LCLS Newsletter 28-February-2000

Project Management *Lowell Klaisner, Max Cornacchia*

LCLS General Seminar

There will be an LCLS seminar on "Schemes to Generate Femtosecond Pulses of Spontaneous Radiation at SLAC". The seminar will take place on Monday, February 28, in the 2nd floor conference room of Bldg. 137 (SSRL), starting at 3:00 pm. The speakers (15 min. each) are Joe Frisch, Patrick Krejcik and Pantaleo Raimondi. A discussion will follow, with Art Toor and Roman Tatchyn commenting on possible applications for the LCLS x-ray optics.

Photoinjector R&D News *J. Clendenin*

GTF Status.

We are expecting to make the first QE measurement with this (Cu) cathode within a few days.

Using Cleveland BBO crystals, we now have 300-500 μJ of UV for a >5 ps pulse. Since the IR is now about 5 mJ, the conversion efficiency is about 10%. There is an additional 15% loss in the transport to the gun and 10% at the final window.

The rf power is now up to 8-10 MW, which should result in about 90 MV/m at the cathode, sufficient for a QE measurement. At this level the dark current is about 0.05 nC per 300 ns macropulse. RF processing will continue. Goal is to reach about 14 MW with reasonable dark current.

The gun has an electropolished amorphous-Cu photocathode that was installed after baking using a N_2 bag. The Design Study Report indicated a QE of 10^{-5} as "conservative". (See the references in the Report.) At the ORION Workshop now underway at SLAC, Tom Cowen reported an initial QE with the Cu cathode in the new Falcon x-ray source is 10^{-5}. Dennis Palmer reports that the first test of the QE of the single-crystal Cu cathode at UCLA is 10^{-5}. At a QE of 10^{-5}, about 500 μJ of UV light is needed to produce 1 nC of charge.

The Mg cathodes now being routinely used at the ATF at BNL routinely have QE of 1-3×10^{-3} when illuminated with UV light. However, the thermal emittance using Cu cathodes illuminated with 260-nm-light is most likely 0.3 μm within, perhaps, a factor of 1.5. (See Clendenin et al., SLAC-PUB-8284 or LCLS TN 99-8 (October 1999).) Using the same analysis (G. Mulhollan, unpublished), the thermal emittance using Mg cathodes illuminated with 260-nm-light is most likely 0.6 μm. Thus the thermal emittance of Mg

may be too high to permit a study of sub-micron emittances, but for the routinely-operating LCLS with optimized emittance compensation, may be ok.

The cathode test chamber is in bake. This apparatus will be used to study the BNL laser-cleaning method as applied to the SLAC Cu cathodes.

Steve Gierman has arrived and joined the SLAC photoinjector R&D effort.

AFEL SASE Experiment.

The AFEL SASE experiment terminated about February 10 due to a problem in the HV PS for the klystron. The supply is being sent back to the manufacturer for repair, after which the experiment will continue.

Linac *Vinod Bharadwaj*

The start-to-end simulation system is close to completion. It is anticipated that we will use Parmela (LANL) up to 150 MeV and Elegant (Borland/APS) for the rest of the linac. Elegant was run using a million particles through LEUTL and took about 100 minutes of CPU on a PC.

There will a workshop dedicated to the measurement of short bunches held at BNL on March 3rd and 4th. The purpose of the workshop is to try to define the techniques that will be used to measure the phase space of the extremely short bunches that are anticipated in the LCLS and to define the needed R&D program. The workshop agenda is as follows.

LCLS Fast Instrumentation Miniworkshop

Location: Room A (upstairs), NSLS, Building 725, Brookhaven National Lab

Friday, March 3

Session Chair: Xijie Wang

08:45 - 08:55 *Welcome*, Peter Paul, BNL Deputy Director for Science and Technology

08:55 - 09:10 *Purpose of workshop,* Vinod Bharadwaj, SLAC

09:10 - 09:50 *Description of LCLS Instrumentation Requirements,* Paul Emma, SLAC

09:50 - 10:20 *Measurement Methods and Solutions I,* William Graves, BNL

10:20 - 10:30 Break.

