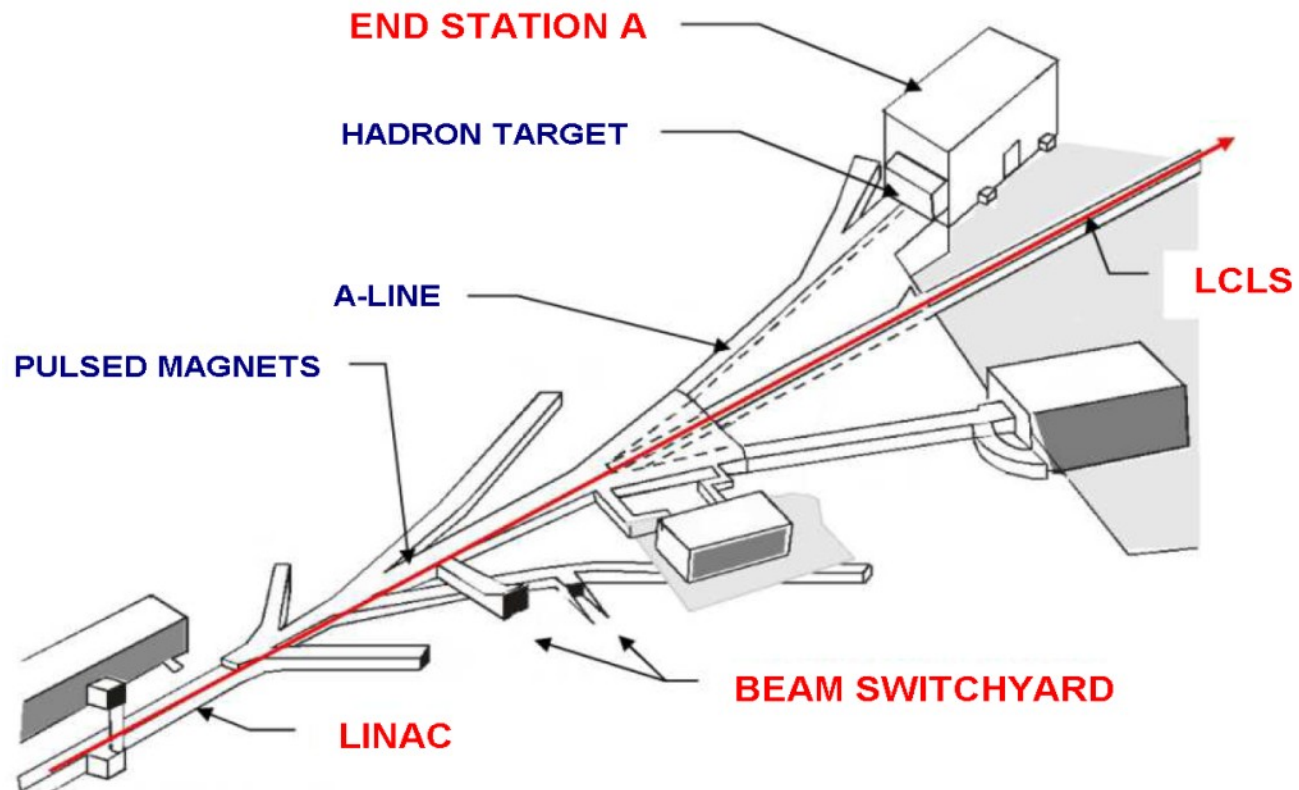
LCLS uses 1/3 of
SLAC LINAC

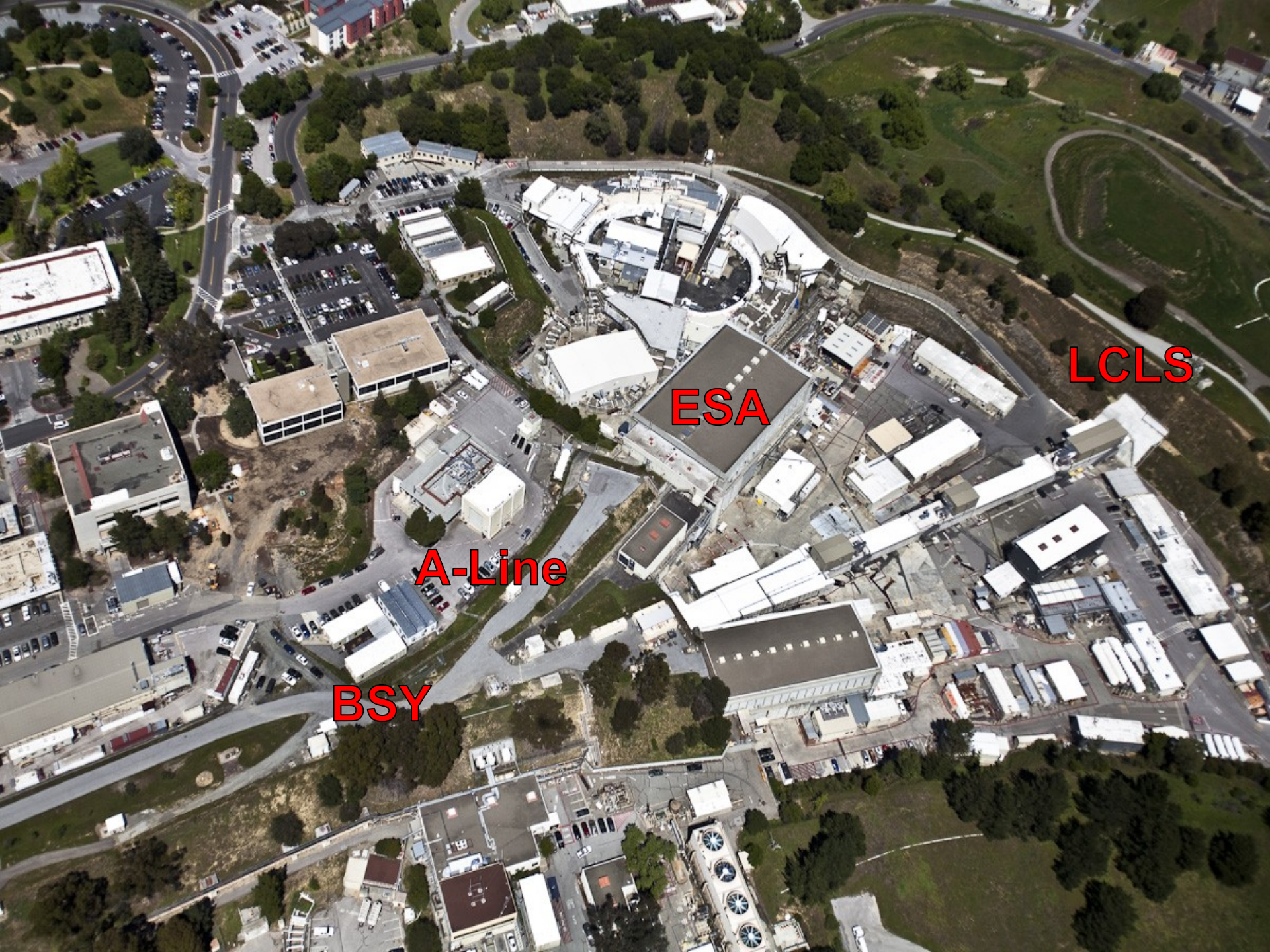
This is an aerial photograph of the SLAC National Accelerator Laboratory. A long, narrow, light-colored structure, the SLAC LINAC, runs vertically through the center of the image. A white arrow points from a green text box to a section of this structure. Below the LINAC, a large complex of buildings is visible, with a white arrow pointing from another green text box to one of the buildings. The surrounding area consists of green fields, roads, and some trees.

