LCLS Newsletter 27-Mar-2000

Project Management *Lowell Klaisner, Max Cornacchia*

The shielding and personnel protection system for the injector can be simplified by eliminating the mode that allows the LCLS injector to be operating while the linac tunnel is open. This means that the LCLS injector can not be operated during maintenance days and linac shutdowns. We would still have the mode that allows access to the injector while the linac is running. The working decision is to eliminate the first mode.

We have uncovered a number of expenses for the LCLS R&D budget that were not included in the earlier versions. The largest was $166,000 in SLAC indirect costs for FY99 and FY00 due to the way the money was transferred. Next was $52,000 for travel for members of the Scientific Advisory committee to two meetings. We have reviewed all of this and prepared the final budget for FY00, which is attached. There are no more LCLS R&D funds for FY00 beyond this budget. Any overruns will have to be covered other funds from the collaborators or the scope of work reduced.

LCLS General Seminar

There will be no seminar on Monday, March 27. The next seminar will take place on April 10 at 3:00 PM in LOS 2nd floor conference room. Ingolf Lindau will summarize the discussions and outcome of the LCLS Scientific Advisory Committee meeting.

Scientific Advisory Committee Meeting (J. Stohr)

The purpose of the meeting is to discuss possible scientific experiments for the LCLS and to establish a priority list based on scientific excellence and promise, with the goal of selecting about 5 experiments for the initial phase of the LCLS. Our marching orders from DOE are to prepare a document by September 1 that contains 5 detailed examples of scientific experiments. These experiments can be high risk, forward-looking ideas that would not necessarily be the basis of a normal research proposal - but, if successful, would lead to outstanding science. This document will be evaluated by a group of experts who will complete their evaluation in time for the next BESAC meeting, October 24-25, 2000. The evaluation will provide the basis for a critical decision point of the LCLS project.

Agenda for SAC meeting - March 30&31, 2000

Thursday, March 30: SLAC Training Center, Room C/D

8:00 am	Continental Breakfast	
8:30am	Keith Hodgson, Gopal Shenoy, J. Stohr	
	Charge to Committee and discussion of generic types of experiments	
9:30am	Bill Colson	Flexible capabilities of the LCLS FEL

9:50am	Max Cornacchia	Ultra short x-ray pulses
10:10am	Claudio Pellegrini	SASE versus seeding
10:30am	Break	

Space-Time Correlation:

11:00am	Keith Nelson, MIT , Four-wave mixing measurements with coherent x-rays: Ultrafast time scales and mesoscopic length scales
11:30pm	Jerry Hastings, NSLS, Four Wave Mixing
12:00pm	Mark Sutton, McGill University , Scientific Opportunities for Intensity Fluctuation Spectroscopy Using Coherent X-rays from the LCLS
12:30pm	Lunch

Pump-Probe:

2:00pm	Michael Wulff, ESRF, Structural snapshots of photo-induced biochemical and chemical reactions
2:30pm	Paul Champion, Northeastern (not confirmed) Femtosecond biological processes
3:00pm	Inuk Kang, UC Berkeley, Ultrafast time-resolved x-ray studies of lattice dynamics in solids
3:30pm	Robert Cauble, LLNL , Warm Dense Matter
4:00pm	Break
4:30pm	Discussion pump-probe issues

7:00pm Dinner, Left Bank Restaurant, Menlo Park

Friday, March 31 , SLAC Training Center, Room A/B

8:00am Continental breakfast

Non-Linear X-ray Processes:

8:30am	Denny Mills, APS, Non-linear x-ray science
9:00am	Discussion of non-linear x-ray physics

Flash Crystallography

9:30am	Janos Hajdu, Uppsala, Single molecule imaging
10:00am	John Miao, SSRL, Extending X-ray Crystallography by LCLS
10:30 am	Break
11:00am	Ian McNulty, APS , Flash imaging and related issues of damage
11:30am	Discussion of Flash Crystallography/Holography
12:00pm	Lunch

