

*Project Management**Lowell Klaisner, Max Cornacchia*Technical Advisory Committee (TAC) Meeting

The LCLS Technical Advisory Committee (TAC) meeting is Friday and Saturday, February 11 and 12. The agenda has been updated to make time for a tour of the facilities at SLAC. We expect to tour the sector 20 off-axis injector tunnel (location of the future LCLS injector), the FFTB tunnel (future home of the LCLS Undulator), the Gun Test Facility and other points in between.

The new agenda is :

Friday February 11, 2000

8:00 - 8:30 am	Continental Breakfast	
8:30 - 9:00 am	TAC Executive Session	W. Colson
9:00 - 9:15 am	Welcome and Charge to the Committee	K. Hodgson
9:15 - 9:45 am	Project Overview	M. Cornacchia
9:45 - 10:00 am	LCLS Parameters	H-D. Nuhn
10:00 - 10:15 am	Coffee Break	
10:15 - 11:00 am	FEL Physics and VISA experiment	C. Pellegrini
11:00 - 12:00am	Injector	J. Clendenin
12:00 - 12:45 pm	Lunch	
12:45 - 1:45 pm	Tour	L. Klaisner
1:45 - 2:00 pm	Break	
2:00 - 2:45 pm	Linac and Electron Bunch Compression	V. Bharadwaj
2:45 - 3:30 pm	Undulator	E. Gluskin
3:30 - 3:45 pm	Coffee Break	
3:45 - 4:30 pm	X-Ray Optics and Optical Pulse Compression	A. Toor
4:30 - 5:15 pm	Initial Experiments	I. Lindau
5:15 - 6:00 pm	Executive Session	W. Colson

Saturday February 12, 2000

8:00 - 8:30 am	Continental Breakfast	
8:30 - 9:00 am	Report on work at Los Alamos	D. Nguyen
9:00 - 9:30 am	Report on work at Brookhaven	I. BenZvi
9:30 - 10:00 am	Status of the LCLS R&D Budget	L. Klaisner
10:00 - 10:15 am	Coffee Break	
10:15 - 10:45 am	Report on the Conceptual Design Report	V. Bharadwaj
10:45 - 11:15 am	Plans for the next 6 months and summary	E. Paterson
10:15 - 12:15 pm	Executive Session	W. Colson
12:15 - 1:00 pm	Lunch	

1:00 - 3:00 pm	Executive Session and Report Writing (LCLS personnel will be available for discussions)	W. Colson
3:00 - 4:00 pm	TAC Closeout	
4:00 - 6:00 pm	LCLS Collaboration Meeting	E. Paterson

A dry run for the meeting is planned at SLAC on Tuesday February 8, 2000.
The agenda for the dry run is:

Dry Run Tuesday February 8, 2000

8:30 - 8:45 am	LCLS Parameters	H.-D. Nuhn
8:45 - 9:30 am	FEL Physics and VISA experiment	C. Pellegrini
9:30 - 10:30 am	Injector	J. Clendenin
10:30 - 10:45 am	Break	
10:45 - 11:30 am	Linac and Electron Bunch Compression	V. Bharadwaj
11:30 - 12:15 am	Undulator	E. Gluskin
12:15 - 1:00 pm	Lunch	
1:00 - 1:45 pm	X-Ray Optics and Optical Pulse Compression	A. Toor
1:45 - 2:30 pm	Initial Experiments	I. Lindau
2:30 - 3:00 pm	Status of the LCLS R&D Budget	L. Klaisner
3:00 - 3:30 pm	Report on the Conceptual Design Report	V. Bharadwaj
3:30 - 4:00 pm	Project Overview	M. Cornacchia

FY00 Funding

\$1.2 million of the LCLS FY00 R&D funds will be distributed as soon as we complete the addenda to the MOUs. These documents will be derived from the Budget Task Proposals and distributed by the end of next week (January 28, 2000). \$300K is being held back and will be distributed after the TAC meeting. This will allow adjustments to the priorities based on input by the TAC. We expect that there will be another TAC meeting in 6 months allowing a review of the TAC advice prior to the beginning of FY01. This will allow the first distribution of FY01 money shortly after the fiscal year begins.