End Station A

LCLS and ESA

Use pulsed magnets in the beam switchyard to send beam in ESA.





LCLS

ESA

A-Line

BSY

LCLS/ESTB Beams

LCLS beam

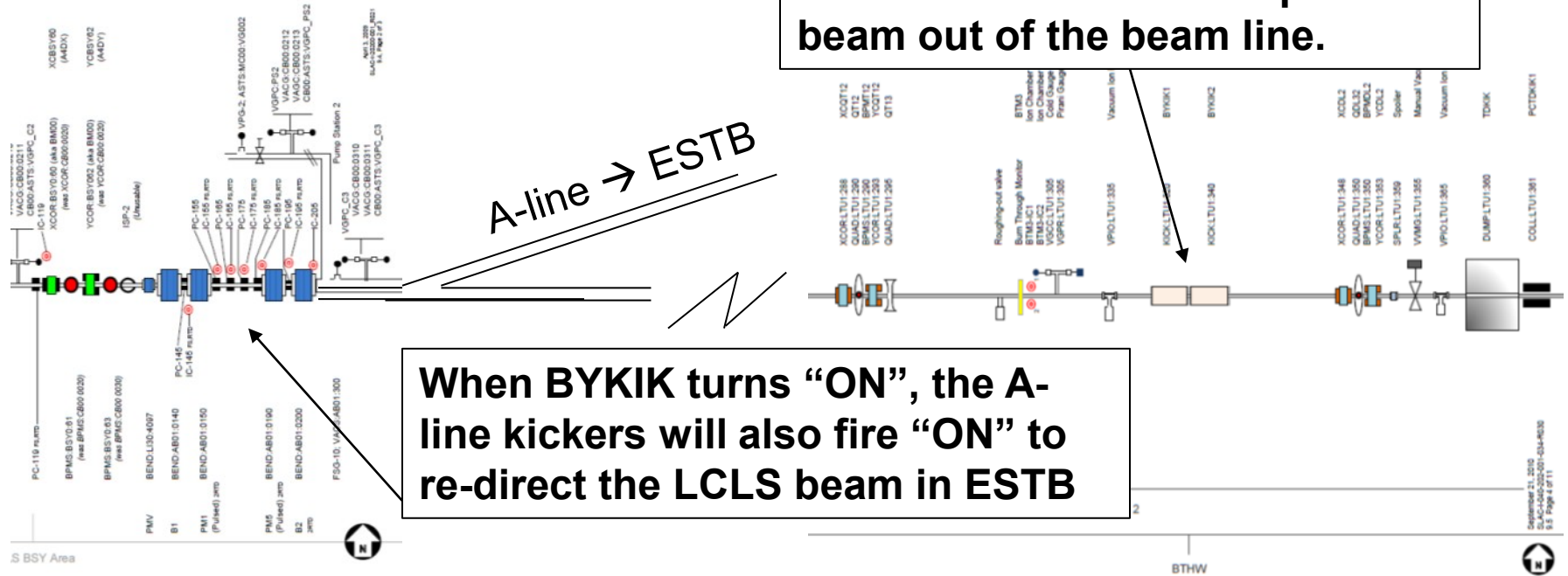
- Energy: 3.5 –13.6 GeV
- Repetition rate: 120Hz
- Beam current: 20 to 250 pC
 - 150 pC preferred by LCLS Users these days
- 350 pC @ 120Hz has been provided
 - This is the current upper limit for the present cathode
 - Radiation Safety approved yesterday 600 pC running!
- Beam availability >95%!