10:30 - 11:00 *Measurement Methods and Solutions II*, Theo Kotseroglou, SLAC

11:00 - 11:40 *Measurement Techniques of the High Brightness Electron Beam in Five Dimensions Developed and Used at the ATF,* Vitaly Yakimenko, BNL

11:40 - 12:00 *Sub-picosecond Electro-Optic Detection of a Charged Particle Beam,* Dimitrios Nikas, BNL

12:05 - 12:45 Lunch

12:45 - 13:40 Tours of ATF and DUVFEL facilities.

13:40 - 14:20 *Coherent Off-Axis Undulator Radiation as a Bunch Length Diagnostic,* Charles Neuman, Duke U./ BNL

14:20 - 14:40 *Coherent Transition Radiation Measurements of Longitudinal Bunch Profile,* Aaron Tremaine, UCLA

14:40 - 15:00 *Software Tools Development at the ATF*, Robert Malone, BNL

15:00 - 15:20 Break.

15:20 - 15:40 *Short Pulse Generation in the SLC Arcs*, Josef Frisch, SLAC

15:40 - 16:20 *Bunch Length Measurements at APS/LEUTL*, Gil Travish, ANL

16:20 - 16:40 *Photo-electron Beam's Longitudinal Phase Space Tomography Studies at the BNL-ATF,* Shigeru Kashiwagi, BNL

16:40 - 17:00 *Experimental Comparison of Different Bunch Length Measurement Methods,* Xijie Wang, BNL

18:30 - ?? Dinner in Port Jefferson.

Saturday, March 4

Session Chair: William Graves

09:00 - 09:40 *Short Bunch Measurements at JLAB*, Kevin Jordan, TJNAF

09:40 - 10:20 *Bunch Length Measurement Methods Using a Laser Time Gate*, William Graves, BNL

10:20 - 10:30 Break

10:30 - 11:10 *NLC Timing Distribution System,* Josef Frisch, SLAC

11:10 - 11:50 *Femtosecond Transient Bragg Mirror,* David Reis, U. Mich.

11:50 - 12:10 *Bunch Length Measurements at SLAC,* Mark Hogan, SLAC

Undulator *Efim Gluskin*

N. Vinokurov continues to investigate different options for triplet focusing between undulators, with the goal of reducing the gain length. He is also reviewing several options with single quadrupoles focusing. R. Dejus is helping by working on the calculations for the different options. L. Moog continues to investigate the effect of using stronger magnetic materials in the undulator magnetic structure. LCLS management has set two deadlines: one for the completion of the investigation of focusing options by mid-March, and second for the final review of the undulator line magnetic lattice by the end of April. All activities are planned to meet this schedule.

VISA Report *Aaron Tremaine*

Robert Ruland and his team came out and did an alignment using the laser interferometer this last holiday weekend. They did a rough alignment and then the pop-ins were inserted. After insertion, the undulator was re-aligned to high precision (<30um) over the 4 m which is within the prescribed tolerance. Robert will give a more in-depth report shortly. It was found after insertion of the pop-ins the undulator moves upwards of 100 um in the wiggle dimension. During initial insertion of the pop-ins there is inevitable contact with the undulator and then fine adjustments of the pop-ins is needed so as not to make contact with the undulator.

The alignment laser (the laser used during running to propagate e-beam) was unable to be aligned. Without using the alignment laser there is little hope of e-beam propagation through the "sweet spot" of the undulator. The laser finder needed for this procedure had broken. It will be fixed and the alignment laser will be aligned next Tuesday. We will then re-connect the beamline surrounding the vacuum tank and begin pumping down - probably on Thursday starting the slow pumpdown process. We will definitely not be ready for our scheduled (see http://www.nsls.bnl.gov/AccTest/user-info.html) run days on March 3 or March 7. We will have to reschedule for the later part of the month.

The difficulty with which the pop-ins are inserted are making us consider changing the design. Now that we are convinced that OTR can work for us, there is no need to have a pop-in with a YAG holder. This makes it very probable to reduce the vertical dimension of the pop-ins thus giving more room between them and the undulator when inserted. Contact between the pop-ins and the undulator will throw off the micron level alignment. Also, we need to pay close attention during pump-down to see if the pop-ins make contact with the undulator due to this process.