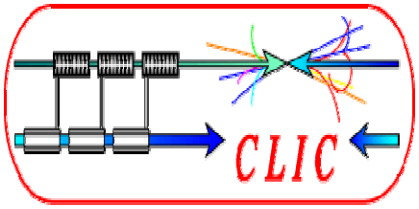


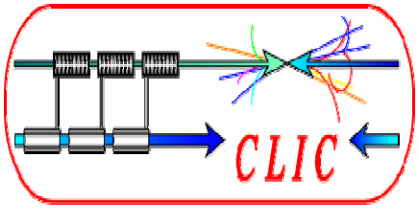
On a possibility of much shorter collimation system for CLIC

Andrei Seryi (SLAC)

October 15, 2008

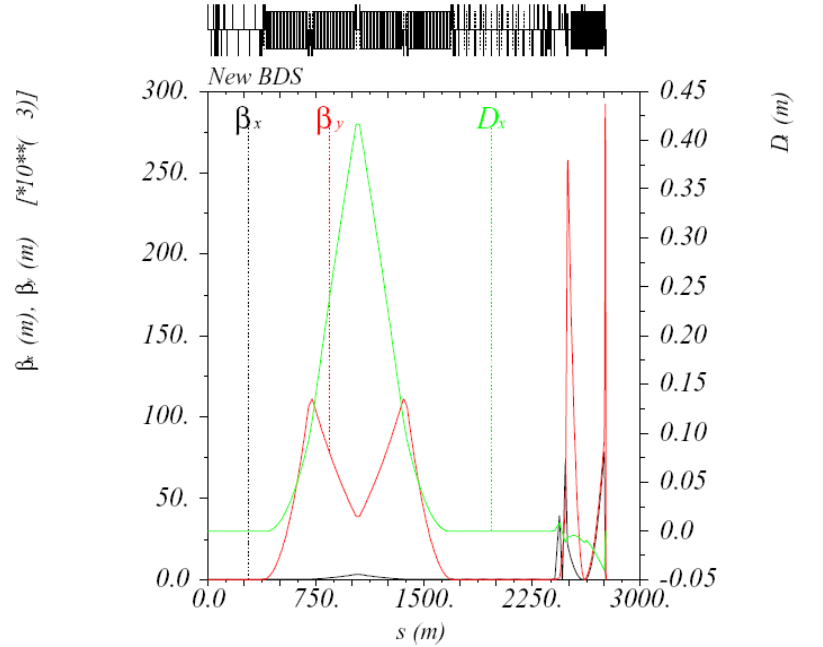
CLIC 08 Workshop

Plan of the talk



- CLIC BDS and collimation
  - **beam damage as criteria for collimation design**
- Experimental observations at SLAC that show that damage threshold for CLIC-short bunches is pushed out
  - **that change approach to CLIC collimation system design**
  - **experimental studies would be needed to clarify the new damage threshold**

Collimation design



CLIC 2008 PARAMETERS

CLIC-Note-764

H. Braun, R. Corsini, J.-P. Delahaye, A. De Roeck, S. Doebert, G. Geschonke, A. Grudiev, C. Hauviller, B. Jeanneret, E. Jensen, T. Lefevre, Y. Papaphilippou, G. Riddone, L. Rinolfi, W.-D. Schlatter, H. Schmickler, D. Schulte, I. Syratchev, M. Taborelli, F. Tecker (editor), R. Tomás, S. Weisz, W. Wunsch,
CERN, Geneva,
A. Ferrari, Uppsala University,