ESTB beam

- Kick the LCLS beam into ESA @ 5 Hz
- Primary beam 3.5 -13.6 GeV
 - Determined by LCLS
 - $<1.5 \times 10^9$ e-/pulse (250 pC)
- Clean secondary electrons
 - 1 GeV to 13.6 GeV, 0.1/pulse to 10^9 e-/pulse

Additional Rate: BYKIK “On”

If LCLS experiments don't need full 120 Hz rate, the remaining beam is parked out by BYKIK



Extra 5% of beam time at 120Hz possible

ESTB Hardware Needed

- 4 new kicker magnets including power supplies and modulators and vacuum chambers are designed and components are being ordered and manufactured
- Build new PPS system and install new beam dump

A-Line Extraction:

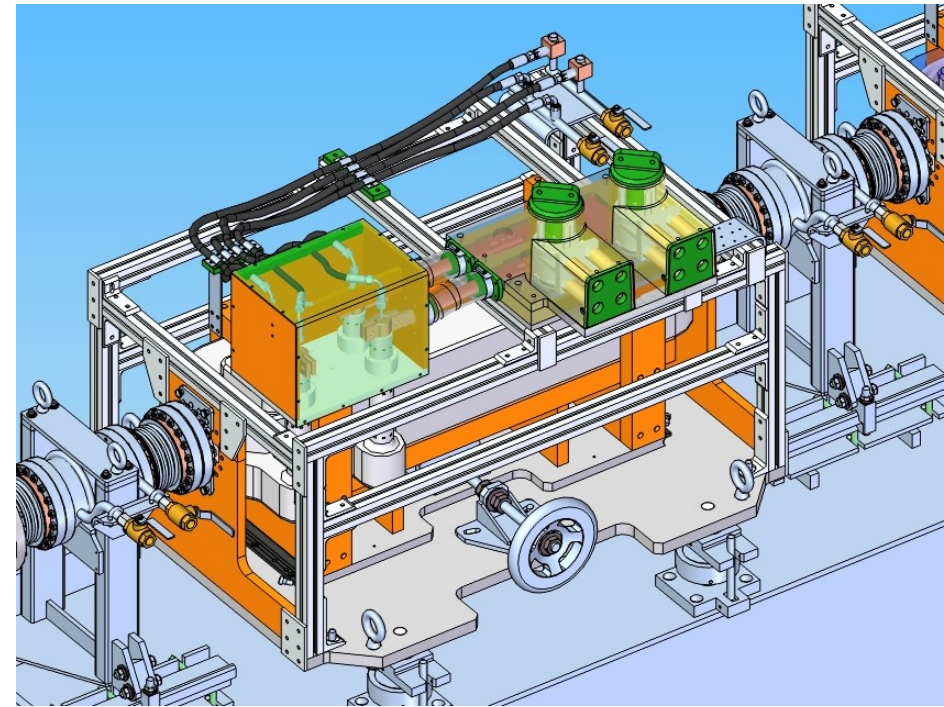
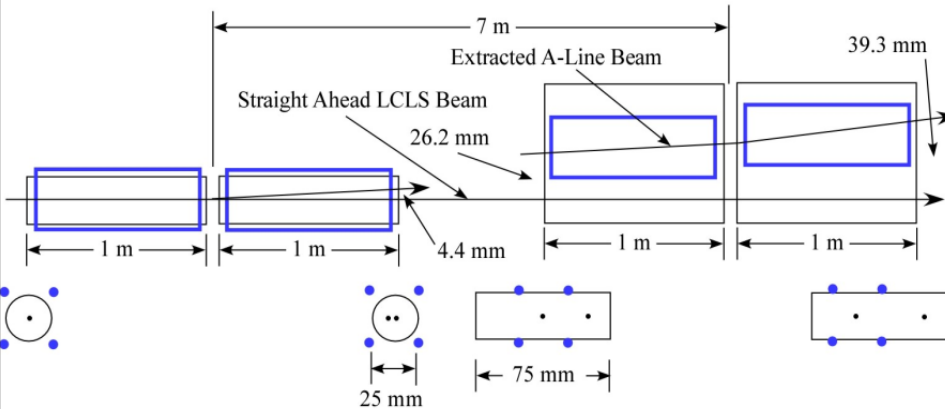
Total Kick = 8.7 mrad

