
CLIC Collimation Wakefield Studies in ESA at SLAC

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CLIC Collaboration Meeting
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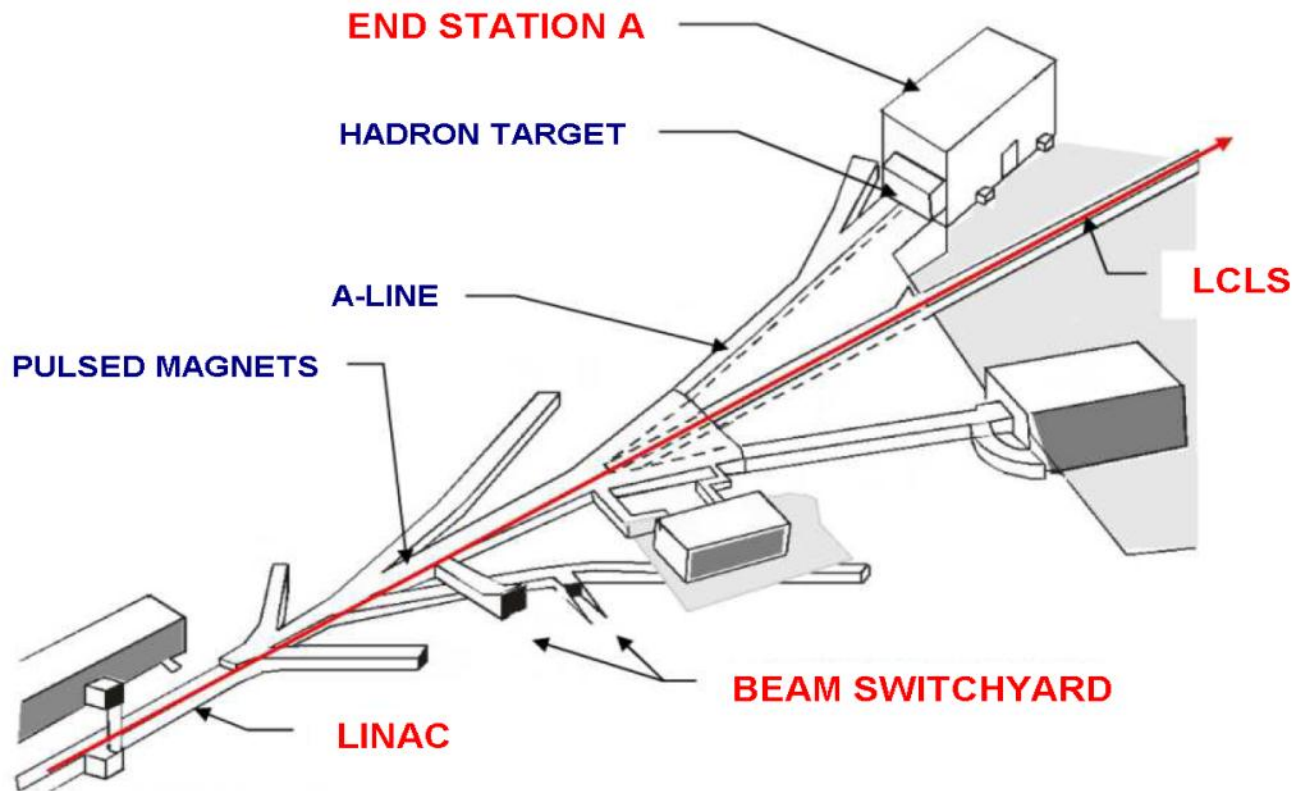
An aerial photograph of the SLAC National Accelerator Laboratory. A long, straight, light-colored structure, the SLAC LINAC, runs vertically through the center of the image. To the right of the LINAC, there is a large complex of buildings, including a prominent rectangular building with a dark roof. The surrounding area is a mix of green fields, trees, and parking lots. Two green callout boxes with white arrows point to specific features: one points to the LINAC and the other points to the rectangular building.

