
Test Beams at SLAC

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

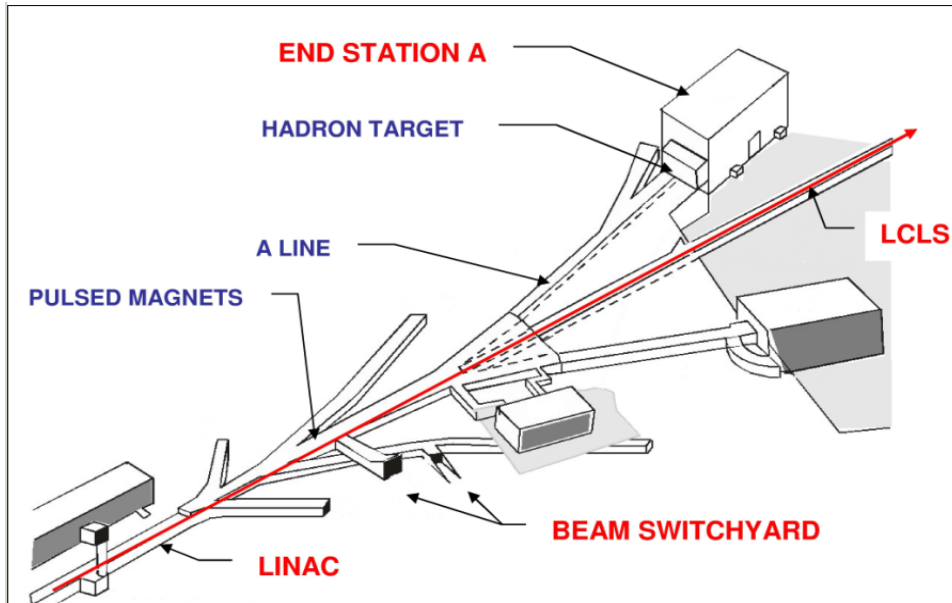
- * **There is a Long History of Linear Collider studies at ESA and FFTB**
 - Final Focus feedback studies
 - Beam Energy Spectrometers
 - MDI, Collimator Wakefields, Beam Pickup

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

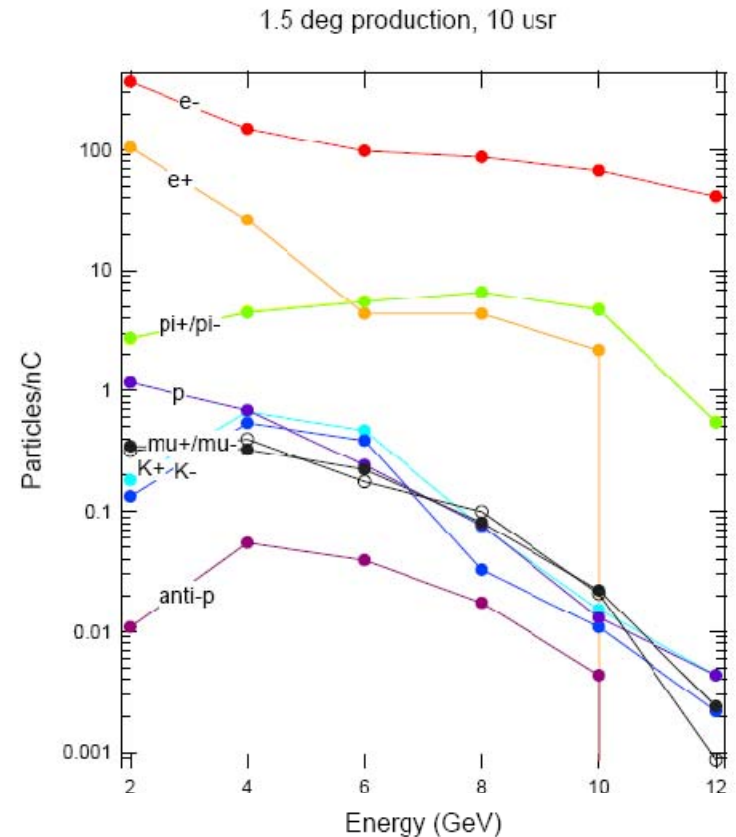
- * **Proposed Test Beam Facility is a Unique HEP Resource**
 - World's only high-energy primary electron beam for large scale Linear Collider MDI and beam instrumentation studies
 - Secondary electron, hadron, and photon beams available for detector development and calibration for LC, SLHC, Super B, 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, 2×10^9 e⁻/ pulse primary beam
- **Clean secondary electrons/positrons**
 $p < 13.6$ GeV, 0.1/pulse to 2×10^9 e⁻/pulse
- **Secondary hadrons**
 $\sim 1 \pi$ / pulse < 12 GeV/c



