Proposal for the End Station Test Beam (ESTB) at SLAC

John Jaros

ALCPG09 Albuquerque

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End Station Test Beam (ESTB) Proposal Will Restore Test Beams at SLAC

* **There is a Long History of Linear Collider studies at ESA and FFTB**
  - Final Focus feedback studies
  - Beam Energy Spectrometers
  - MDI, Collimator Wakefields, Beam Pickup

* **Test Beam Activities Have Been Interrupted by Installation and Operation of LCLS, SLAC's X-ray Laser.**

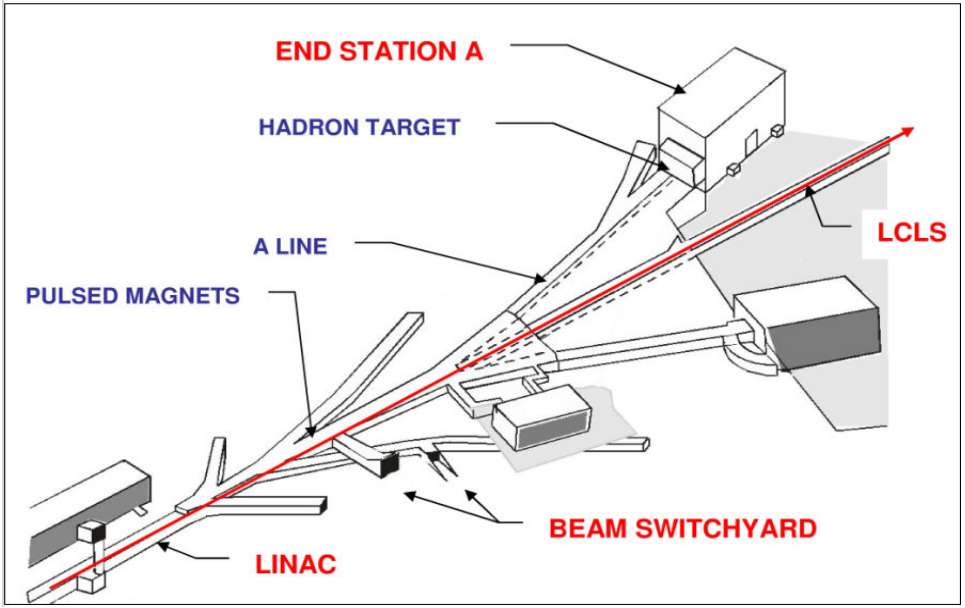
* **Proposed Test Beam Facility is a Unique HEP Resource**
  - World's only high-energy primary electron beam for large scale Linear Collider MDI and beam instrumentation studies

  - Exceptionally clean and well-defined secondary electron beams, secondary hadron beams, and photon beams available for detector development and calibration for LC, SLHC, Super B, and Particle Astro

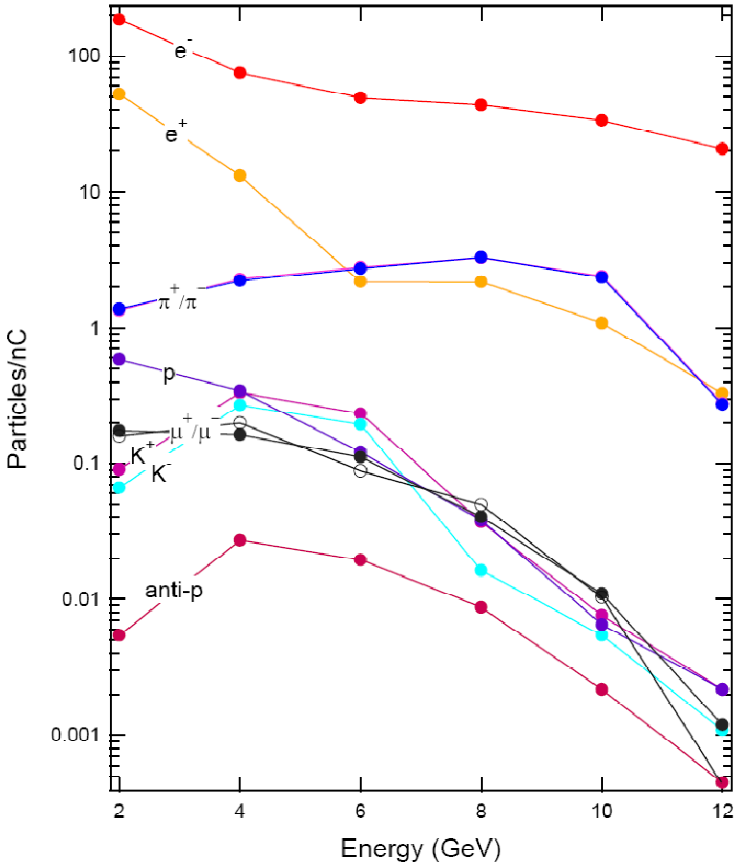
  - Huge experimental area, existing DAQ and conventional facilities, and historically broad user base