for the CLIC study team

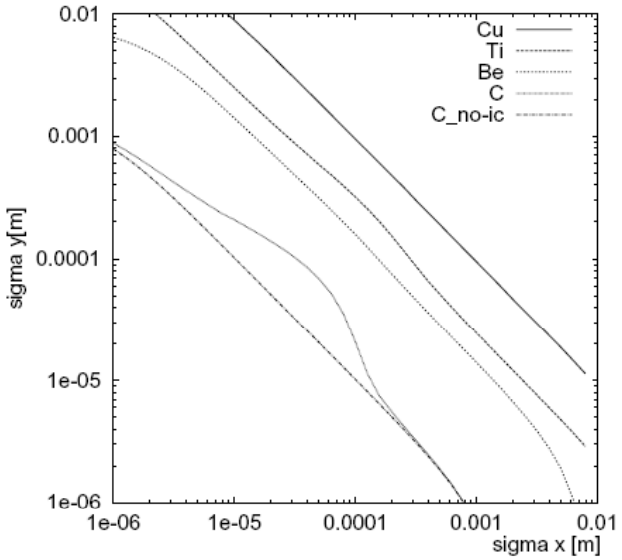


Figure 2: The boundary curve above which a full bunch train can impact the spoiler without making damage, independently of the impact parameter, with in abscissa the horizontal beam size σ_x and in ordinate the vertical one σ_y.

S. Fartoukh, J.B. Jeanneret and J. Pancin

CERN-SL-2001-012 AP
CLIC Note 477

Heat deposition by transient beam passage in spoilers

Design of CLIC coll. is based on damage threshold analysis
(Ohmic heating & standard dE/dz & thermal conductivity were considered)

However, for CLIC-short bunches there are new effects!

Exploring Ultrafast Excitations in Solids with Pulsed e-Beams

S. J. Gamble, M. H. Burkhardt
SLAC, Stanford University Department of Applied Physics

H. C. Siegmann, J. Stöhr
SLAC

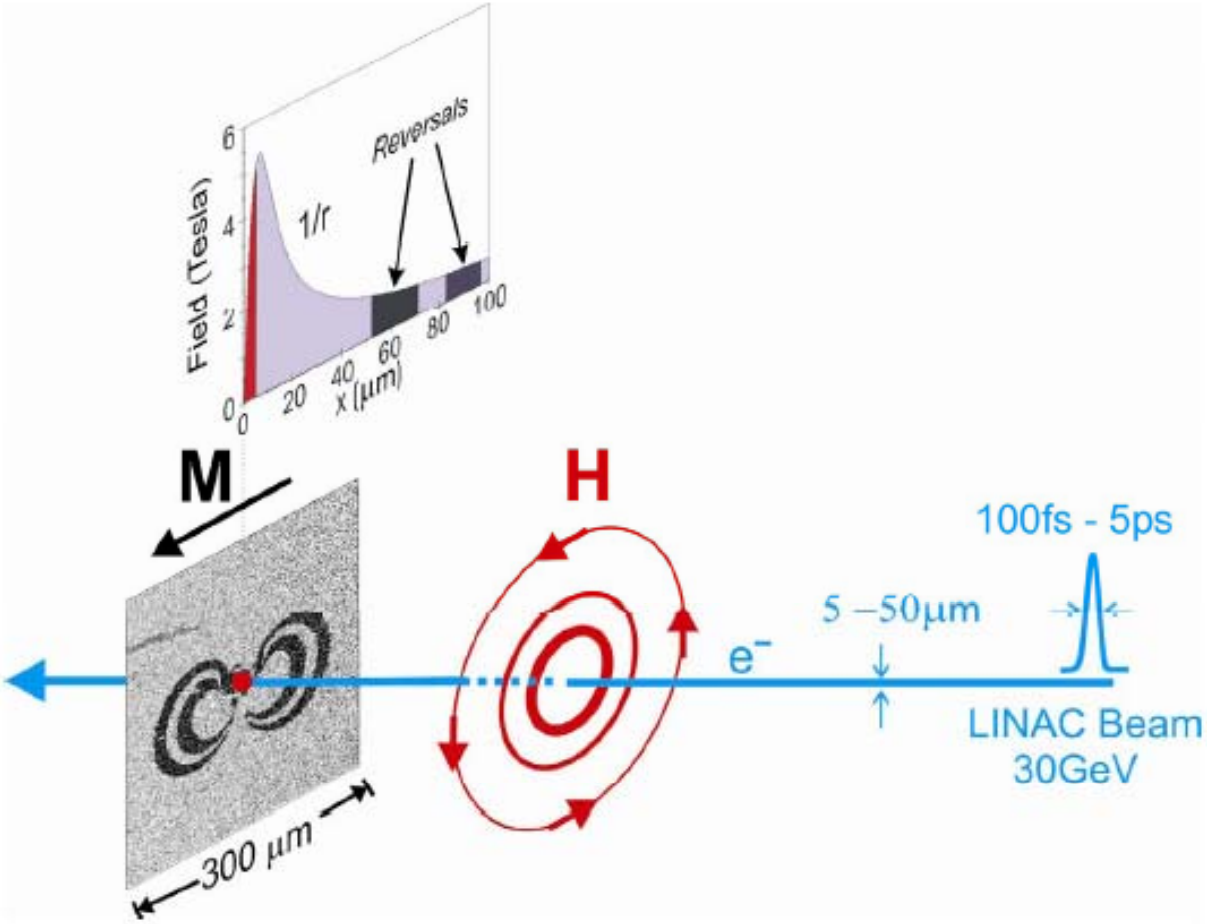
A. Kashuba
Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine

R. Allenspach
IBM Research Division, Zürich Research Laboratory

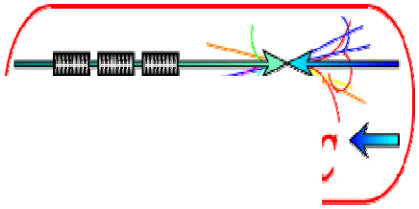
S. S. P. Parkin
IBM Almaden Research Center

Several next slides are from J. Stohr (SLAC), “Other Experiments using FACET ASF”, presented on Feb 19, 2008 at SLAC FACET review.
http://www-group.slac.stanford.edu/ppa/Reviews/facet-review-2008/Agenda.asp

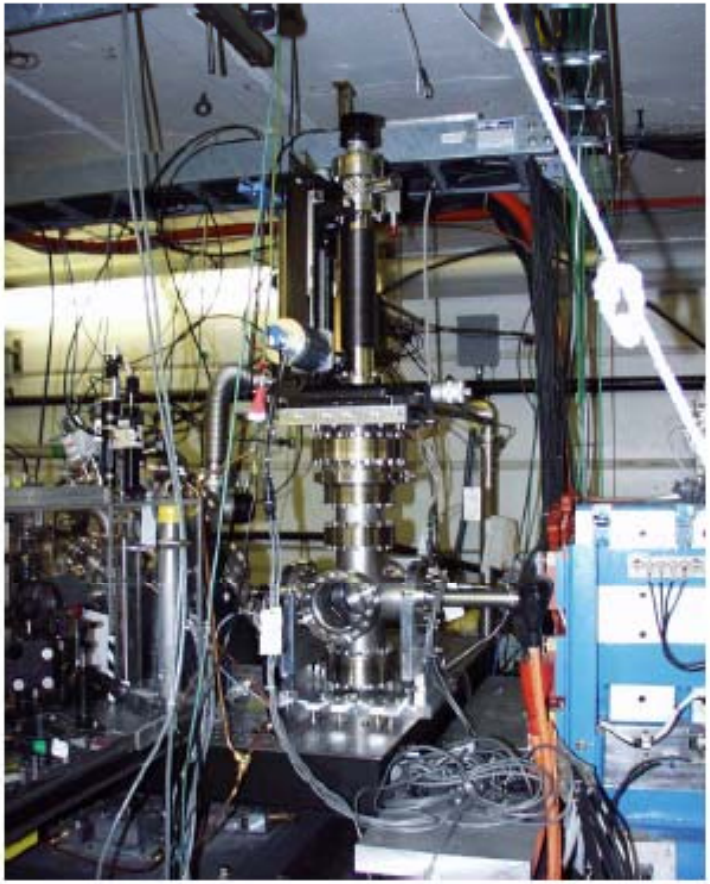
Experimental Geometry and Magnetic Field