Secondary Particle Yields



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 Jan 2010, maybe 2011

Use LCLS Kicker Magnets in BSY

A-Line Extraction:

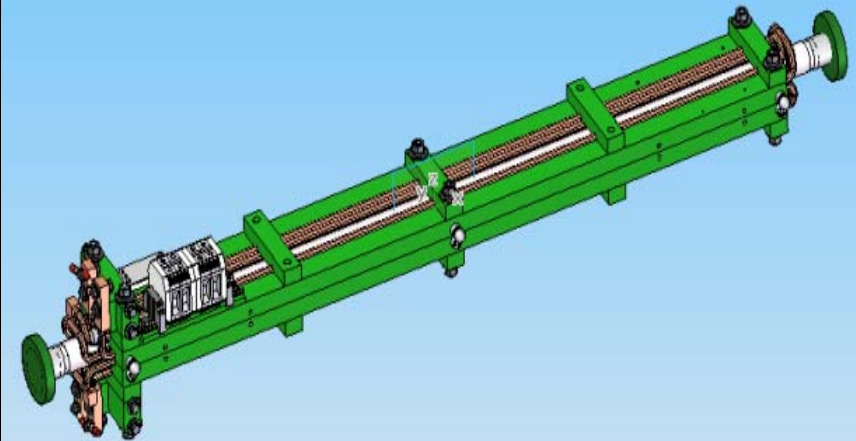
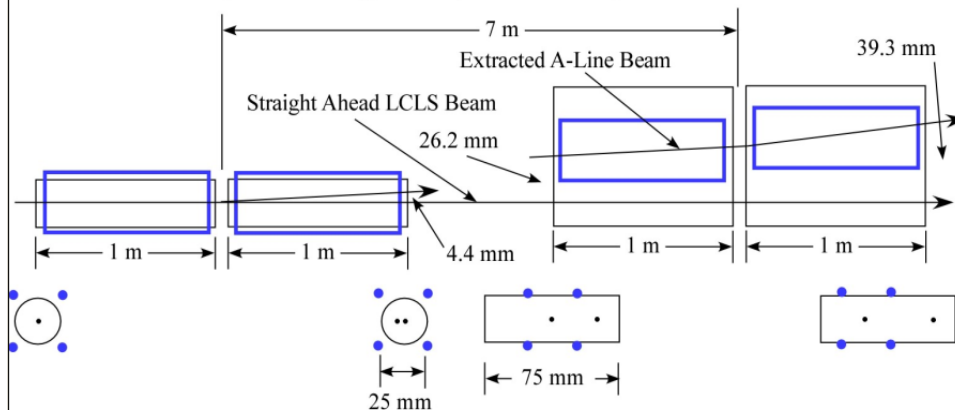
Total Kick = 8.7 mrad