ESA Test Beam Provides Electrons/Hadrons up to 13.6 GeV, from single particles to full beam intensity

- **Kick 13.6 GeV LCLS beam to ESA**
  5 Hz, 2 x 10^9 e^-/ pulse primary beam
- **Clean secondary electrons/positrons**
  p<13.6 GeV, 0.1/pulse to 2 x 10^9 e^-/pulse
- **Secondary hadrons**
  ~1 π / pulse < 12 GeV/c



Secondary Particle Yields



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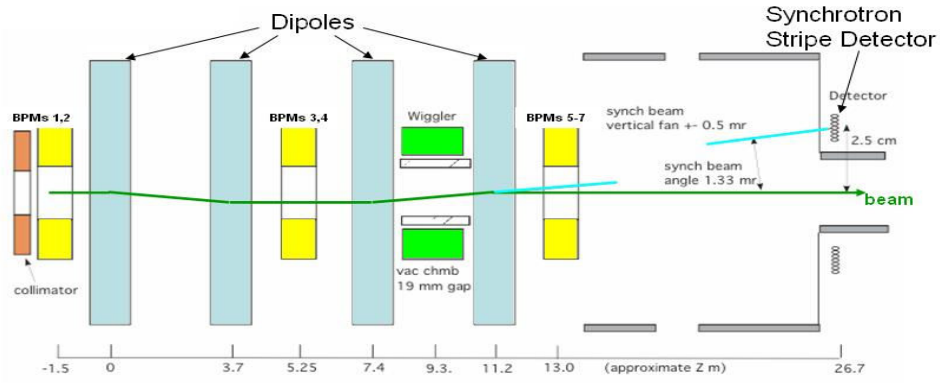
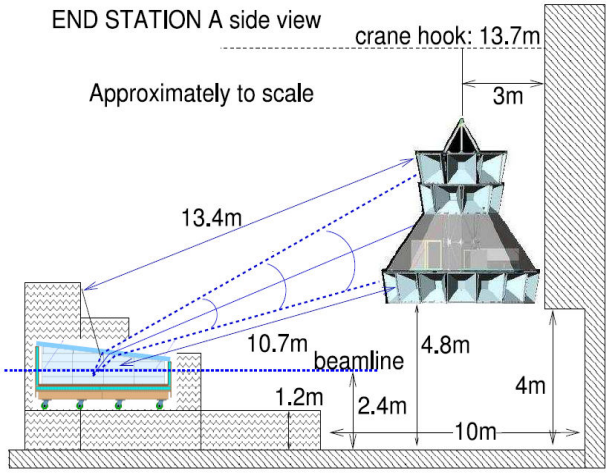
PPA Particle Physics & Astrophysics

LC Beam Instrumentation, MDI, Detector R&D

LC Beam Energy Measurement



Calibrate Anita with Full Beam into Ice



Ideal for LC Detector R&D

- LC beam timing—precisely known arrival time
- Ultra-clean, known momentum electrons for ECal studies
- Tagged photon beam possible
- ~12 GeV/c hadrons for tracker, vertex detector studies. Multiple scattering negligible at these momenta.
- Hadrons suitable for Hcal studies at the low and intermediate energies which dominate ILC jets.