LCLS General Seminar

We plan to hold seminars/discussions on LCLS topics about once a month. Typically, these will be held on a Monday afternoon (2:30-4:00). The first of such meetings, however, will be held on Friday, Jan. 28, 1:30-3:00 pm in the LOS (Bldg. 137) 2nd floor conference room. Paul Emma will talk on "Bunch compression parameters". The proposal is a set of parameters that is different, and an improvement, from the one described in the LCLS Design report. A discussion will follow. Please send Max any suggestions you might have of topics for future seminars.

Personnel

Carl Schroeder and Sven Reiche have joined the group as post-doctoral fellows on 1/3 and 1/18/2000. Carl resides at SLAC, in the LCLS trailer. Sven will work part time on the UCLA PWT photoinjector project, and part time on LCLS. The group has also a graduate student, Hai Jiang, who is starting now to learn about FELs.

VISA

The undulator installation in the ATF experimental hall has been completed, and the first beam was propagated through the undulator on 1/11/2000. Beam signals were seen on OTR and YAG screens within the undulator, and about 30 to 50% of the beam was propagated to the undulator exit. Another run has been done on 1/18 and two more days of running are scheduled for 2/1 and 2/2. The goal of these initial runs is to debug the system, check the diagnostics, and start to understand the beam matching and propagation through the undulator.

Beam slicing and matching

C. Schroeder, with help from Heinz-Dieter, Claudio, Sven, is looking at the possibility of designing a "beam-slicer", a system to scrape the beam in betatron space, at an energy of about 50 MeV, to reduce the charge and the emittance, while keeping their ratio constant. This approach would have the following advantages:

- a. Operate the photoinjector at constant conditions, and control the emittance and charge with the beam-slicer;
- b. Running at a reduced charge, like 0.2 to 0.3 nC, would reduce the wakefield problem in the linac and compressor and would make easier to get a good beam to inject in the undulator;
- c. Reducing the emittance would provide a better matching of the beam to the radiation; using the simple Xie scaling we obtain a gain length reduction of about 10 to 20%;
- d. The output power would be reduced like the charge, but this is not a problem, at least initially.

Problems to be studied are: matching of the beam to the radiation for the new transverse distribution; possible emittance dilution due to non-linearities in the beam optics in the beam-slicer and wakefield effects at the scrapers.

Harmonics

Zhirong Huang is evaluating the 3rd harmonic content of LCLS for the reference case and for the case of a larger emittance and operation with a fundamental line at 4.5A.

X-ray pulse manipulation

We will continue to work with the X-ray optics group to study the possibility of modifying the pulse length or the line-width of the X-ray pulse.

Photoinjector R&D News

J. Clendenin

A paper describing the "new working point" developed last summer during Massimo Ferrario's stay at SLAC is being prepared for the proceedings of the Workshop on the Physics of High Brightness Beams held at UCLA in October. This will be followed by a more comprehensive paper for journal submission that will go into the details of how this working point is to be applied to the LCLS photoinjector design.

GTF

Since reconfiguring the GTF laser to a dual head system as was done at ANL, the laser system has been operating quite steadily and reliably at high power. Presently laser work centers on characterizing and standardizing the optics systems (compressor, harmonic conversion, stacker, etc.) for their final configuration.

The streak camera (synchroscan unit only) is now working and integrated into the laser system.

An IR FROG is being commissioned.

The gun with the new Cu cathode is pumped down and the RF processed to 12 MW (adequate for 120 MV/m at the cathode).

AFEL

The LANL AFEL, configured with a modified version of the 2-m wiggler used for the LANL/UCLA SASE measurements a couple years ago, is being readied for a new SASE experiment designed to demonstrate saturation at 18 um. The first run in mid-December revealed several minor problems that have now been corrected. The second run is expected to begin next week.