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

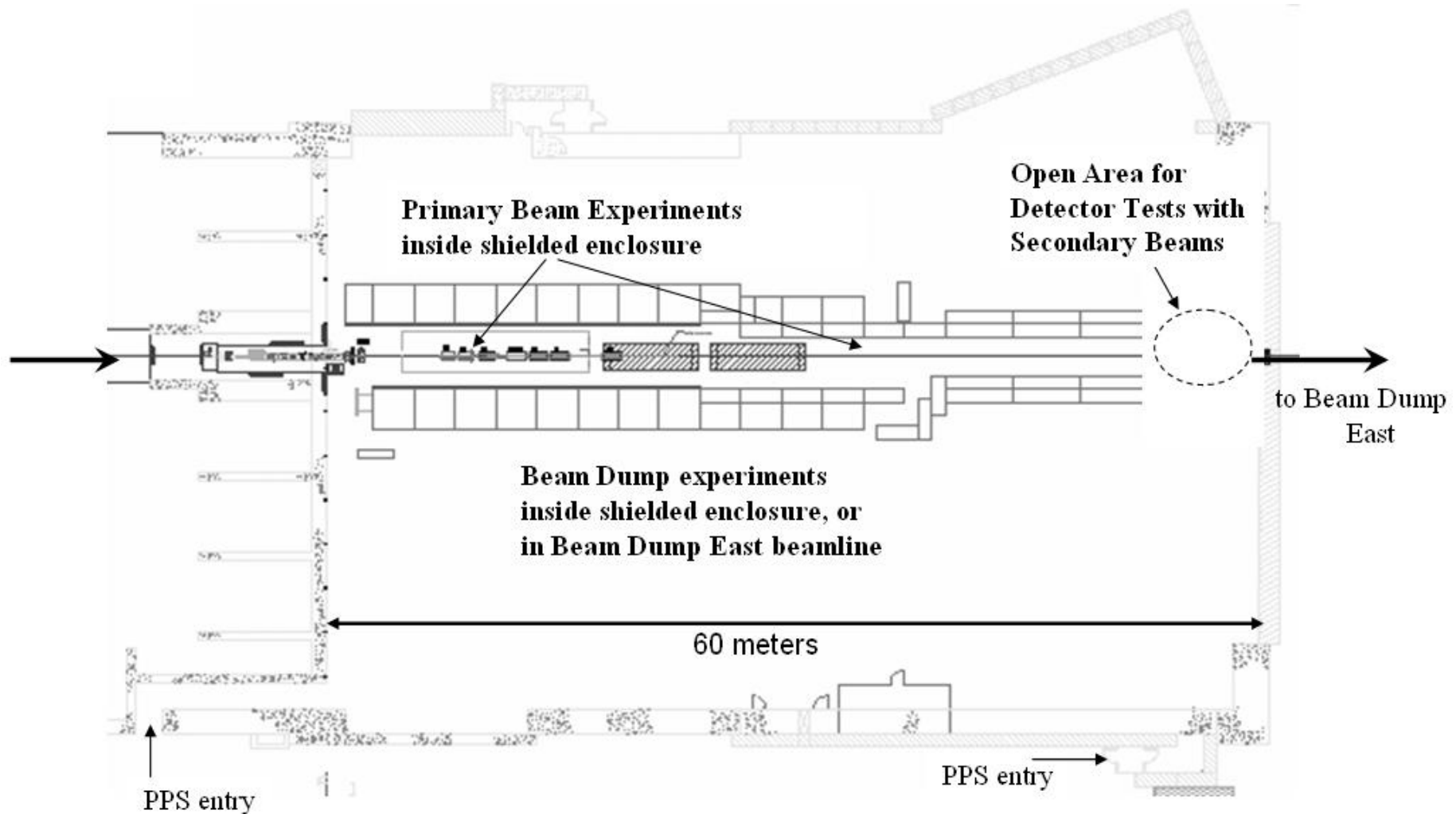
Distances and separations are approximate, need to check layout



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 ($\gamma\epsilon_x$ $\gamma\epsilon_y$)	(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	Lots of room for apparatus
Transverse space available for experimental apparatus	5 x 5 m	