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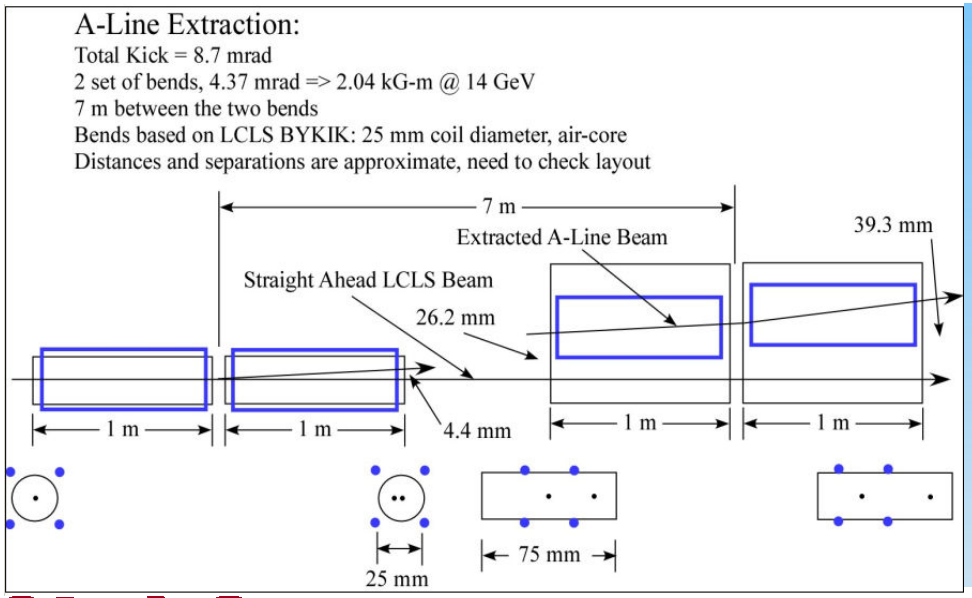
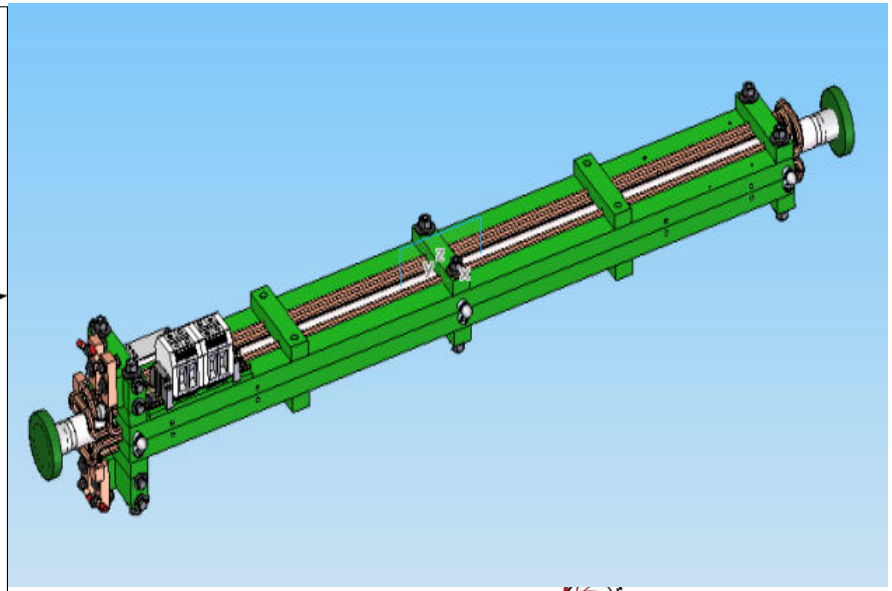
ESTB Stage I Proposal

* Construct kicker magnets and vacuum chamber for BSY
* Update PPS System and install new beam dump for ESA
* Update MPS and Controls as needed
* Schedule: Ideally install Summer 2010, maybe 2011

Use LCLS Kicker Magnets in BSY





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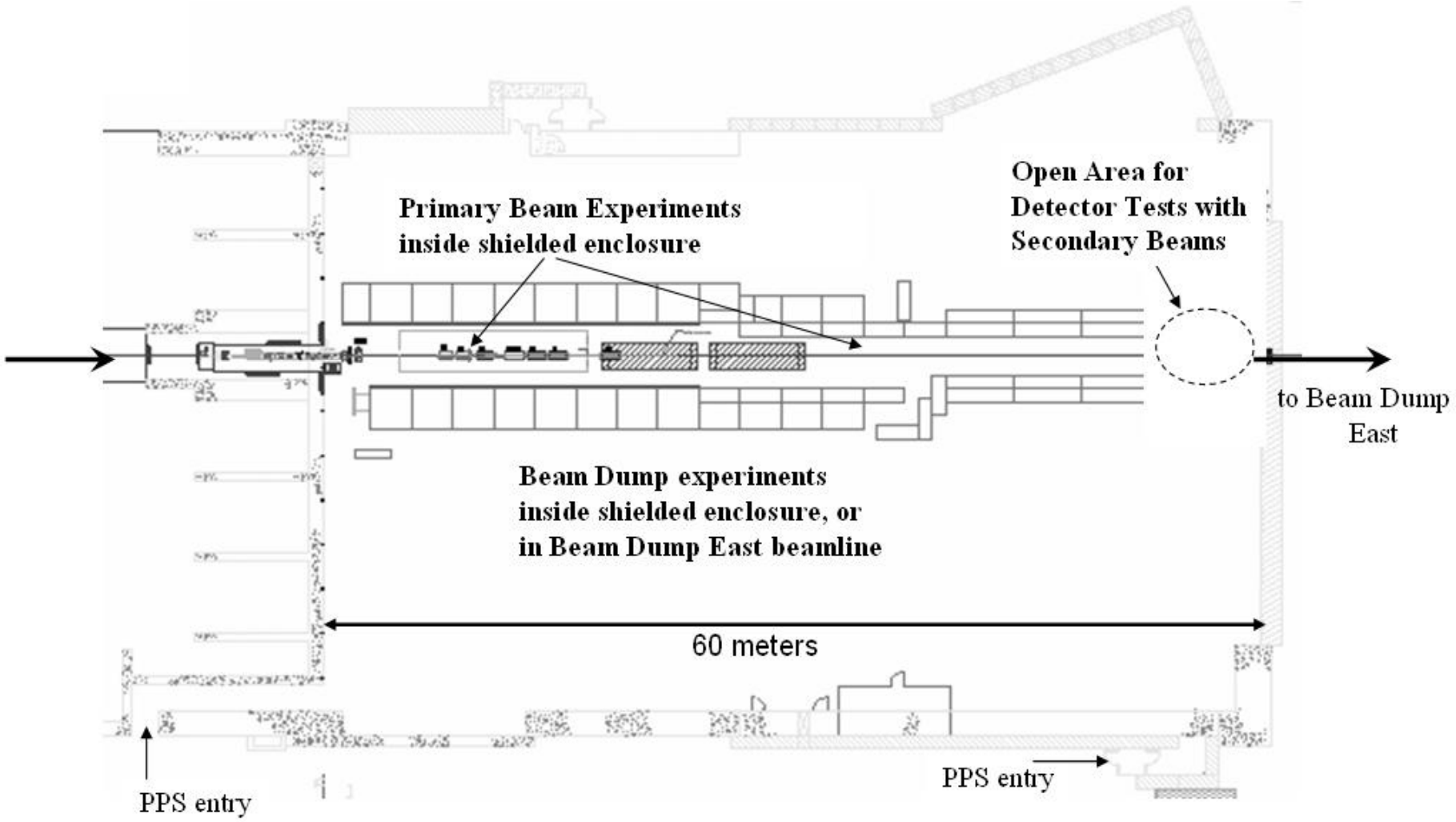
Primary Electron Beam Properties