2 set of bends, 4.37 mrad \Rightarrow 2.04 kG-m @ 14 GeV

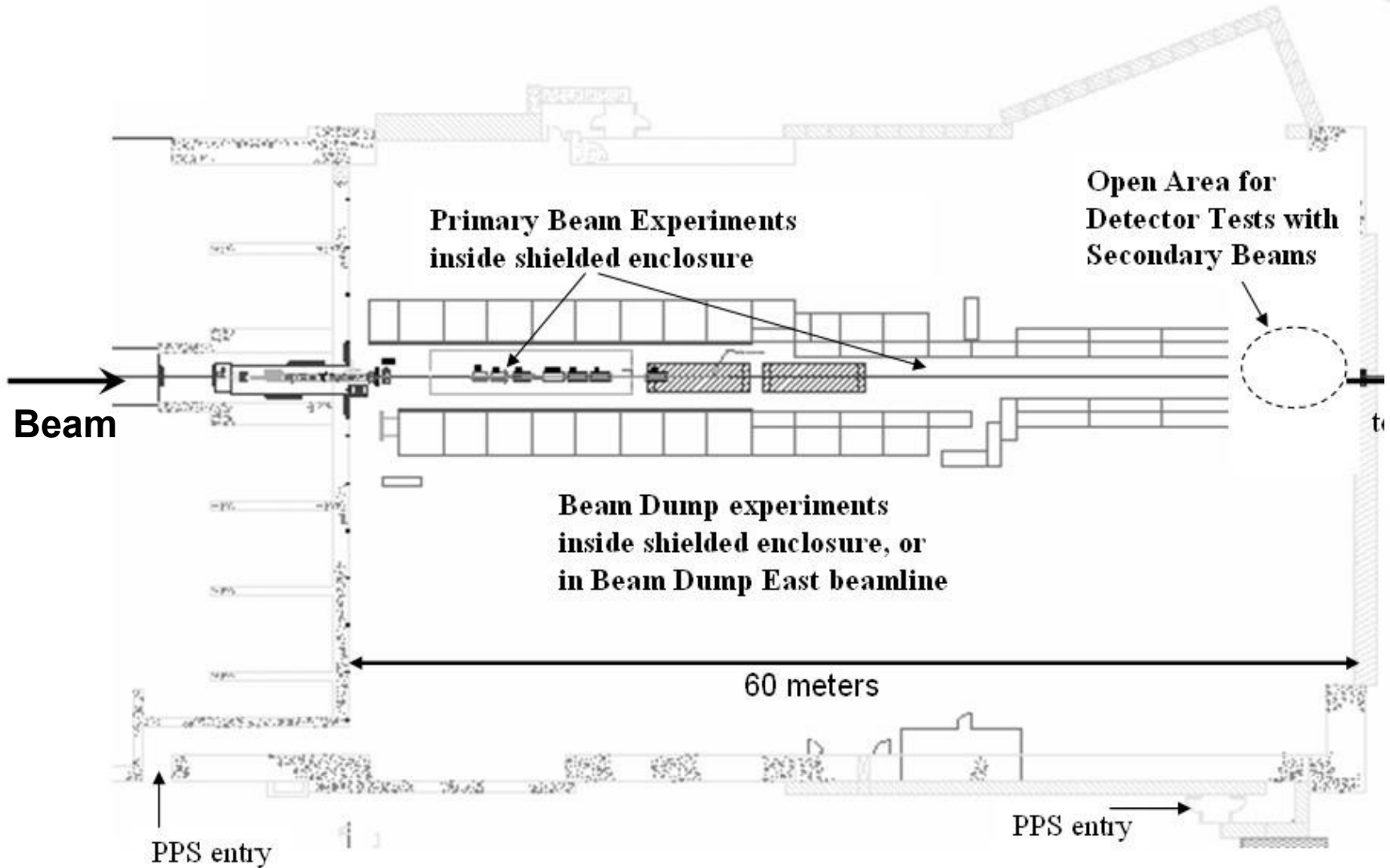
7 m between the two bends

Bends based on LCLS BYKIK: 25 mm coil diameter, air-core

Distances and separations are approximate, need to check layout



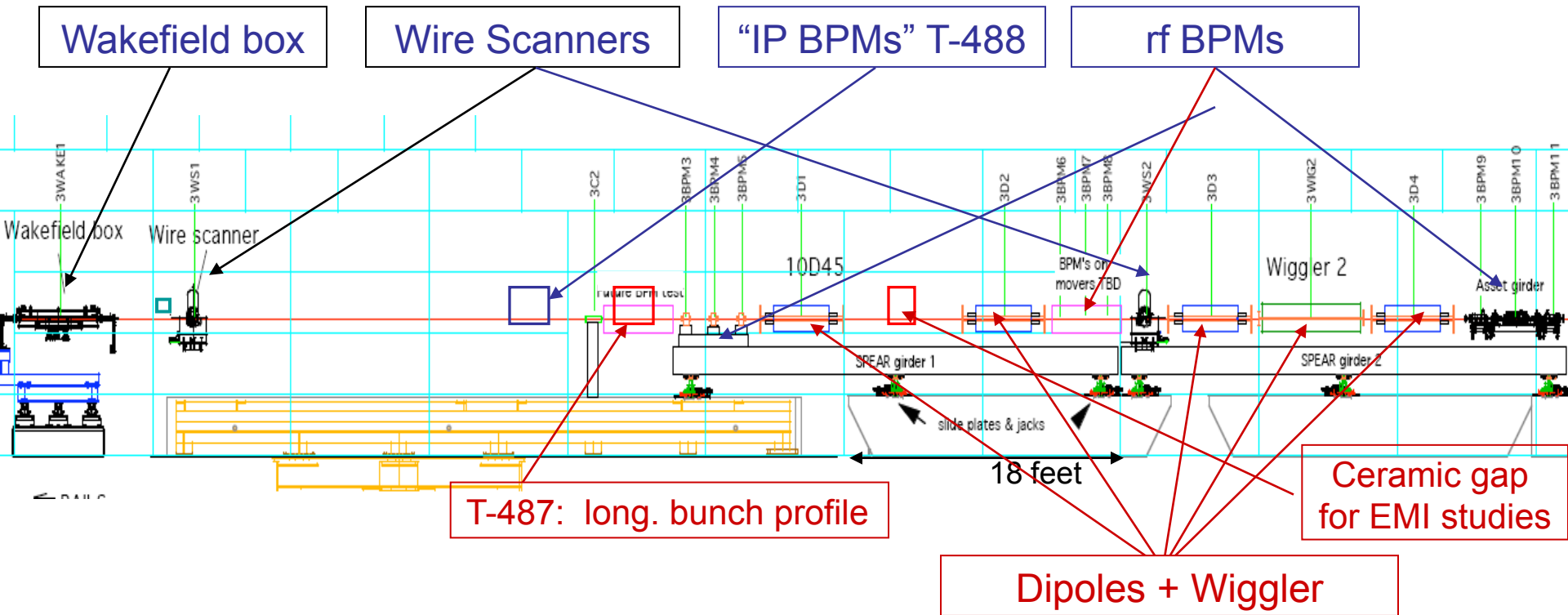
End Station A Experimental Area



End Station A Experimental Area



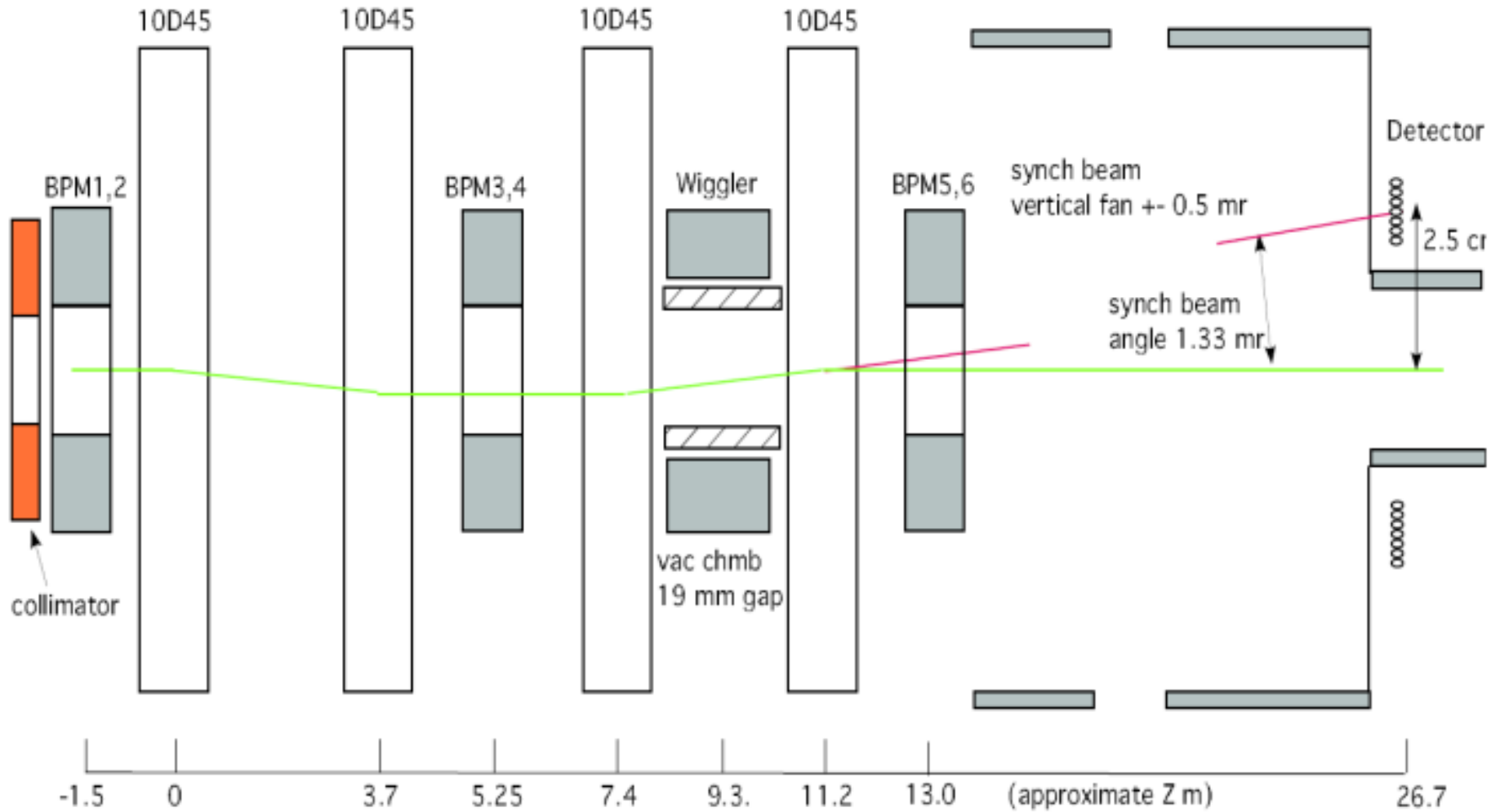
ESA Past Experiments



BPM energy spectrometer (T-474/491)
 Synch Stripe energy spectrometer (T-475)
 Collimator design, wakefields (T-480)
