LCLS Newsletter 31-January-2000

Project Management ***Lowell Klaisner, Max Cornacchia***

LCLS Access to the FFTB Enclosure

Access to the FFTB tunnel for LCLS construction. Currently, the FFTB tunnel is being used for beam tests of advanced accelerator components - plasma focusing, plasma acceleration, materials research, etc. New experiments are being proposed and it is likely that this facility will be used actively until needed by the LCLS. The LCLS construction funding is expected in FY03. This will result in the LCLS taking over the FFTB tunnel around January of 2003. It will take around one year to clear out the tunnel and install utilities, piers, etc. Installation of the undulator and other beam line components could begin in January 2004. This is very broad-brush estimate of the schedule and, presently, is of most interest to people planning experiments in the existing beamline.

LCLS Seminar Meeting

An LCLS Seminar Meeting was held on Friday, January 28th. Paul Emma gave a presentation on "Bunch compression parameters". His proposal is for a set of parameters that is different, and an improvement, from the one described in the LCLS Design report. A discussion on the physics and on the mechanism for adopting a change in the LCLS parameters followed (see below). These meetings are scheduled to be held approximately once a month on Mondays at 3.00 PM. The next seminar meeting is scheduled for February 28th and will be about the possibility of generating short bunches at SLAC and their possible use in making intense spontaneous radiation.

Proposed Change of Parameters Procedure

Today we discussed the procedure for modifying the official parameters in the LCLS parameter list. We came up with the following procedure that we will use for now.

1. The relevant manager prepares a description of the change in a memo to the Project Manger, Ewan Paterson. This memo should include a brief description of the change, motivation for the change, and results of reviews. The change should list the existing parameters that will be affected and their old and new values.

2. The change should be reviewed by the Manager of the Parameters Group (Heinz-Dieter Nuhn). The change should be forwarded to Ewan with the approval of the relevant manager and Heinz-Dieter.

3. The change memo will be forwarded to all LCLS managers for their review. They will be given 2 weeks for comment or objection. Also, the change will be included in the biweekly LCLS newsletter for general comment.

4. After the review period, the Project Manager will consider the comments and approve the change if he concurs. Otherwise, he will return the request to the manager for further action.

5.

The Workshop is sponsored by DESY, ENEA/Frascati, ICFA, INFN/Frascati, KEK, LBNL, SLAC, UCLA. The Workshop Chairmen are Max Cornacchia (SLAC), Ingolf Lindau (SLAC/Lund Un.) and Claudio Pellegrini (UCLA).

Registrations and requests for information should be sent to the Workshop Coordinator, Ms. Melinda Laraneta, at laraneta@physics.ucla.edu.

Workshop Organization

The workshop is organized with two main working groups and subgroups. The two main working groups are:

1. Physics and technology of the XFEL. Group Coordinator: Alberto Renieri (ENEA)
2. Science with the XFEL. Group Coordinator: Brian Stephenson (ANL)

Each working group has a coordinator, who will organize the work of the group, including the formation of subgroups. The working group coordinators will give the final summary report on the last day of the workshop.
The workshop will be opened by four introductory talks:

1. Present status of the X-ray FEL. Speaker: Kwang-Je Kim (ANL)
2. Physics and technology issues for an XFEL. Speaker: Jamie Rosenzweig (UCLA)
3. Present status of experiments with short x-ray pulses, and/or coherent x-ray pulses. Speaker: Andreas Freund (ESRF)
4. What new science can we do with the XFEL? Speaker: Ingolf Lindau (SLAC/Lund. Univ.)

Additional talks will be presented during the workshop sessions, as plenary talks or talks for groups or subgroups. A room will be available for posters for the full duration of the workshop.

The Proceedings of the workshop will be published.

Housing will be provided at a local hotel, at walking distance from the XII century castle where the workshop sessions will be held. Lunch and coffee will be provided for the participants at the castle. A companion program with visits to local points of historical and artistic interest will be organized.

FEL Physics Section Report ***C. Pellegrini, H-D Nuhn***

See the VISA report excerpted from the ATF newsletter below.