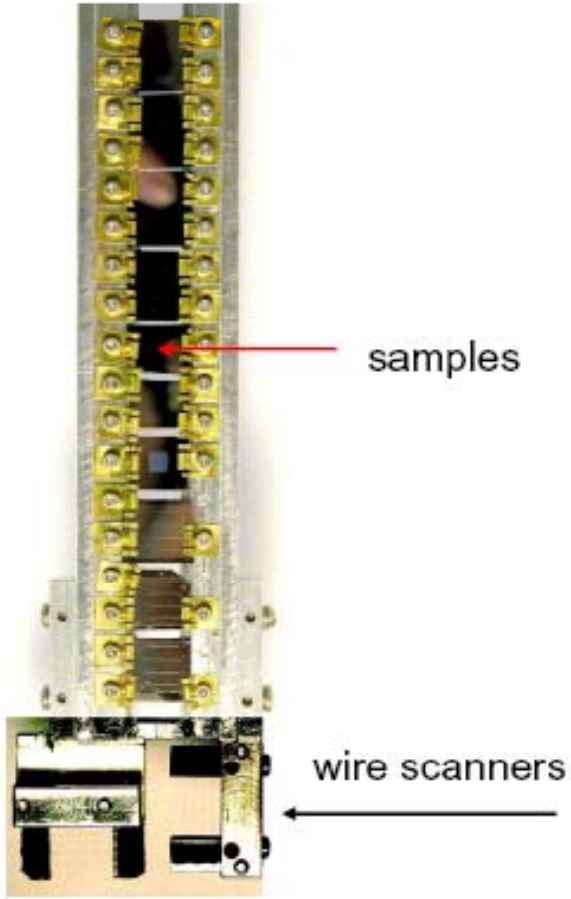


J. Stohr (SLAC), et al



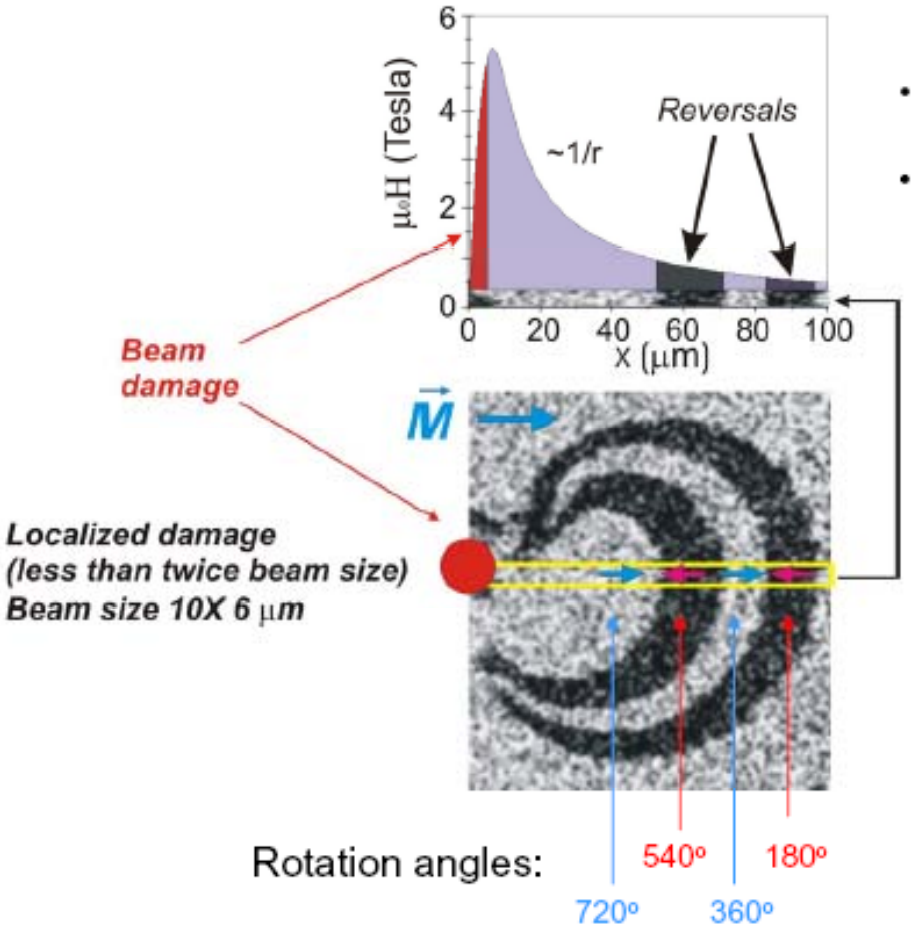
Experimental Setup in FFTB