 Bunch length diagnostics (T-487)
 Smith-Purcell Radiation

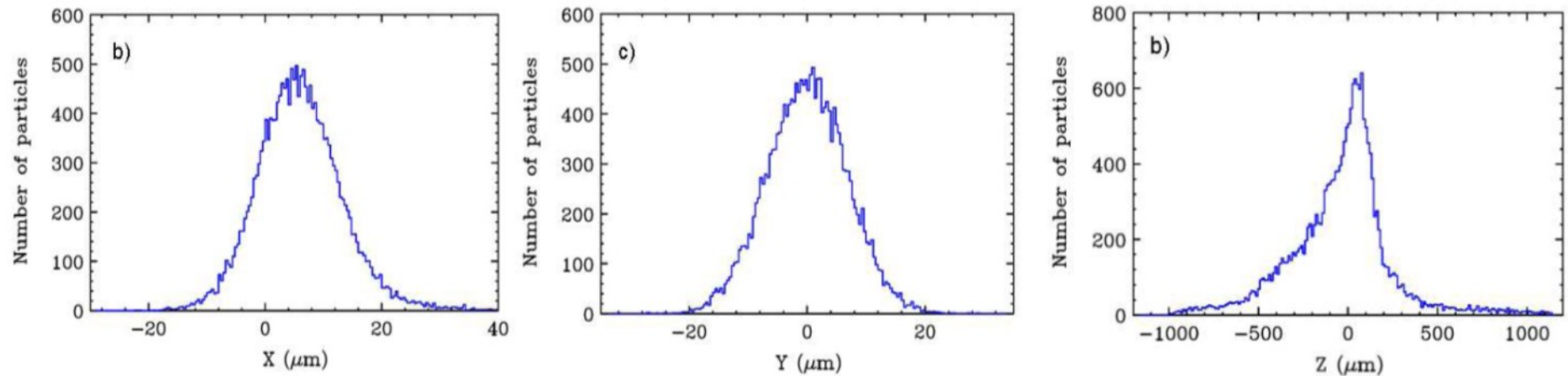
IP BPMs—background studies (T-488)
 LCLS beam to ESA (T490)
 Linac BPM prototypes
 EMI (electro-magnetic interference)
 Irradiation Experiments

Energy Spectrometer Chicane and Wiggler



Primary e⁻ Beam Operations

- A full intensity, high energy e⁻ beam
- The beam is focused in the middle of ESA



- $\sigma_x \sim \sigma_y \sim 7 \mu\text{m}$
- $\sigma_z = 280 \mu\text{m}$
 - 28 larger than LCLS, large R56 in A-line
- 3.5-13.6 GeV, up to 250 (maybe 350) pC