Update : Comparison between the FODO and Triplet Focusing Structure

The performance of the Triplet focusing structure, as proposed by E. Gluskin and N. Vinokurov, is compared to that of the old FODO focusing structure using the Ginger simulation code. The Ginger code has been recently upgraded as part of the LCLS R&D effort to support separations between undulator segments as well as to support lumped focusing. The runs that are discussed here have been done for an ideal error free situation. The Ginger code does not yet support magnet errors.

The result of the simulations is that there is very little difference between the FODO and Triplet focusing structures. If any, the total power appears to be higher for the Triplet Structure at the 112-m point (the presently proposed end of the undulator structure including segment separations). More details are available from H-D Nuhn.

Photoinjector R&D News ***J. Clendenin***

Personnel Changes:

Ray Alley, a laser engineer in the SLAC Accelerator Department who has been providing important support for the GTF laser system, will be leaving SLAC next week for private industry.

Steve Gierman, who recently received his PhD for work performed with the AFEL at LANL, will be joining the GTF team in early February.

GTF:

The regen experienced a catastrophic rod fracture on Jan. 26th. Since going to the ANL-inspired dual head configuration last October, the laser has performed exceptionally well, producing on the order of 7 mJ output power routinely with relatively minor and infrequent problems. Interestingly enough, the APS, which operates at 6 Hz vice the GTF 2.5 Hz, experienced the same sort of failure only a few days earlier. Positive Light is presently evaluating the situation for both systems. We have one spare rod and a second slightly damaged rod that was only recently sent out to be re-polished.

Linac ***Vinod Bharadwaj***

New Bunch Compression Parameters

Paul Emma gave a presentation on the proposed new bunch compression parameters at the LCLS Seminar Meeting on Friday January 28th. The main features of this proposal are that the bunch compressor energies move (BC1 at 250 MeV and BC2 at 4.5 GeV) and the bunch lengths in the various L0, L1 and L2 segments are shorter. As before control of the beam distributions out of the injector are critical. The new scheme has considerable

advantages (contact Paul Emma for further details) and the Linac group will adopt this new scheme.

Short Bunch Task Force

Work is proceeding on the effort to extend the range of bunch length for the electron bunch from the nominal 20 microns down to 5 microns (RMS). There is hope that by using a smaller charge (0.2 nC or less) the emittance growth of the very short bunches can be controlled. In addition a scheme to provide the needed energy chirp (~1%) may be feasible.

Undulator ***Efim Gluskin***

The undulator team is continuing to prepare for the TAC review. The main task is to figure out how to cover in the 45 min. presentation several equally important topics: results of the magnetic design, SASE calculations and specifications based on these calculations, beam-based alignment, vacuum system, e-beam and x-ray diagnostics, etc. And it doesn't count any questions. We just need a lot of luck! We have established regular communications with the SLAC team to discuss the technical progress. G.Decker has visited SLAC this week to meet beam diagnostics people and start to develop the engineering design for the BPMs.

X-Ray Optics ***Art Toor***

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Optical Compression Task Force

A task force to examine methods to optically compress the 280 fs x-ray pulse to 50 fs or shorter has been convened by Claudio and Art. At the second task force meeting on January 27, Max presented initial calculations by Paul Emma that indicate an energy chirp of up to 4% can be imposed on the photon pulse. This is a preliminary finding, and if it turns out to be correct it is very good news, since it would allow most of the optical methods presently being considered to shorten an LCLS pulse to substantially less than 50 fs. Two separate pulse compression techniques, based on the use of dispersive optics to introduce a path difference of ~200 fs between the beginning and end of the pulse have previously been suggested by Claudio Pellegrini and Richard Bionta. Slicing of a chirped LCLS pulse using a single diffraction grating and a pinhole has been considered in earlier work by Roman and more recently by Richard. An alternative slicing technique based on reflection off a multilayer has also been proposed by Roman. Roman and Richard will continue to refine the initial calculations for all four concepts and examine the effect of the optics for each concept on the FEL beam parameters.