Energy	13.6 GeV
Repetition Rate	5 Hz
Charge per pulse	0.15 to 0.6 x 10^{10} (1 nC) e-
Momentum spread rms	<0.058%
Bunch length rms	280 μm
Emittance rms ($\gamma\varepsilon_x$ $\gamma\varepsilon_y$)	(4,1) x 10^{-6} m rad
Spot size at waist ($\sigma_{x,y}$)	~10 μm
Momentum dispersion η and η'	<10mm
Drift space available for experimental apparatus	60 m
Transverse space available for experimental apparatus	5 x 5 m

Lots of room for apparatus

ESA Experimental Area



ESA Infrastructure

Available Instrumentation

Trigger counters; Halo veto counters; High resolution beam hodoscope; Particle ID (Cerenkov, TOF, shower counter); Small, high field solenoid; sturdy support table with remote movers

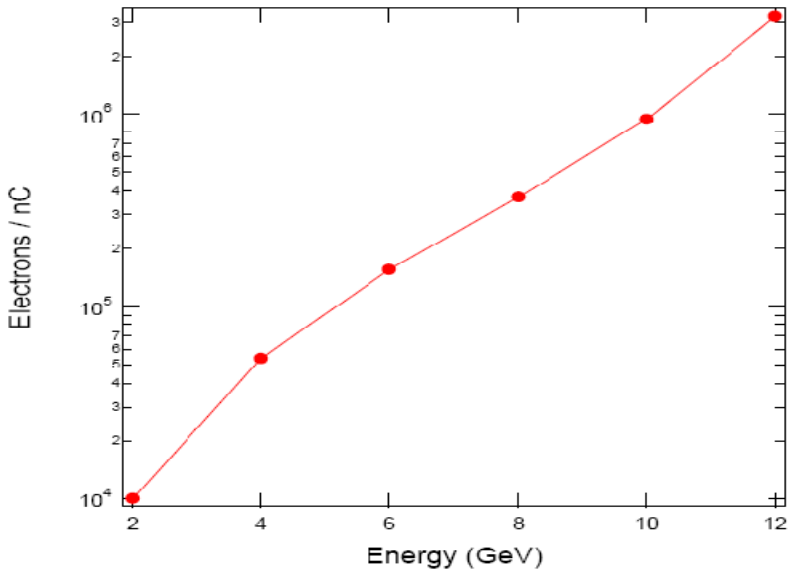
Cranes

15 and 50-ton cranes available

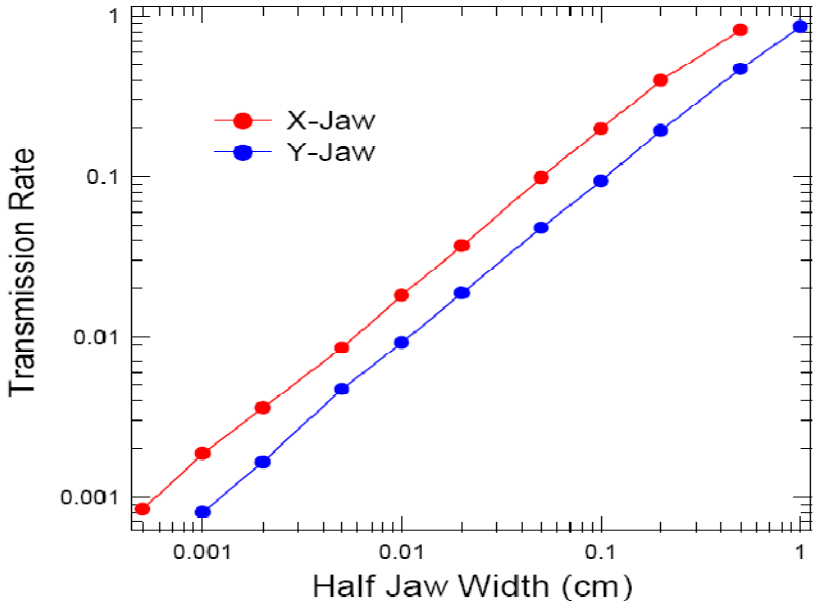
Secondary Electrons and Positrons

* Inserting a thin foil in the transport line to ESA, and using the beamline as a spectrometer, creates a clean secondary electron/positron beam over the full range of energies (<13.6 GeV/c) and a wide range of intensities down to ~1/pulse.