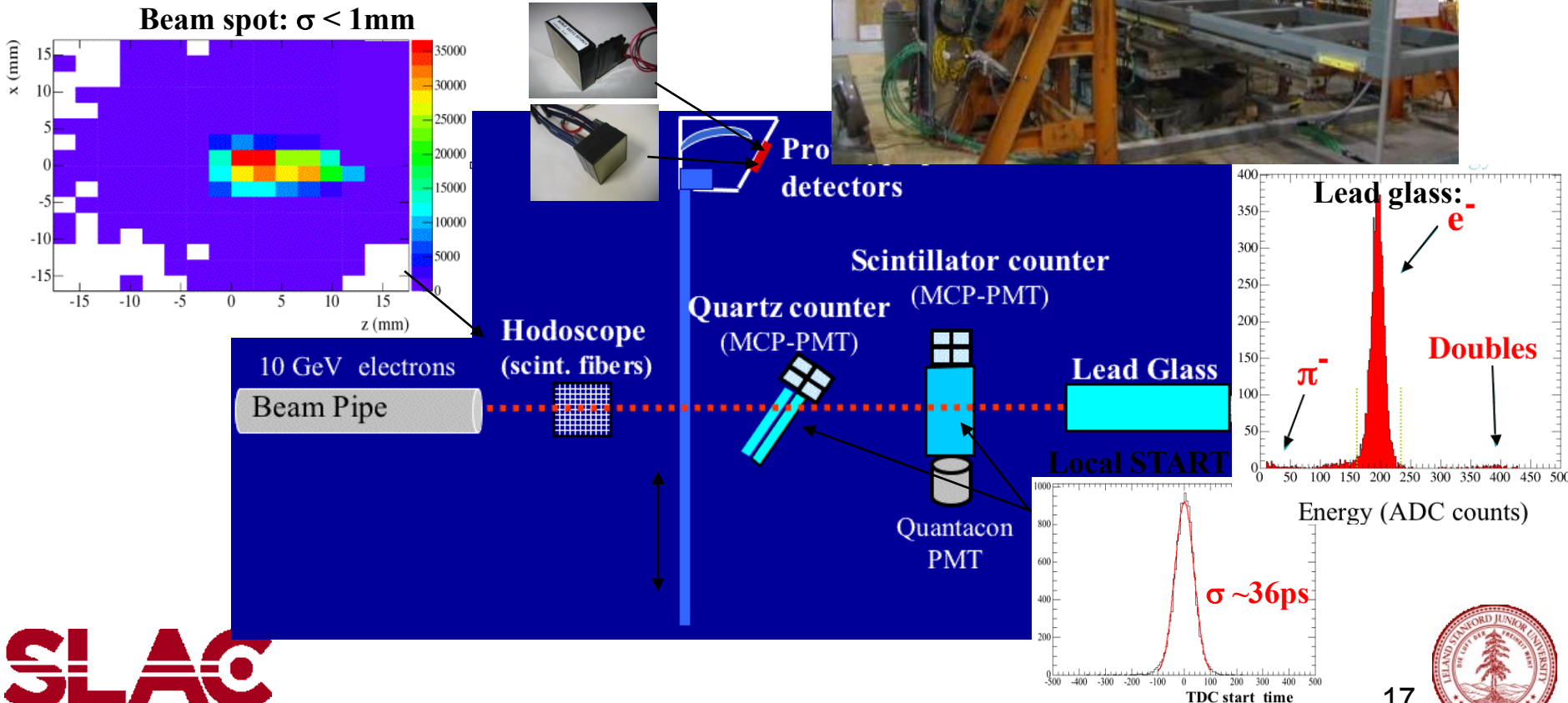
Secondary e⁻ Beam Operations

Primary beam can be directed onto a target

- Secondary e⁻ are momentum-selected in A-line
 - 1 GeV (maybe, has been done in the past)
 - 2 GeV for most likely
 - 4 - 13 GeV easy, 10^{-4} momentum resolution
- Adjusting 2 existing collimators
 - 0.1 - 10^9 particles/pulse

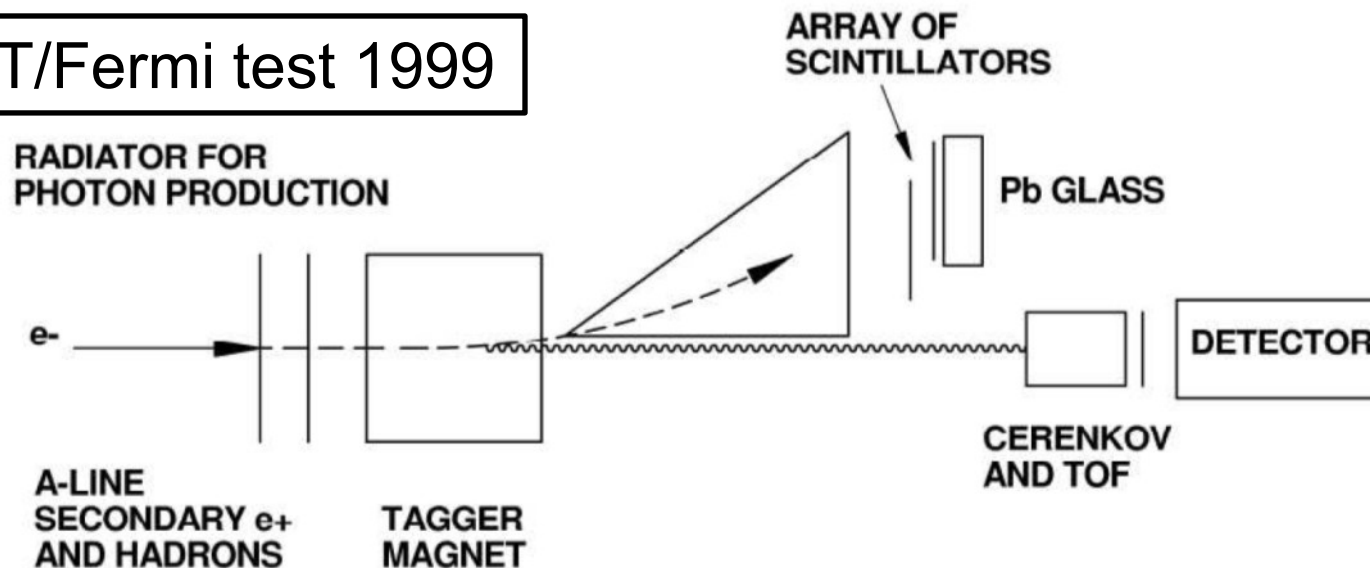
Jerry Va'vra's Focusing DIRC Tests

- SLAC 10 GeV/c 2nd electrons
- Time start from the LINAC RF signal, but correctable with a local START counter