Instrumentation Development for LCLS Diagnostics

Roman Tatchyn has proposed a conceptual "multi-interferometer" approach capable of characterizing both the fine-scale temporal structure and total length of the lasing regions of an LCLS pulse on a single-shot basis. In principle, the method is applicable to pulses substantially shorter even than those generated by the LCLS. Calculations and studies of possible designs are in progress.

Absorption Cell Design

Dmitri Ryutov has completed preliminary calculations for a conceptual absorption cell design. A 25 cm length of xenon at about 75 Torr pressure will provide four orders of magnitude attenuation at 1.5 Å. With a 1 mm aperture the overall length of the cell could be kept to less than 1 meter and provide negligible gas efflux with a combination of 100 l/s pumping of the inner chambers and a lower rate of ion pumping just outside of the exit and entrance apertures. Further designs and calculations associated with increasing aperture size to ~1 cm and studies of potential molecular condensation problems are continuing. Possible adaptation of the basic design to serve as the beam stopper mask at the entrance to the X-ray optics experimental hall will also be explored.

Excerpts from the ATF Newsletter ***Ilan Ben-Zvi***

Observation of the Optical Klystron Effect in SASE (reported by XiJie Wang)

On Tuesday, January 4th, Marcus Babzien, Vitaly Yakimenko and I did a study of Optical Klystron on the SASE gain using the ATF HGHG setup. Bob Malone and I first laser-cleaned the cathode on Monday so that the QE of the Mg cathode now better than 0.1%. HGHG consists of three magnets. The first one is the short modulator undulator. The second one is the dispersion magnet consisting of a three magnet chicane, and the last one is the two meters APS undulator A. For our studies, there was no CO2 seed laser, the modulator was set on resonance at 5.3 um, and the radiator was set at 10.6 um. We first aligned the e-beam with an alignment laser, tuned the beam to match the radiator undulator. The figure below:

http://www.nsls.bnl.gov/AccTest/R0/1_14_SASE_OK.htm

shows the maximum SASE signal as function of the strength of the dispersion. During the measurement, the alignment of the e-beam and matching are kept constant. We believe that, to the best of our knowledge, this is the first observation of one order of magnitude SASE gain enhancement due to the optical klystron effect. Using optical klystron to improve SASE gain have been discussed by many authors, it could significantly reduce the technical difficulty of the X-ray SASE FEL, reduce the length and cost of the undulator. Furthermore, this scheme is compatible with HGHG seeded FEL. We intend to vary the modulator resonance frequency, to optimize this effect, and compare with theory.

VISA Experiment (reported by Aaron Tremaine)

We ran this last Tuesday. What we saw during the run was:

A Molectron detector was set up at the FEL mirror of Pop-in 8. When the flipper was down (no radiation from inside the undulator to the detector) we saw 50mV of background. When up (radiation from undulator gets to detector), we saw 400mV or about 1.7nJ (from the manufacturer's calibration). This radiation was linear with charge. Calculations show the expected amount of spontaneous emission expected for our angular and frequency bandwidth to the detector is about ~1.5nC. It appears that the measured energy is within error to the expected spontaneous.

BPMs: Our main mission here is to engineer BPMs with OTR. We can see plain OTR with sensitive Cohus and the Hitachi can give a reasonable signal. Also, the Hitachi does give an image at 4 (OTR+ BPM optics), but this signal is weaker than all the rest. It looks like the way to go is to use OTR/BPM with more sensitive cameras, but more testing is to be done. One note: We must be cautious not to confuse spontaneous emission with OTR through the BPMs (cameras) which would be very sensitive to the energies above.

Magnets: As discussed before, there is very little room between the steering magnet pole piece and the BPM optics. Removal of this pole piece leaves us with a C-magnet. The measured higher order effects from lack of symmetry gives a quadrupole field much less than a percent of the undulator field. It looks as though the near term solution is to run with a C-type steering magnet, but other solutions are being looked into. It may be down the line that 450 windings would not give the resolution needed, and may have to return to a lower winding. If it only takes ~150 windings to give the necessary steering, the steering magnet and BPM optics could co-exist. We are going to try this on one of the steering magnets. (We do have extra pole pieces).