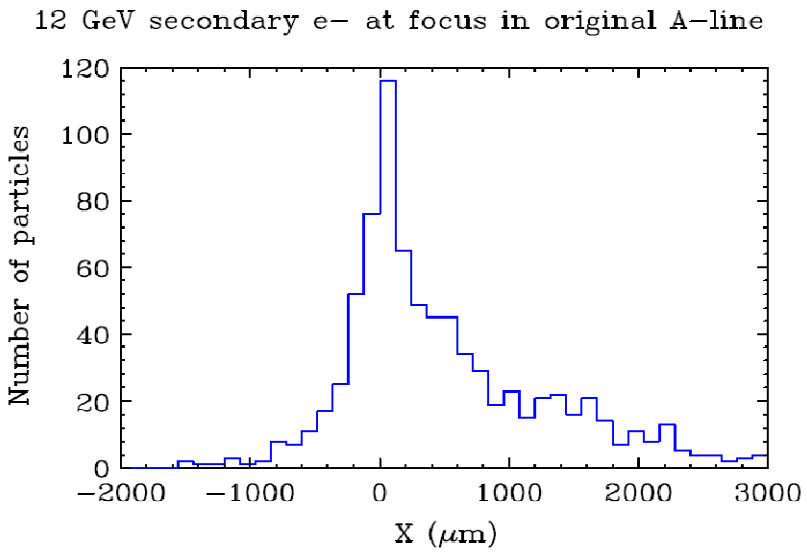
Production Rate from Foil

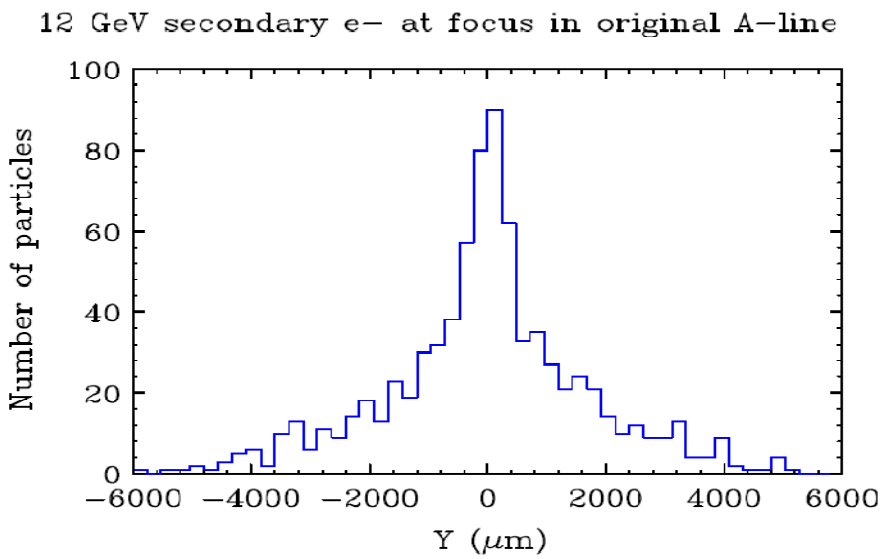


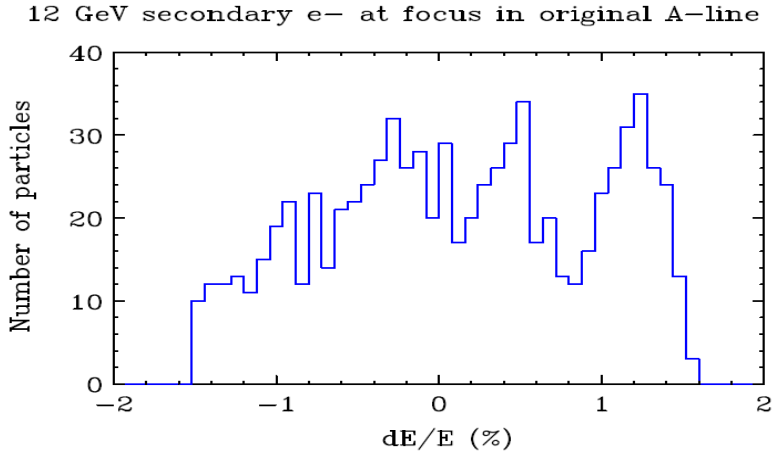
Attenuate up to Factor 10^6



Secondary Electron Beam Properties







$\sigma_{x,y}$~ 1 mm

$\Delta p/p \sim \pm 1\%$

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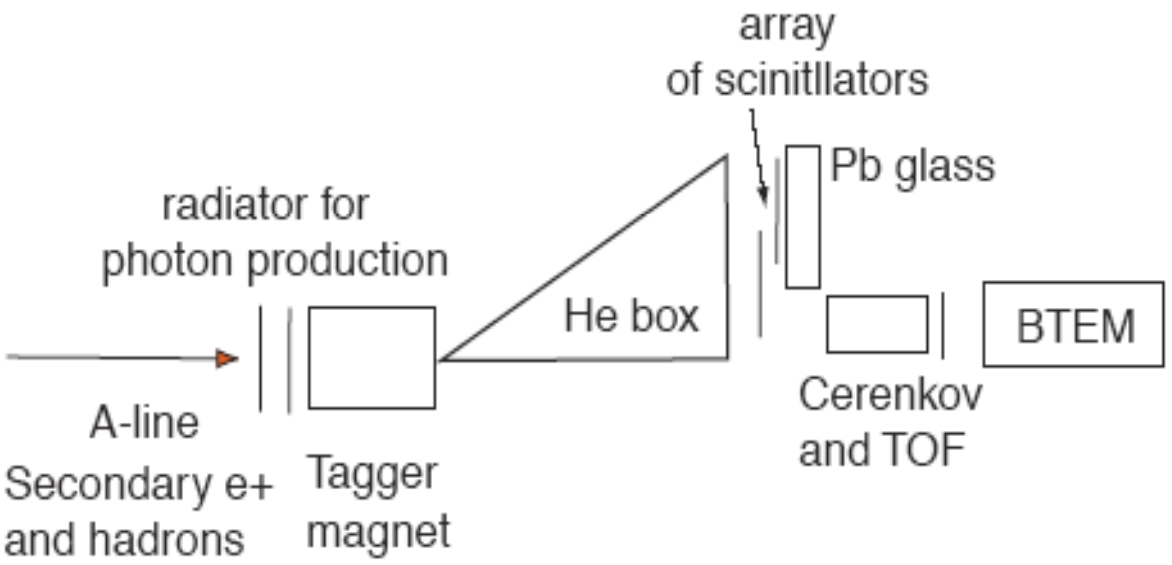