J. Stohr (SLAC), et al

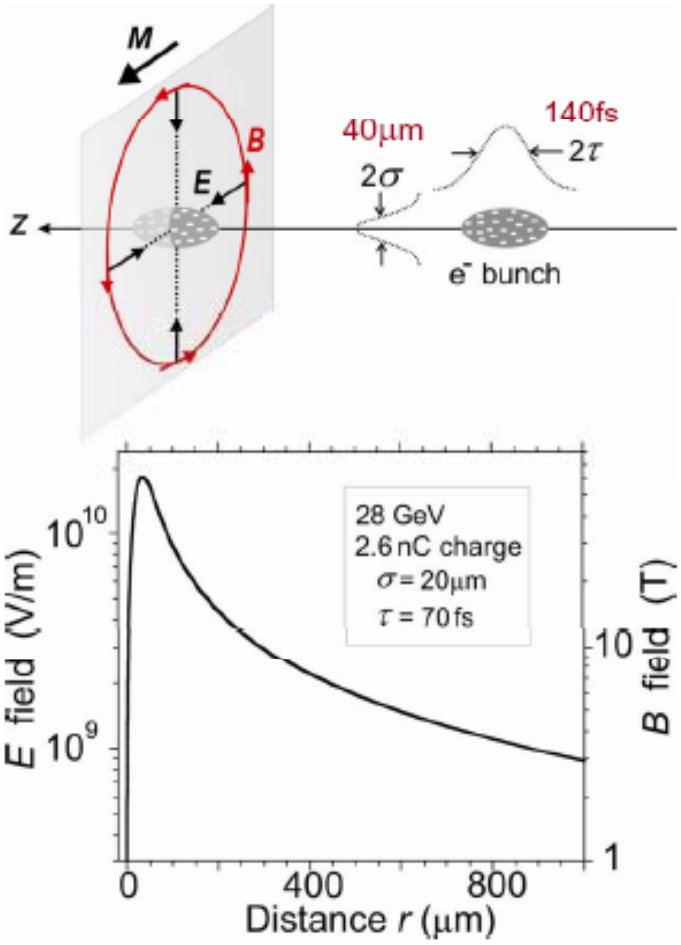
In-Plane Magnetization: Pattern development