Tagged Photon Beam in ESA

GLAST/Fermi test 1999

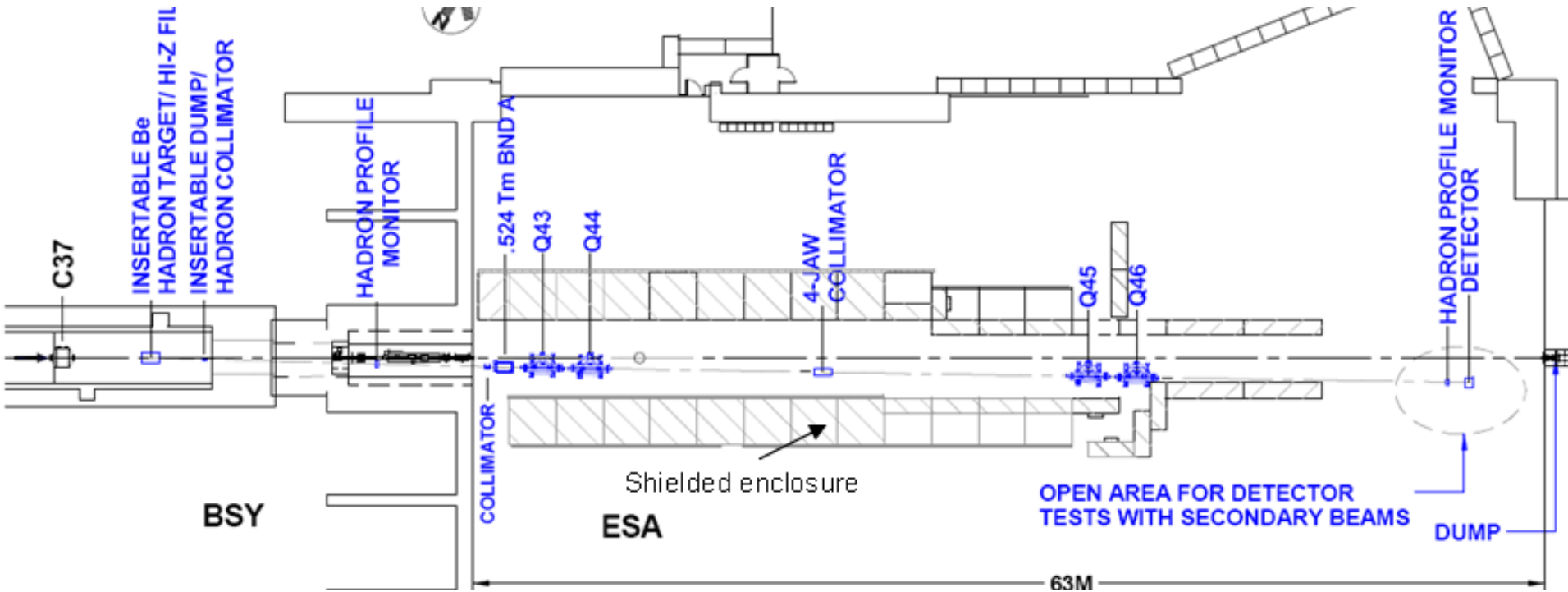


- 2nd e⁻ beam hits thin radiator in ESA
- Bend e⁻ off axis and measure displacement = energy of e⁻
- tagging the photon energy

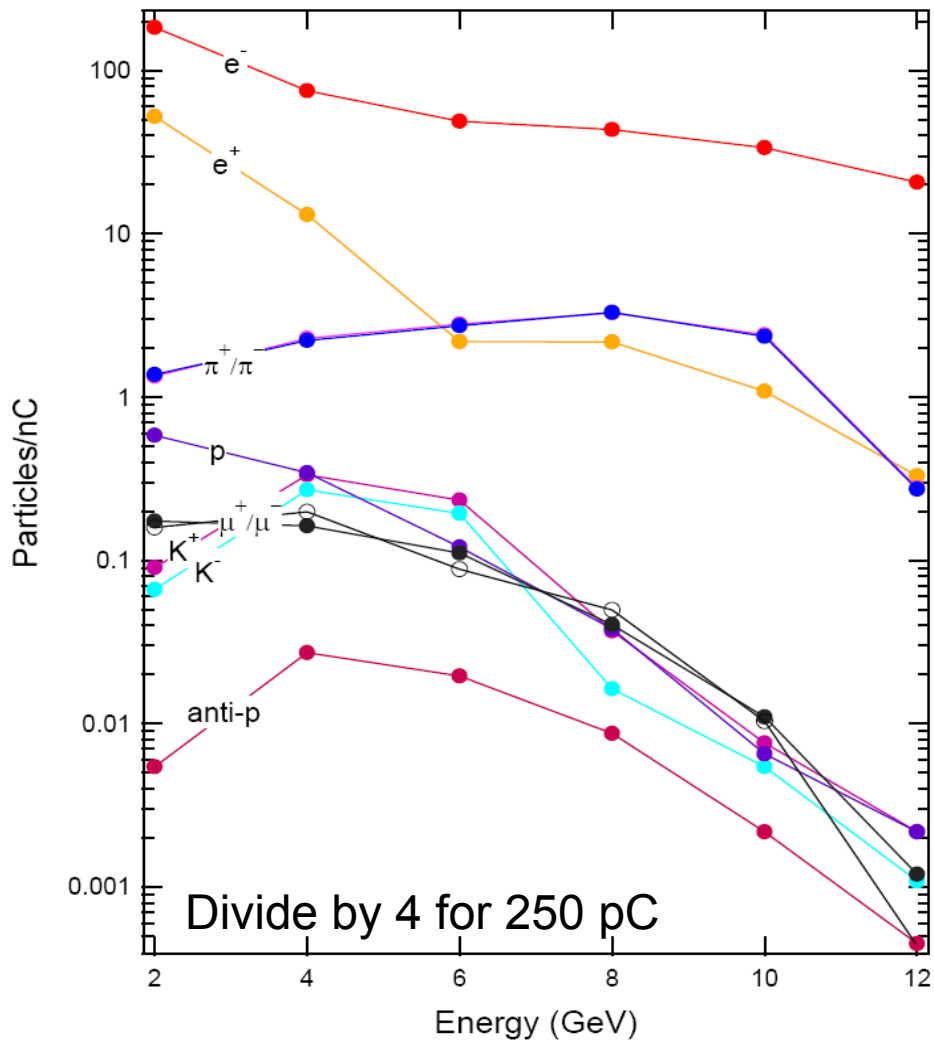
We need 10cm by 2cm, 100 μm pitch Si strip detector
Donations welcome!