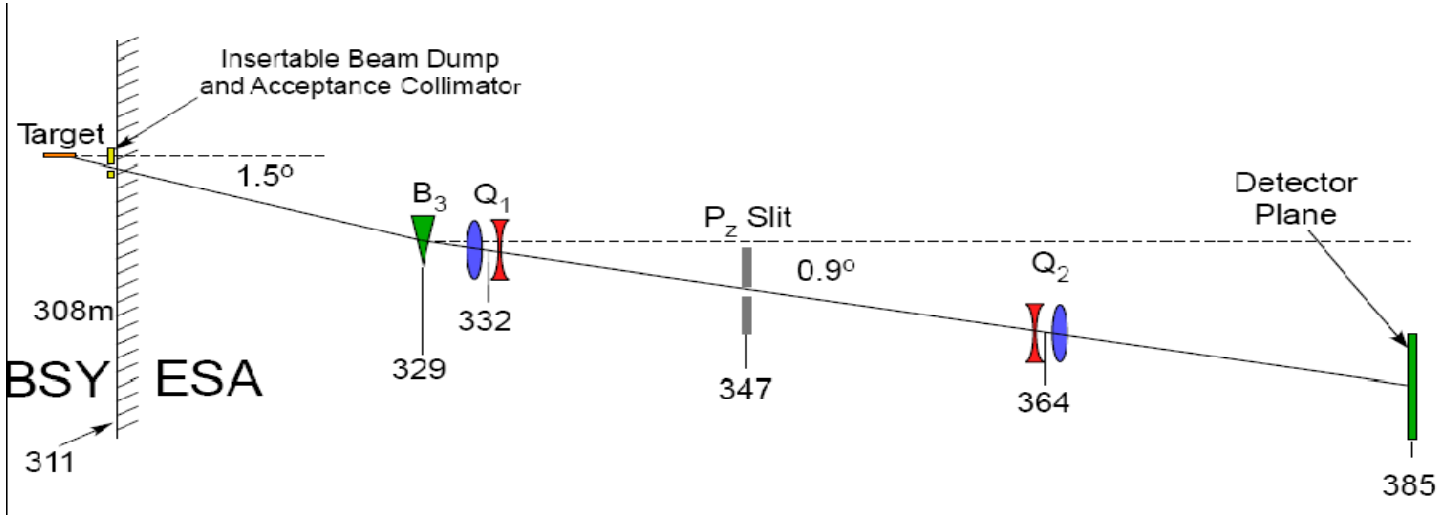
Photon Beam Possible

Clean electrons plus tagging system provides photon beam capability



ESTB Stage II Hadron Production

Add Be target, beam dump, analyzing magnet, momentum slit, and quadrupole doublets to produce a secondary hadron beam in ESA. Production angle = 1.5^{o} and Acceptance = 10 μsr