1:00pm Round Table on Experimental Stations and Facilities led by Andreas Freund:
2.00PM Arthur Toor, LLNL (not confirmed) Beam line optics
2:30pm Break

3:00pm Closeout Session:

Establish priority list of scientific experiments
Discussion of instruments for experiments
Discussion of "instrument development groups" – IDG's
Discussion of establishment of optics/beamline/detector group in support of IDG's
Time table for experiment write-ups

Photoinjector R&D News *J. Clendenin*

GTF Status

The Regenerative Amplifier is currently being reconfigured by Positive Light to more closely duplicate the ANL configuration: curved mirrors, 5 Hz. The Schott rods are also being installed. This work will probably necessitate a couple weeks of laser realignment.

Cathode Testing

The cathode testing apparatus will be taken to LLNL where the initial laser cleaning tests will be conducted. The plan is to first try cleaning using a large spot, high-energy IR laser. After these results are characterized, a small spot UV laser will be used.

Continuing the "tradition" of rapid reporting of other QE results, we at SLAC heard a talk by K. Nakajimi who showed data from NERL for QE = 1.4×10^{4} for a Cu cathode for 263 nm excitation. Interestingly, as the radius of the laser spot is increased, the QE drops.

Long Range R&D Plans

The basic R&D plan is, to first measure the emittance at 20 MeV for a shaped pulse using the present GTF system. Then the booster will be removed and the emittance out of the gun measured as a function of axial distance. Finally, the booster will be reinstalled at a location corresponding to the new, high-gradient working point and the improved emittance will be measured. This latter measurement will require an upgrade of the present XK5 klystron to a 5045. The present plan is to remove the booster and install the travelling emittance monitor during the summer 2000 shutdown. However, due to funding constraints, the rf upgrade will not take place before calendar 2001. This pushes the final confirmation of the new working point into late 2001 at the earliest.

Off-Axis Vault

Although the rf gun and L0 for the high-gradient design will itself fit in the existing off-axis vault, the matching section and diagnostics will require some enlargement of the vault. A possibility now being studied is to extend the vault toward the north by about 10 feet, and then install the injector along the northeast side of the diagonal, i.e., pointing toward the accelerator housing. A simple vault extension of 10 feet would probably be on the order of $100K.

A tentative decision has been made not to allow access in the accelerator housing when the photoinjector is operating. This will greatly simplify the PPS as well as lower the operating cost and space requirements. Since PEPII is expected to operate all but 1-month per year, this decision is expected to have little impact on commissioning or operating the photoinjector.

Access to the photoinjector vault while the accelerator is operating in any mode is still planned.

Linac *Vinod Bharadwaj*

We now have a complete LCLS lattice from the 150 MeV point to the entrance of the undulator. It is being tested using "elegant". Mike Borland is tentatively planning to visit SLAC in the week of April 17th. This lattice will be extensively tested during this visit using elegant and the start-to-end simulation will be put together at this point.

There is a plan to layout the injector at an angle of 45 degrees to the main linac axis. Design on such a scheme is being worked out to see if the beam degradation effects can be controlled.

Undulator *Efim Gluskin*

Alignment sensitivities to quadrupole displacements have been simulated for the FODO and Triplet lattices. If the criterion used to set the tolerance is a lengthening of the saturation length by one gain length, the lateral displacement tolerance for the quadrupoles in the FODO case is 0.65 microns. For the triplet case, three different displacement errors were considered: a transverse displacement of the line through the centers of the three quadrupoles, an angular error in the line of the three quads (i.e., equal and opposite transverse displacement of the first and third quads), and a transverse displacement within the triplet (i.e., the line through the quads is not straight). The tolerances found for these were 8 microns for the overall displacement, 15 microns transverse displacement of the first and third quads from the rotation, and 0.45 microns displacement within the triplet. N. Vinokurov is discussing the results with H.-D. Nuhn and P. Emma.