Linac

Vinod Bharadwaj

Electron Bunch Compression Parameters

Paul Emma will present details of the proposed changes to the bunch compression scheme in a talk on Friday 28th. January 2000 at 1.30 PM in the LOS 2nd. Floor Conference Room.

Short Bunch Task Force

A task force to examine the generation of even shorter electron bunches than the nominal 280 fs FW has been convened led by Max and Vinod. This task force will determine the possible range of bunch length and charge of the electron bunches that can be incorporated into the LCLS design. This task force will work in parallel with the task force that is looking at optical compression of the X-rays.

Electron Bunch Tomography Workshop

A mini-workshop on special instrumentation for measuring temporal distribution of the electron beam in both the mm and 100 um and smaller regimes is being planned for March, most likely to be held at BNL. A formal announcement will be made soon.

General

Work has started on looking at the options for SLAC HEP test beams to the A-line during LCLS running. These beams will be an integral part of the LCLS CDR.

There have been meetings to look at the radiation safety, machine protection and beam enclosure access issues for LCLS running.

Undulator

Efim Gluskin

The undulator team is completing the series of magnetic calculations for the magnetic design of the undulator periodic structure and the focussing triplet. The calculations have been carried out using TOSCA and MERMAID 2-d and 3-d codes. G.Decker is studying the feasibility of the utilization of button BPMs (such as those widely used at the APS storage ring and FEL) as a beam diagnostics choice for the LCLS undulator line. He is planning to finish this study by TAC meeting in February. P.Emma is modelling the beam-based alignment procedure with the 5.4 meter long cell and triplet focussing. It is very likely that D.Waltz and all of us will get a break with the diameter of the vacuum pipe. The current plan to go with 1/4" SS pipe that much easier to get with the surface quality required.

We hope that by the time of the TAC meeting Heinz-Dieter and Nikolai will make at least several runs of FEL codes with the 4.8 meter undulator and triplet focussing.

Overall we are looking forward for to be prepared well to TAC meeting.

Time Compression/Slicing Optics

Roman Tatchyn is continuing to evaluate the effect of the FEL short temporal duration on various optical elements including transmissive optics, gratings and multilayers. Roman and Richard Bionta will present a paper on this effect in multilayer optics at the San Diego SPIE conference in last August. In addition, Roman continues the spontaneous radiation calculations.

Attenuation Cell

Dmitry Ryutov has developed a conceptual design for a gas attenuation cell. The same concept could be used to provide the FEL beam stop. The cell is a DC cell in contrast to the pulsed cell described in the Design Study. Basically the cell consists of several nested plenums with small apertures defining the optical axis. Each plenum is pumped separately. The vacuum loading is greatly reduced if the apertures in the inner plenum are Laval nozzles that are tilted to direct the gas flow off the optical axis. Dmitri has begun an engineering design to see if the total length of the attenuation cell and differential pumping sections can fit in the limited space between the collimating slits and the electron beam dump.

Rich London has examined the use of two rotating shutters to reduce the vacuum loading from a gas attenuation cell. Each shutter is a disk with a 1 cm diameter hole at a radius of 4 cm. One disk rotates at a rate that is synchronized with the FEL (~120 Hz) and the other rotates in the same direction at ~2500 Hz. Kinematic and strength analysis shows that for materials with strength/density ratios greater than 1 kbar/(g/cc) the vacuum loading from an attenuation cell can be reduced by a factor of 400. Materials that meet the strength/density criterion include Be, Ti alloys, epoxy composites and polymeric composites such as Kevlar. The advantage of the shutter system is it is compact. The disadvantages are the requirements for high-speed precision bearings and synchronization.

FEL/Matter Interaction

Richard Bionta has completed his model to calculate the FEL electric field amplitude, Gaussian waist and phase curvature at arbitrary locations downstream from the undulator for electron kinetic energies between 4.54 and 14.35 GeV. Richard has met with Heinz-Dieter several times to get clarifications on details and we now believe this model is appropriate to use for our dose and diffraction calculations. Richard has written up a technical note "Controlling dose to Low-Z Solids at LCLS" which will soon be forwarded to Heinz-Dieter for posting on the LCLS website.

