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 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

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
- Photon beam possible
- ≤12 GeV/c hadrons for tracker, vertex detector studies. Multiple scattering negligible.
- Hcal Studies for the low and intermediate energy hadrons which dominate ILC jets.

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

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 (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 ~1/pulse.

Production Rate from Foil

Attenuate up to Factor 10^6

Secondary Electrons Beam Properties

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

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

Photon Beam

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

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

Filter eliminates $e^{\pm}$ contamination

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.

ESTB
End Station Test Beam

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

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