- Magnetic field intensity is large
- Precisely known field size

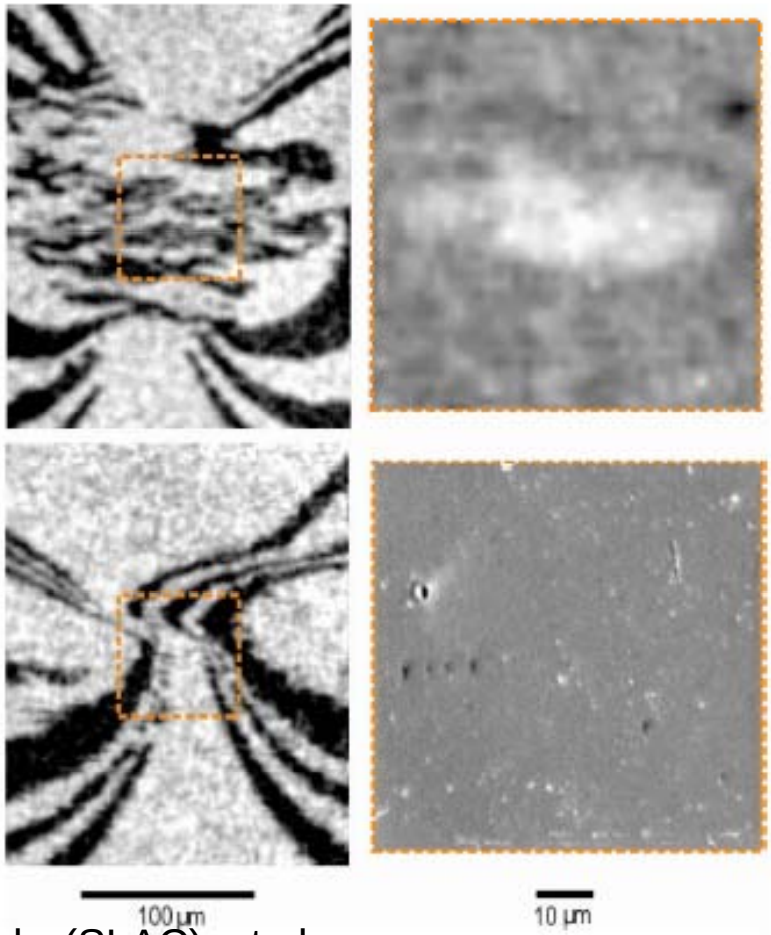
J. Stohr (SLAC), et al

Experiments with femtosecond bunches



J. Stohr (SLAC), et al **Observe two key new effects**

Ultra-short, ultra-strong field pulse shows no heating and damage



Pulse length: 4 ps

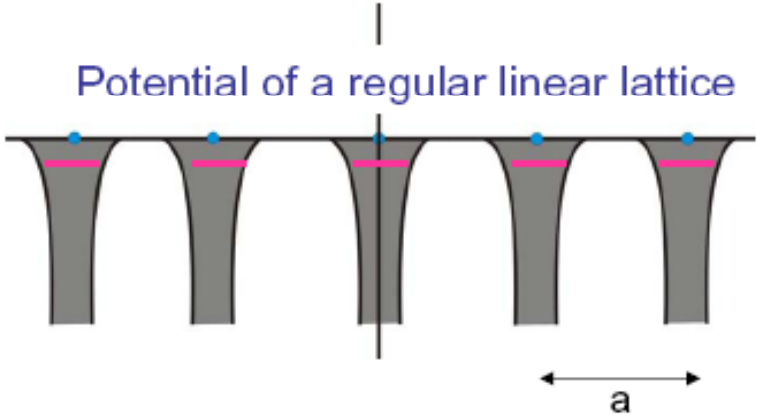
Pulse length: 140 fs

Peak field 35 times stronger

J. Stohr (SLAC), et al

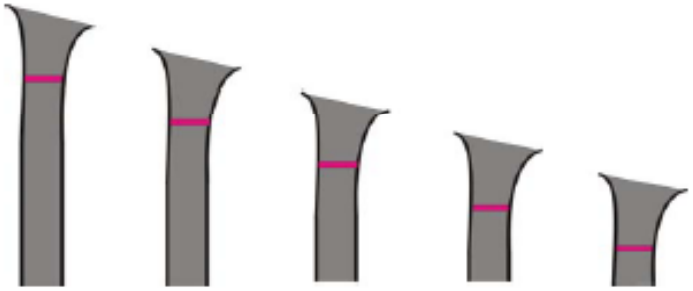
Electric Fields and Electronic Structure