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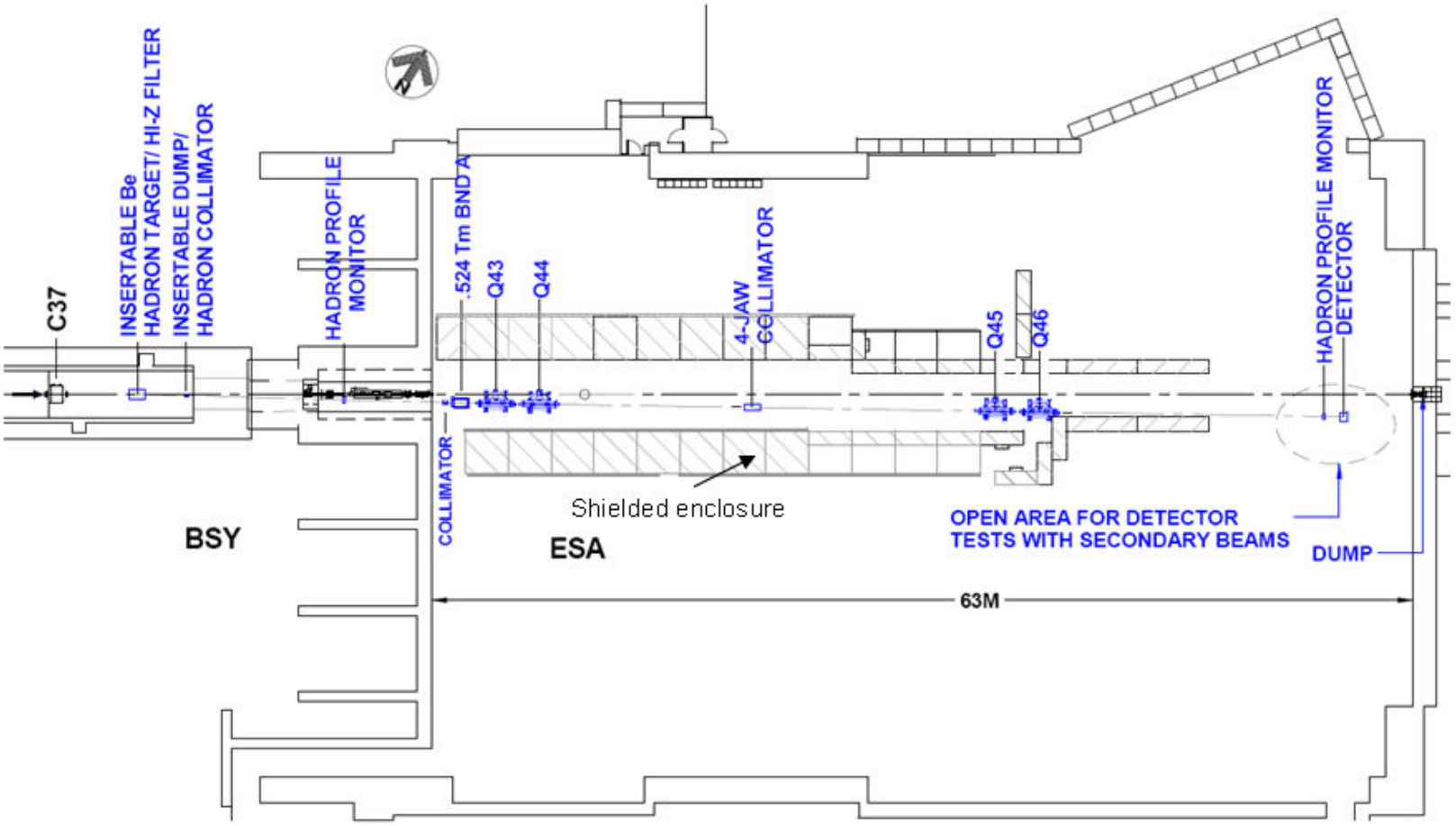
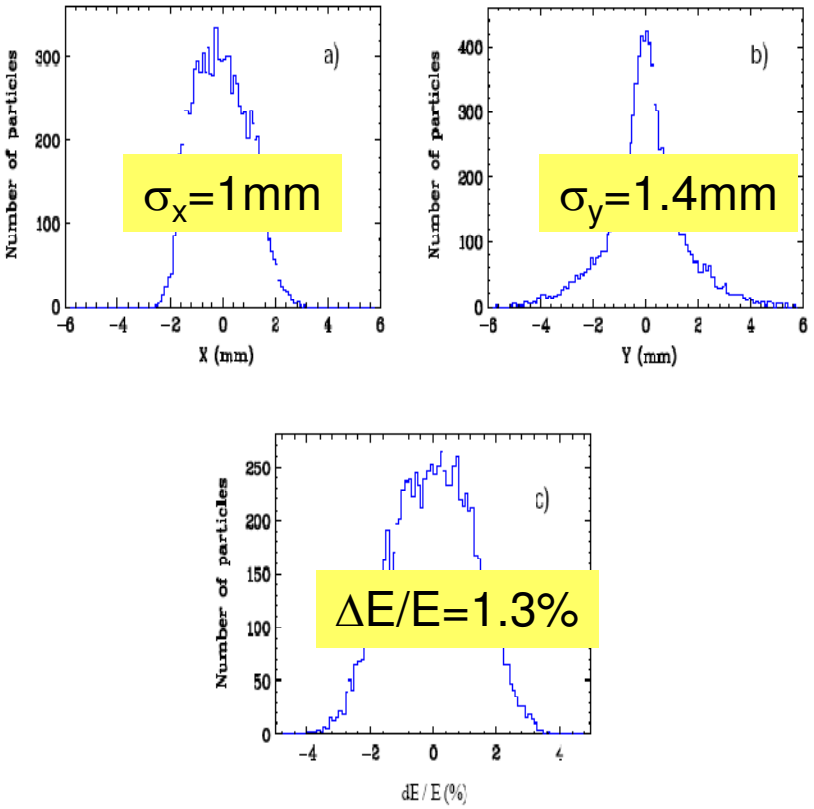