Rich London has begun 1D hydrodynamic simulations of the interaction of the FEL at normal incidence with several low-Z solids including: Be, B and C.

Hutch Layout

Biweekly meetings with the Radiation Physics Group are proceeding. The R&D tasks for the next quarter have been identified and work is in progress. The tasks include:

- Dump magnet design
- Revised X-Ray Optics
- Mask design
- Stopper design
- Slit and collimator design
- Define PPS and EPS access and safety protocols
- Integration of new or redundant detectors into PPS system (e.g., field sensors for dump magnets, SR and gas-flow detectors for masks and stoppers)
- Radiation calculations through revised layouts
- Start of realistic code test calculations of thermal neutron flux
- Hutch design based on radiation calculations (wall and barrier composition, materials, thickness, dimensions)
- Drafting iteration
- Protocol manual

VISA Report from ATF Newsletter

Ilan Ben-Zvi

Only the VISA report is excerpted from the ATF newsletter for the week ending January 14th 2000. There is other news in the ATF newsletter that may be of interest to the LCLS collaboration and you are encouraged to read it.

VISA EXPERIMENT (REPORTED BY AARON TREMAINE)

On Tuesday, we propagated beam to Pop-in 1 which is just a silicon mirror without use of the BPM optic design. This is to get a baseline for expected OTR. We saturated one of the ATFs sensitive cameras with OTR. We then exchanged this camera with one of the VISA cameras and saw signal, not nearly as bright though. These pictures can be seen at Beam was then propagated to BPM 2 which includes collecting optics. BPM 2 has a YAG screen. Using a VISA camera we saw signal through the BPM optics but was fuzzy and improvement on alignment and focusing is needed. We need to do more study on the intensities seen. Just for fun we looked at the Faraday cup at the end of the beamline. While running and making minor upstream modifications, we saw that ~1/3 of the charge was making it downstream (about 250pC). Unfortunately, no profile measurements at the undulator end could be made so we really don't know what was being spit out the end of the undulator.

I would like to say that it took about 1.5 months from the time the undulator was inserted and aligned (late November) in the chamber to the first commissioning run on Tuesday. I think this was amazing progress-vacuum, controls, pop-ins, cabling ...etc. Without the help of Don Davis, Marc Montemagno, Bill Cahill, Bob Malone, John Skaritka, Pedro Frigola and Bob Harrington (Don and I worked most weekends!), I know our present status would not have been possible. Unfortunately, there is still much more to do on infrastructure and diagnostics.

Continuing, We were unable to look at the beam with the other Pop-ins. It is difficult to align the BPM optics without more modification to the magnets. Also, the prototype BPM has the two mirrors mounted so that there are tilt and rotation capabilities. The production BPMs don't have this capability and makes it extremely difficult to align. (Aligning with two mirrors and 1 degree of freedom on each mirror is tough.) We are working on modifications which give us the second degree of freedom on the BPM optical mirrors. The steering magnets were not tested with beam. They have been tested off line and some problems have been found. Currently, they are still being evaluated. The biggest problem is there seems to be around a 5 minute decay. Testing shows that when commanded to output 5 amps, the output ramps up to 6 amps and finally settles at 4.6 amps in around 5 minutes. If true, modifications will be necessary.

On Wed., it took the majority of the day to fix problems from the previous and when we were ready to run, there was a power problem with the controls. For next Tuesdays run, it is important to test out the steering power of the magnets. We need to know how many windings we actually need to give us the steering necessary for the beam in the undulator. In addition, we want to set up BPMs along the 4m and try to propagate as best we can. The Joule meter will be installed and well see what radiation we get out. In addition, there is a 2 week shutdown starting Feb. 7 and Robert will come out to do another laser interferometer alignment during that time. We'll try to get as much done as we can before then, but as expected with commissioning, it takes a runs to find out what else needs to be done.