LCLS light source uses
1/3 of SLAC LINAC

End Station A

LCLS and ESA at SLAC

Use pulsed kicker magnets to send the beam from the Linac Coherent Light Source (LCLS) to End Station A (ESA)



CLIC Collimation Wakefield Studies at SLAC

End Station A (ESA)

- Collimation wakefield “box installed
P. Tenenbaum, S. Molloy *et al.*
- Different jaw apertures & lengths
- Tests: optimal materials and geometry to minimize wakefields

Slot	Side view	Beam view	
1			$\alpha=335\text{mrad}$ $r=1.9\text{mm}$
2			$\alpha=335\text{mrad}$ $r=1.4\text{mm}$
3			$\alpha=335\text{mrad}$ $r=1.4\text{mm}$
4			$\alpha=\pi/2\text{rad}$ $r=3.8\text{mm}$



- “Wakefield box” allows swapping of collimators and adjusting jaw aperture
- measured wakefield kick to the beam by downstream BPMs



CLIC collimation wakefield: Bunch Length

- CLIC bunch length is 44 μm .
- Bunch length 100 μm in ESA. With installation of 4 existing quadrupoles the bunch length can be reduced to 20 μm .
- Precise measurement of bunch length for CLIC studies, options :
 - Smith Purcell Radiation bunch Profile Monitor actually under tests in FACET (SLAC)

Status of ESA facility: installed kicker in LCLS and extracted beam destined to ESA

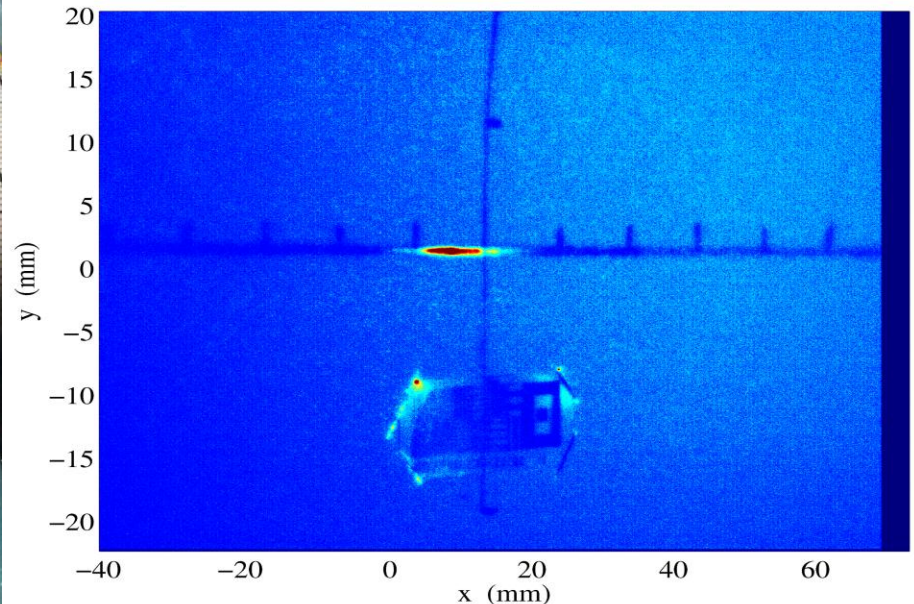
Overview of LCLS beam line

Recently installed Kicker to extract beam into ESA

LCLS beam parameters	Units
Energy	3.5 - 14.7 GeV
Charge	250 pC
Rep. rate	5 Hz
Bunch length	100 us – (20*us)

* need beam line upgrade of 4 quadrupoles

Profile Monitor PROF:BSYA:1800 07-Feb-2012 20:19:58



Profile image of LCLS beam successfully extracted into line upstream ESA, ready for **CLIC studies**.

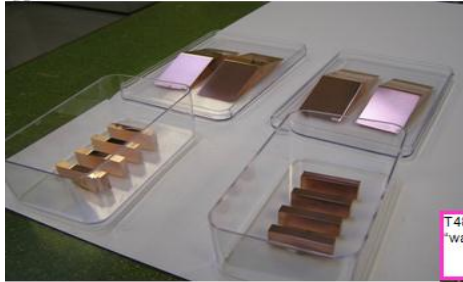
Supporting slides

Collimator Wakefield Measurements

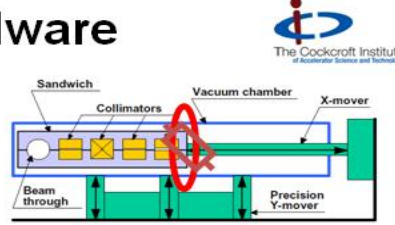
R.M. Jones, D. Schulte, R. Tomas, W. Wuensch for the CLIC team

Motivation

- Collimator wakefields may limit CLIC performance
- CLIC parameters sit close to limit of formulae applicability
- Previous experiments in ESA (T-480)^a show discrepancies with model (is the lack of bunch length measurement the culprit?)
- Non-linear components?