Potential of a regular linear lattice



Co bandwidth ~ 3eV

Potential along E field direction



$E \sim 10^{10}$ V/m

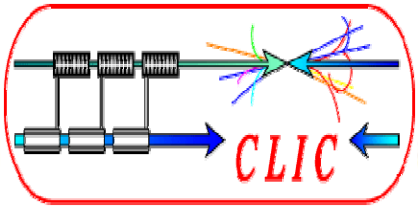
a = 0.25 nm

$\Delta V = e\,E\,a \sim 2.5$ eV

potential gradient leads to breakup of conduction path
no current flow due to field – not heating

J. Stohr (SLAC), et al

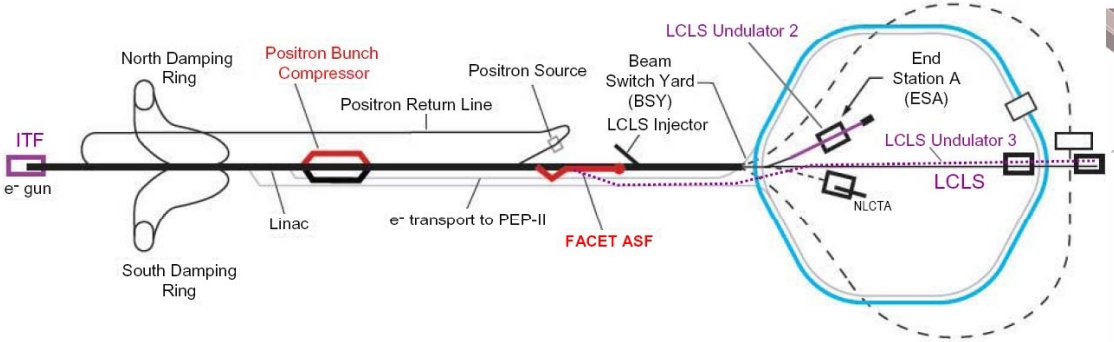
New effects

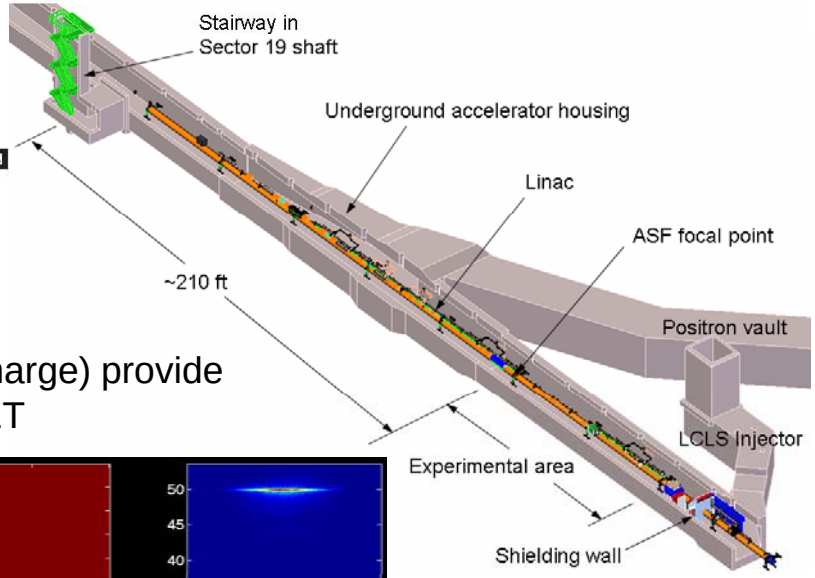


- Reduced damage due to short CLIC-like bunches
  - **(The energy still goes into the material, but probably dissipated via different mechanism (phonons?) on a longer time scale and larger volume)**
  - **This should allow smaller beams at spoilers and thus shorter CLIC collimation system**
  - **How far the threshold is moved out, is not clear**
  - **Also, multi-bunch effects are to be understood**
  - **Experimental tests, at facility like proposed FACET, would be helpful**