ESA Experimental Area



ESA Infrastructure

Available Instrumentation

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

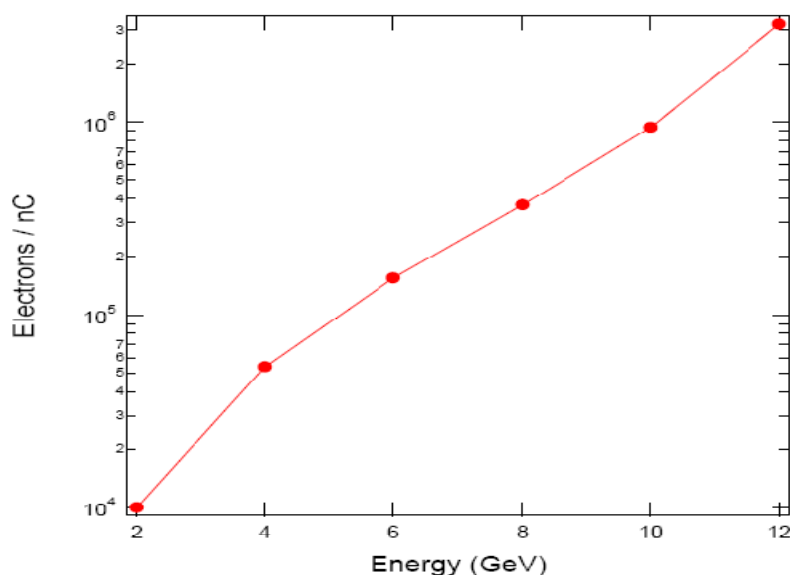
Cranes

15 and 50-ton cranes available

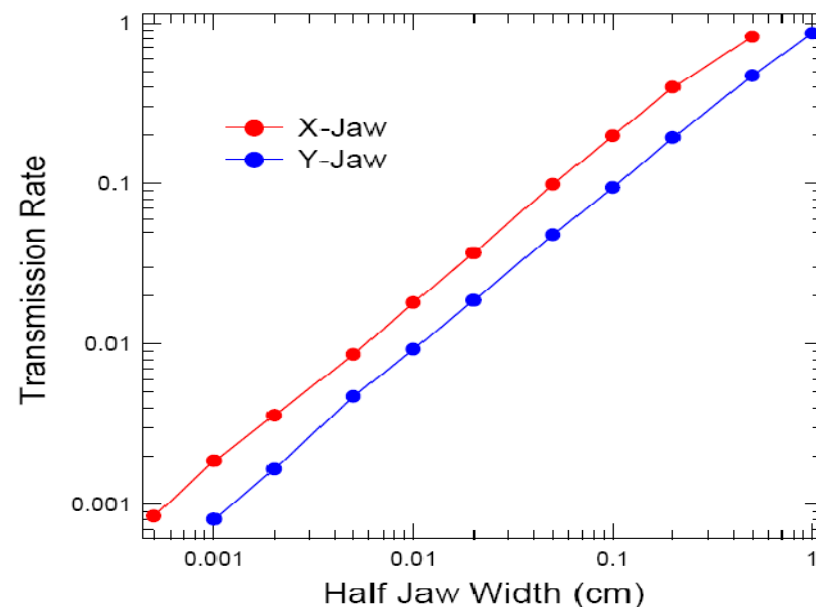
Secondary Electrons and Positrons

- * 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 $\sim 1/\text{pulse}$.