ESTB Stage II: Hadron Production

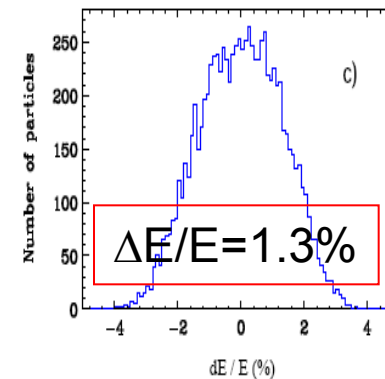
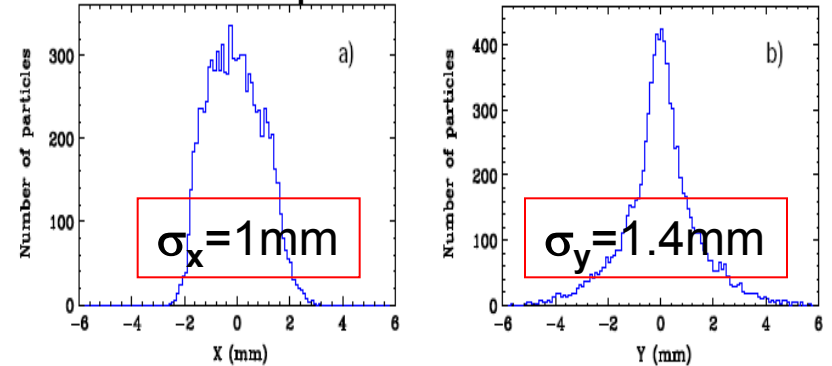
- Add Be target, beam dump, analyzing magnet, momentum slit, and quadrupole doublets to produce a secondary hadron beam
- Production angle = 1.35° and Acceptance = $10 \mu\text{sr}$



Secondary Hadron Beam Properties



Beam Properties at Detector Plane



π produced 1/0.25nC beam

Protons and Kaons at $\sim 0.02/0.25\text{nC}$

Secondary Hadron Beam Properties

**Production of Hadrons
would add
desirable capabilities to
ESTB**

**But:
Not Funded**

We need User Requests!!!

Proposals

- [Test of the SSD Electronics for STAR HFT Upgrade](#)
- [Pixel Sensors for ATLAS Upgrades](#)
- [STAR Pixel Detector](#)
- [Fermi Large Area Telescope](#)
- [LC detector: Silicon-Tungsten Calorimeter](#)
- [Super B R&D](#)
- [Energy Spectrometry](#)
- [CLIC Wakefield Collimator Studies](#)
- [Radiation Physics Beam Tests](#)
- [Beamcal Radiation Damage Study](#)
- [Geosynchrotron Radio Emission from Extensive Air Showers](#)
- [Modeled pulse function for waveform analysis using DRS4](#)

Howard Matis, LBNL

Philippe Grenier, SLAC

Leo Grenier, LBNL

Elliott Bloom, SLAC

Ray Frey, University of Oregon

Jerry Va'Vra, SLAC

Mike Hildreth, Notre Dame University

Roger Jones, Cockcroft/Manchester U

Mario Santana, SLAC

Bruce Schumm, UC Santa Cruz

Konstantin Belov, UCLA

Andriy Zatserklyaniy, Puerto Rico Univ.

Schedule

- This Down Time (now to mid May)
 - We install one BSY kicker with a stainless steel vacuum chamber
- End of May LCLS starts up and runs until Christmas (one week off in October)
- Mid of June FACET runs until August
- Mid of July ESTB can do first test of kicking a 4GeV beam into A-line
- ESA PPS becomes available this summer
 - 4GeV primary beam to ESA
 - 4-14GeV secondary electron beam to ESA
- Commissioning of ESA infrastructure September/October
- Oct 25th – Nov 1st install 4 BSY kicker magnets with ceramic chambers
- First ESTB run in November and December (need commissioning time)
- Linac off from Christmas to end of January
- ESTB running resumes February 2012
- SLAC downtimes are in Aug/Sept and over Christmas for the next years

Summary

- We are excited to re-start ESA test beams!
 - Unique High energy test beam line in the US, with plenty of infrastructures and SLAC support for Users
- We install a short-term system for e^- beams in ESTB with commissioning by summer
 - 4 GeV full intensity or up to 13.6 GeV 2nd e^- beams
- Installation of the full 4 kicker system by end October
 - First ESTB run in November / December 2011
- Beam parameters determined by LCLS. Availability 5Hz. Some opportunities to increase rate when not needed for LCLS.
- Hadron beam line upgrade needs user requests and funding

See you all at SLAC soon!