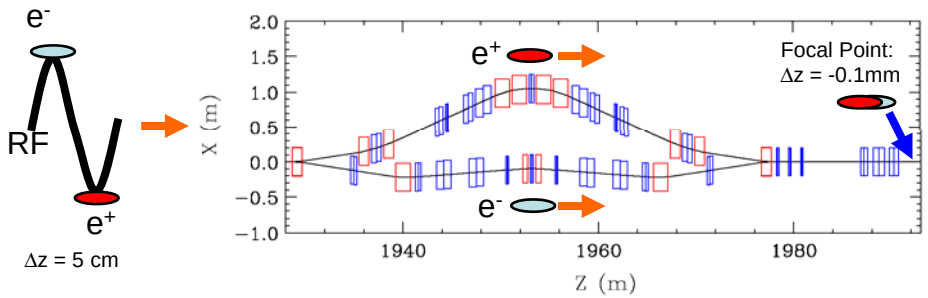
SLAC Duke UNIVERSITY UCLA USC PPA Particle Physics & Astrophysics

Facility for Advanced Accelerator Experimental Tests

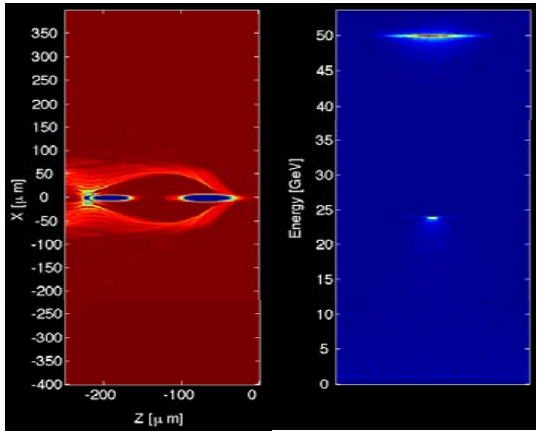




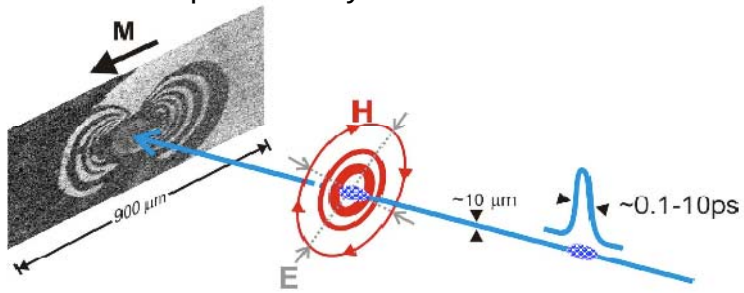
Unique properties of SLAC e+ and e- beams (ultra-short, high charge) provide worldwide unique opportunities for accelerator research at FACET



“Sailboat” dual chicane will give unique opportunity to study acceleration of positrons by an electron bunch



Two electron bunches formed by notch collimator will allow study energy doubling, high efficiency acceleration, emittance preservation

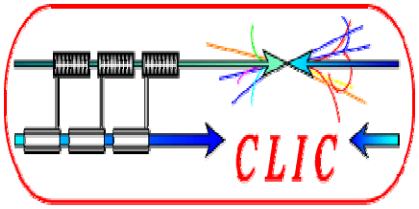


Short bunches and their Tera-Hz radiation open new possibilities to study ultrafast magnetization switching

Unique science opportunities for variety of fields:

- Plasma beam source for LC concepts or BES
- Plasma lens for compact focusing
- Bent crystal for beam collimation or photon source
- e+ and e- acceleration study essential for LWFA & PWFA
- Dielectric wakefield acceleration
- Energy-doubling for existing facilities such as FEL’s
- Generation of THz radiation for materials studies

Summary



- With short CLIC-like bunches, the damage threshold is moved out
  - **There is plausible explanation of the phenomena although further theoretical and experimental studies may be needed**
- This effect should allow the CLIC collimation system to become much shorter (or to have higher safety margin)
- Detailed verification of the new damage threshold would require further experimental studies at facilities like a proposed FACET