Production Rate from Foil

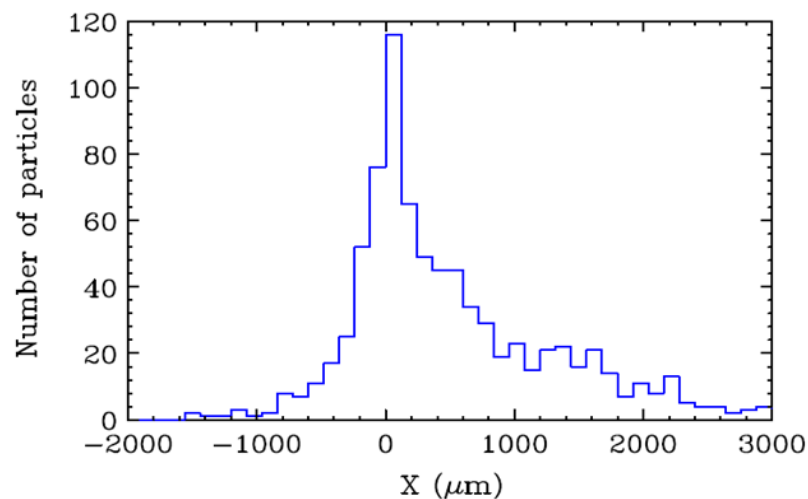


Attenuate up to Factor 10^6

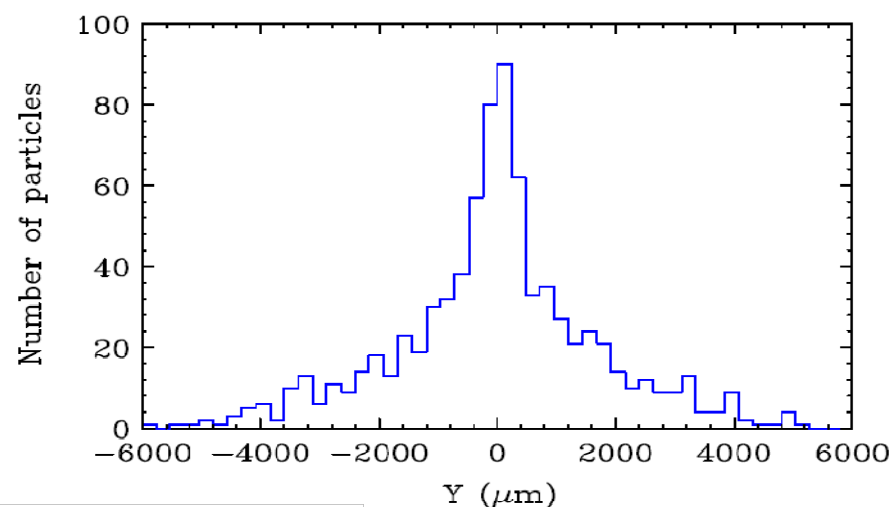


Secondary Electrons Beam Properties

12 GeV secondary e⁻ at focus in original A-line

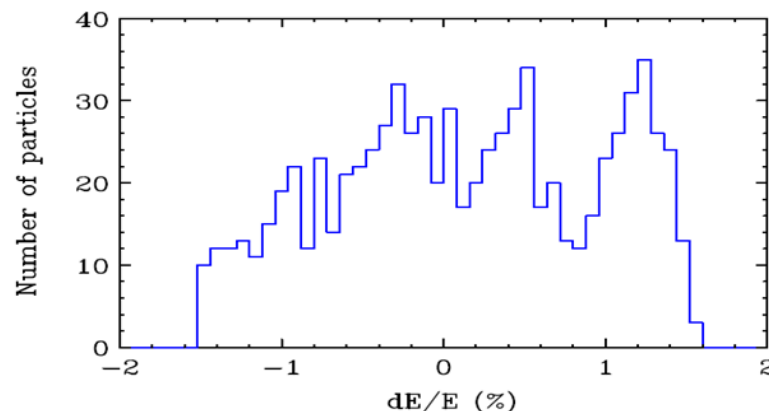


12 GeV secondary e⁻ at focus in original A-line



$$\sigma_{x,y} \sim 1 \text{ mm}$$

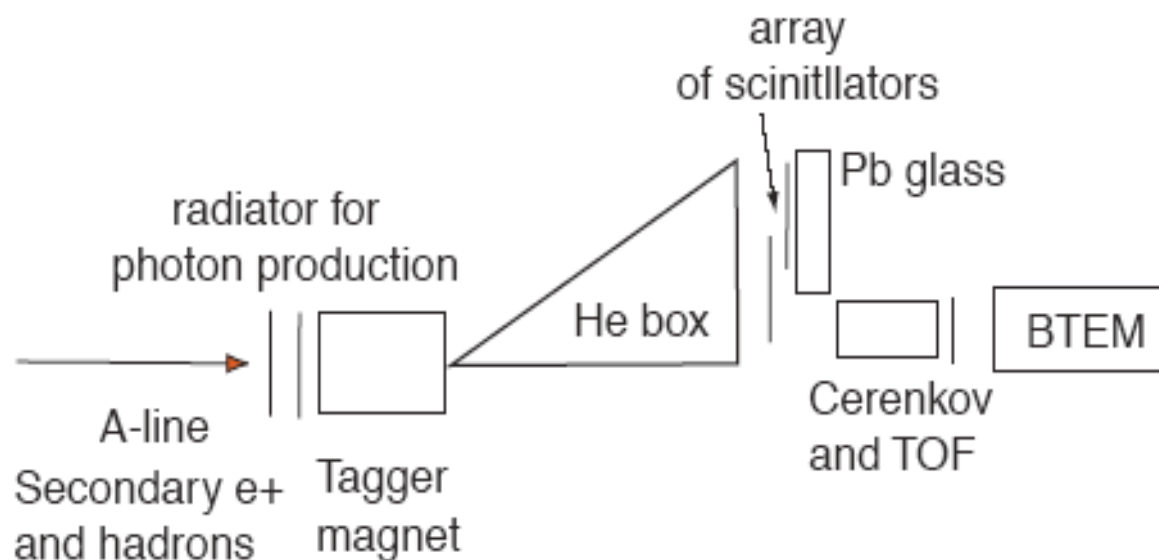
12 GeV secondary e⁻ at focus in original A-line