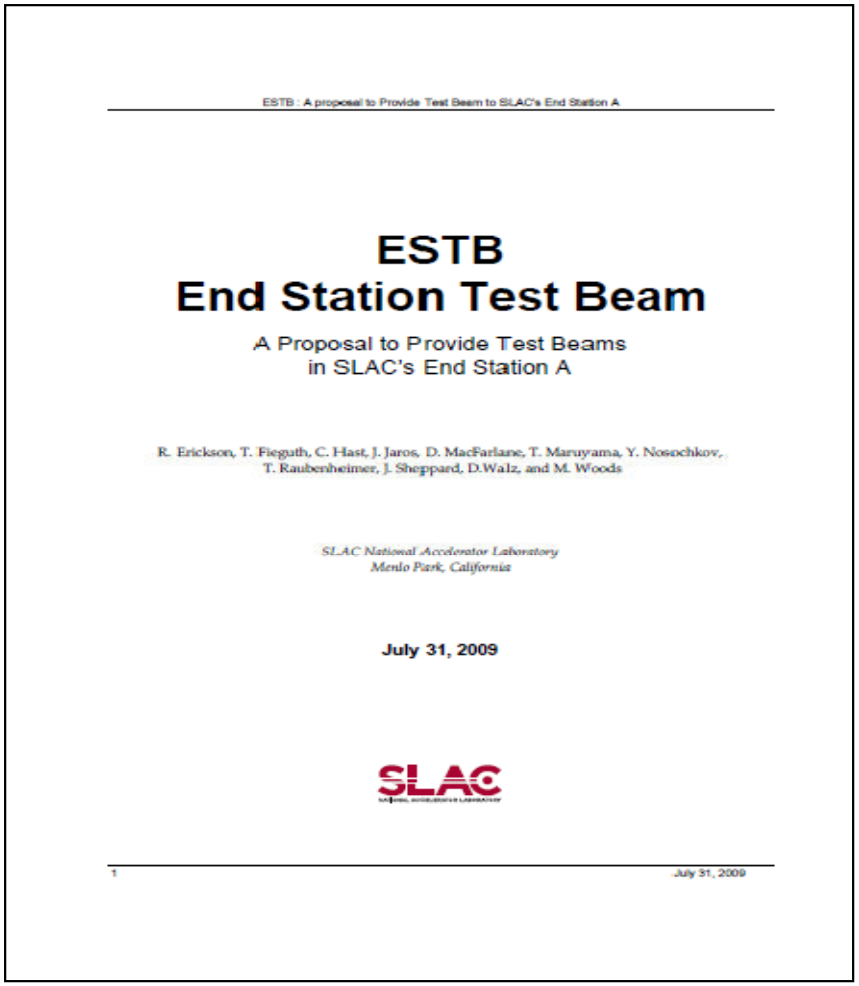
Secondary Hadron Beam Properties

Energy	0.1–12 GeV
Particles per pulse	0.1–10 π/ nC
Bunch repetition rate	5 Hz
Precise beam trigger	Yes
rms x, y spot size	1-2 mm
Momentum analysis	$\Delta p/p \sim 1\%$
X,y,z space available	5 m, 5 m, 15 m
Rate for p, K, μ	0.1-0.01/π

Beam Properties at Detector Plane



ESTB Proposal Submitted to DOE



Proposal submitted early August. Presently out for review. Hope to hear status mid-October.

Co-Authors

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

SLAC National Accelerator Laboratory
Menlo Park, California

SLAC Test Beam Conclusions

* SLAC is proposing to restore test beam capability to ESA, making use of pulses borrowed from LCLS.
* Unique high energy primary electron beam will allow continued studies of LC beam instrumentation and MDI.
* An extremely clean electron/positron beam can be delivered over all the available energies (<13.6 GeV) and a very wide range of intensities, suitable for detector R&D.
* A hadron beam is also planned, with energies up to 12 GeV, suitable for tracker, vertex detector, and calorimeter R&D.
* Beam could be available early 2011.