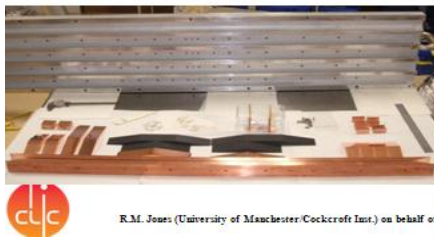


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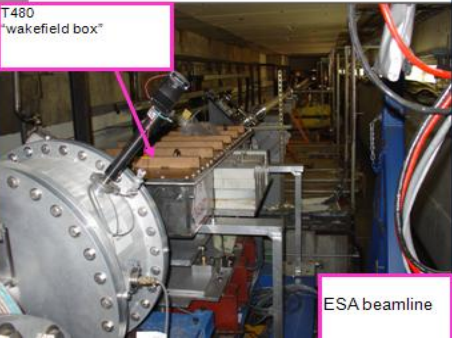


The Cockcroft Institute
of Accelerator Science and Technology


Collimator Hardware



T480 "wakefield box"



ESA beamline



R.M. Jones (University of Manchester/Cockcroft Inst.) on behalf of

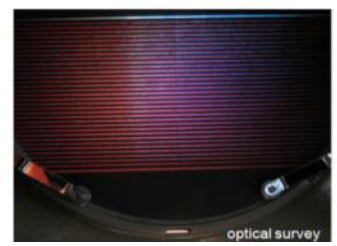
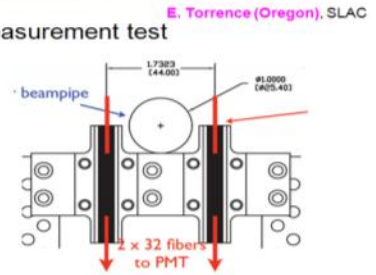
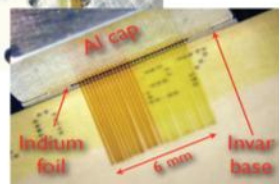
- Bunch length measurement is critical . New electro-optic bunch length instrumentation (CLIC CDR)
- Need BPM resolution in the 100 nm level (partially contributed by CERN)

Energy Spectrometer Tests at End Station A

Mike Hildreth

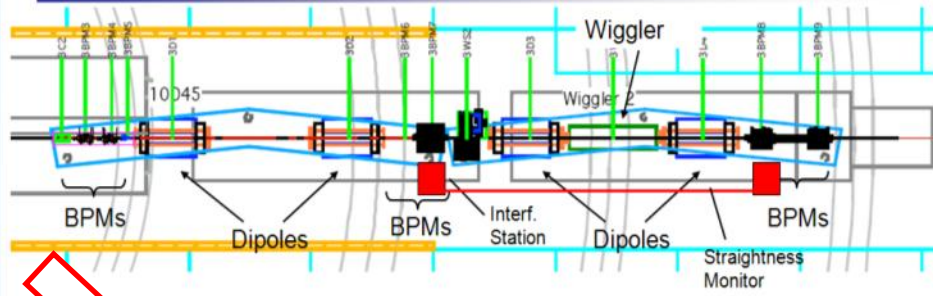
New SR Stripe Detector

- Next-generation prototype for Energy Measurement test
 - schedule advanced in anticipation of ESA closure/hiatus due to LCLS



March 17, 2011

Next Steps for ESA



- check of spectrometer energy measurements
- commission SR-Stripe setup
 - Previous chicane measurements limited by BPM resolution
 - LCLS2 BPMs? (under negotiation)
 - more new hardware/electronics for better resolution/stability
 - aim for 1×10^{-4} relative measurement, cross-calibration
 - Finish what we started!

Development: Short bunch length

- Interest to short bunches $\sim 44\mu\text{m}$ (CLIC, accel. R&D..)
- LCLS beam: $10\mu\text{m}$ and smaller
- In the A-line, bunch length increases to $100\mu\text{m}$ due to 24° bend, large dispersion and large R56
- Solution: installation of 4 available QUADs in A-line
 - to reduce R56 (T. Fieguth)
 - with LCLS beam $\sigma_E \sim 0.02\%$ (Z. Huang)
 - **bl = $50\mu\text{m}$ or shorter in ESA**