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

Photon Beam

Clean electrons plus tagging system provides photon beam capability

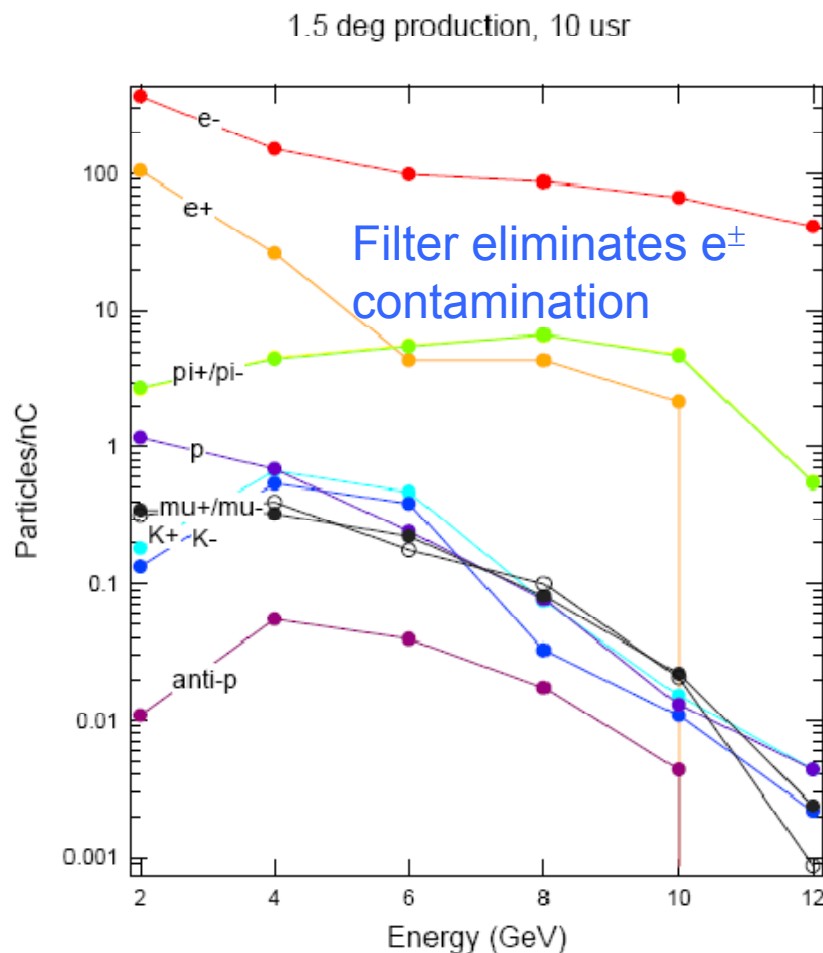


Add Be target, beam dump, analyzing magnet, momentum slit, and quadrupole doublets to produce a secondary hadron beam in ESA. Production angle = 1.5° and Acceptance = $10 \mu\text{sr}$



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



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.
- * Proposal should be submitted soon. Beam could be available in 2010 or 2011.

Proposal and Proponents

ESTB **End Station Test Beam**

A Proposal to Provide Test Beams in SLAC's End Station A

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

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