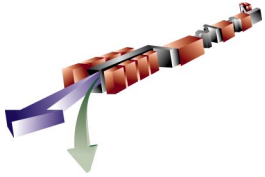# LCLS Linac Overview

## Vinod Bharadwaj
Stanford Linear Accelerator Center

- Vinod Bharadwaj –   Linac Overview   15 min
- Gennady Stupakov – CSR Effects- Theory   20 min
- Paul Emma –   LCLS Linac Update   20 min
- Mike Borland –   Update on Start-to-End   20 min
                                   Simulations

LCLS Linac Status

- Design Changes
  - Operational Modes
    - Diagnostics need to work for charge range 0.1-1.0 nC, with the possibility of routinely running at 0.2 nC.
    - Run "straight through" linac beam through LCLS linac on a pulse by pulse basis (new FFTB beamline and enclosure are planned to take advantage of this).
  - Bunch Compression Scheme (Emma, Borland)
    - BC1 & BC2 go back to being single 4-magnet chicanes
    - Add a sigle period superconducting wiggler before BC2 to kill microbunching
    - Significant additional effort into understanding CSR theory and its application to the LCLS design
    - CSR Workshop ….
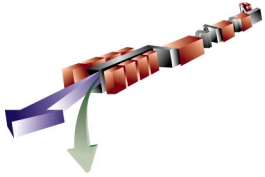
CSR Workshop Status

**ICFA Beam Dynamics mini workshop
(Future Light Sources sub-panel)**

Coherent Synchrotron Radiation (CSR) and its impact on the beam dynamics of high brightness electron beams.

January 14-18, 2002 at DESY-Zeuthen (Berlin, GERMANY)

Chairpersons: John Galayda (SLAC) and Joerg Rossbach (DESY)

Scientific Program Committee: Andreas Kabel (coordination, SLAC), Paul Emma (SLAC), Torsten Limberg DESY)

Organizing Committee: Philippe Piot (coordination, DESY), Torsten Limberg (DESY), Dirk Lipka (DESY), Frank Stulle (DESY)
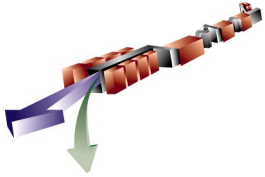
CSR Workshop (cont.)

SUBJECT:

Recent advances in modeling of coherent synchrotron radiation effects during bunch compression have underscored the importance of this phenomenon in the design of free-electron lasers and other high-brightness light sources. This ICFA Mini-Workshop (Future Light Sources sub-panel) will concentrate on computation and modeling of the effect of coherent synchrotron radiation during magnetic bunch compression.

ATTENDANCE:

Attendance is on invitation only. People wishing to attend the workshop may ask for invitation to either of the conference chairpersons.

REGISTRATION:

To register to the workshop, you should send an e-mail to christel.oevermann@desy.de before December 15th, 2001.
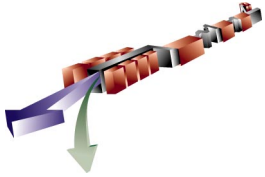
LCLS Linac Status (cont.)

- CSR and emittance preservation studies
  - LEUTL bunch compressor working
  - Mike Borland will present some results
  - SPPS compressor will come online next fall and can be used for emittance studies and measurement of the longitudinal wake (Krejcik's talk)

- CDR & Cost Estimate for Linac almost complete

- Transverse RF Bunch Length Monitor (PK)
  - No progress since last TAC, needed for the SPPS
  - transverse RF structure installed
  - need to RF wave guide to connect to klystron

- SLAC ESD has set up a task force to help with LCLS design issues and cost estimate – very helpful
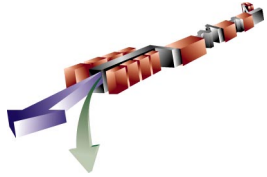
RF Phase & Amplitude Stability

- LCLS Design has very tight tolerances for RF phase stability in the various linacs
  - need 0.1 degrees S-band in L1, L2, amplitude ~ 0.1%
  - to what timescale is the RF stable to this level
  - can the RF be controlled to this level
  - can the control system be used for software feedback to control the RF to the level required for LCLS

- Since the last TAC (Jan 2001)
  - Further measurements of LLRF performance (RA)
  - Design of ORION laser and drive system. This work is applicable to the LCLS (RA)
 - Progress on SSSB
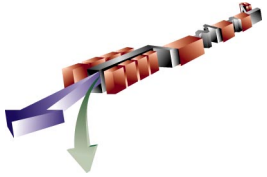
LLRF Plan

- R&D to design software feedback loops to stabilize the RF. SPPS will be useful for this effort.

- LCLS will need to develop new Master Oscillator and ability to send a synchronization pulse to the experiments (ORION work)

- Although we think that the RF system can be made to work with a few modifications it would be nice to get RF Design Engineer to analyze the present system and make sure it is truly adequate for the job.
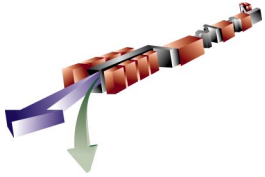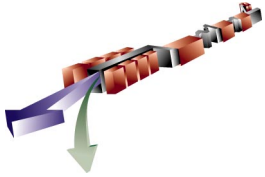
Start-to-End Simulation

- Ideal Final Goal – two independent programs or sets of program to simulate LCLS from the photocathode to the output of the undulator
    - Only one set of programs
- The electron bunch simulation programs will be Parmela and Elegant. Use SDDS for data transfer (both SDDS and Elegant are from Mike Borland/ANL)
- At present Parmela to 150 MeV, Elegant for the rest of the linac and beamlines, Genesis for FEL
- Works and is being used in simulations (*MB, PE, HDN, MW, CL, PK, UCLA, ANL ….)*

- *Mike Borland will talk about S2E status …*
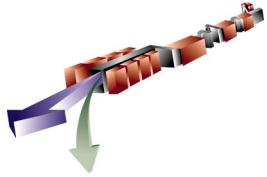
HEP/TEST Beams with LCLS

- LCLS scheduled for 75% time, SLAC would like
  - Dedicated HEP runs for 25%
  - Low rate test beams on demand during LCLS running

- Dedicated HEP Runs
  - Separate runs
  - Changeover less than a shift

- Test Beams during LCLS Running
  - Arbitrary pulse stealing at low rate from LCLS
  - New replacement FFTB beam line and enclosure proposed
  - maximum beam energy (~ 30 GeV)
  - Adds significant complication to LCLS bunch compressors
  - Need pulsed quads to linac to accommodate high energy beam

Linac Presentations

- Gennady Stupakov – CSR Theory

- Paul Emma – LCLS Linac Update
  - Superconducting wiggler reduces CSR effects
  - New full system tracking studies
  - CSR micro-bunching requires new compressors

- Mike Borland – Update on S2E Simulations
  - Review and update on S2E
    - use of Stupakov's drift-CSR formulae
    - addition of detailed simulation of photoinjector jitter
    - effects of the emittance correction quadrupoles
    - GENESIS runs take CSR instability seriously (many slices)
  - Possibility of blocking CSR with ultrathin foils
  - CSR experimental results from APS