X-Ray Optics *Art Toor*

Experiment Hall: The LEH Planning Group, headed by Dave Dungan, met March 13. It was agreed that the X-ray Optics Group would develop an experiment-based floor plan for the Experiment Hall by the next scheduled meeting of the LEH Planning Group,

March 27. In the last two weeks the X-ray Optics Group has met 4 times to develop an initial layout. The layout differs from that in the Design Study in that it provides redundant experimental stations for both mirror beam lines and crystal beam lines in order to provide access to the experimental stations for setting up new experiments while experiments are being conducted. In addition, there are provision for two stations that would use the full intensity coherent and/or spontaneous radiation beams. The space requirements for generic optics and beam lines to conduct experiments in four separate categories were considered: 1) non-linear phenomena at x-ray wavelengths, 2) warm-dense matter, 3) biological imaging and 4) experiments using the coherent, broadband spontaneous radiation. Although definition of such experiments will eventually come from an iterative process between the SAC, the Scientific Experiments Group and the X-ray Optics Group, initial specifications are needed by the LEH Planning Group now to begin developing the cost and schedule estimates for the construction of the Experimental Hall. Using the experiments described above as the basis, an initial layout has been completed and the footprint for the Experimental Hall is approximately 75 x 35 meters. The next step for the LEH Planning Group will be to add the necessary number of offices, conference rooms, rest rooms etc and develop a more detailed plan for the two-story building. Concurrently, issues associated with the radiation shielding requirements, PPS stoppers, Masks and interlocks are being evaluated by the SLAC Radiation Safety Group.

The X-ray Optics Group meets March 23 to review the progress in defining experiments to investigate mirror reflectivity at energy loading near the damage threshold. Richard London presented his analytic considerations and Lasnex simulations for several energy loading levels covering the range from below damage threshold to several times greater than damage threshold. A lively discussion ensued. This work will continue to be refined over the next several weeks.

Troy Barbee has made some extremely high resolving power Layered Synthetic Microstructures (LSMs) using $MoSi_2$ / Si and WSi_2 / Si. The molybdenum LSM consists of 1,250 alternating 5-Å-thick layers of Mo and Si. For 1.5 Å radiation, the calculated reflectivity is 70% and the resolving power is 1000. Initial measurements at 8 keV determined that the resolving power was greater than 700, which was the limit of the x-ray source being used. Arrangements are being made with Richard Deslattes at NIST to perform a detailed calibration of this optical element this spring. We are also requesting time at SSRL to characterize several similar LSMs being developed for beam slicing applications.

The next X-ray Optics Group meeting will be held Wednesday, March 29. Bill Fawley will describe the physics and algorithms in GINGER.

VISA Report from ATF Newsletter *Ilan Ben-Zvi, Aaron Tremaine*

We were able to transport 100% of the beam (700pC) @ 71MeV with no corrector steering. In the diagnostic port just after the undulator we put an additional Beam Profile

Monitor. We also added an additional correction magnet just before the vacuum vessel and one after the last Quad in the matching section. Also a detector was placed down stream of the undulator to collect all radiation out of the end of the undulator. We saw a peak signal of 130mV (560pJ) that was fairly linear with charge. The detector not only collects undulator radiation, but OTR from the mirror in front of the Faraday Cup (~70pJ) and x-ray background.

We found the maximum transmission is associated with driving the beam through the center of the matching section (Quads). In addition, this gives the best spot size through the undulator. The alignment laser was used as reference point because it could be off as much as 200 microns. The beam at the entrance of the undulator measured in the matching section (~30 cm upstream of the undulator) was 90 microns using a YAG screen. Results from last years YAG vs. OTR test would put the beam around 70 microns or so because of YAG saturation.

We could get a good spot before the undulator, but changes in the matching section focusing would greatly change the spot size in the matching section as expected with much less effect in the undulator. We would see the core of the beam change in the undulator, but the overall spot size (~>150 microns) would appear relatively constant. We need to make sure that we are collecting just OTR and no undulator radiation in the undulator BPMs.