Accelerator Systems Division Highlights for the Week Ending July 13, 2001

ASD/LBNL: Front End Systems

The hopes for good performance of ceramic-coated ion-source rf-antennae, raised by one successful test at low duty factor, did not hold up. As duty factors approached the nominal 6%, an alumina-coated version as well as an alumina/chromia-coated hybrid version both failed very soon, exhibiting rather systematic damage patterns. We will continue these tests utilizing antennae coated with 'electrical grade' porcelain by a Knoxville manufacturer.

In addressing simulation results by LANL and SNS-ORNL staff that showed significant beam losses in the Linac, we submitted a new particle distribution to LANL that is based on measured emittances but was somewhat collimated, consistent with the action of a narrow aperture at the RFQ entrance.

RFQ Module #3 was conditioned to full gradient at half-nominal duty factor and has now been equipped with two power couplers, enabling it to reach the full duty factor of 6%. The recently brazed RFQ Module #4 had a substantial vacuum leak across one brazing interface, at its downstream end. After examining various repair scenarios, we cut off 3/8" of the entire structure at this end, and the leak totally disappeared. The difference in length can easily be compensated for by properly designing the end plate that has to be attached to the structure in any case.

The first of two 80-kW / 2-MHz 'production' amplifiers for the Ion Source has been received from the vendor and is being prepared for testing at LBNL. Likewise, amplifiers # 4 and 5 (out of 6) for the MEBT Rebunchers have been received.

ASD/LANL: Warm Linac

The CCL hot model continues to receive daily attention. Both cavity segments are now at LANL and were tuned (Fig. 1). The pi/2 modes in the two segments are tuned to within 20 kHz, and the stop bands to within 15 kHz. The coupling is the same to within 1 part in 570. C. Deibele, SNS-ORNL, participated in the tuning measurements. The bridge coupler also arrived at LANL and is undergoing vacuum checks. (WBS 1.1.2.2)

Fig. 1: CCL hot model tuning.

A preliminary design review for the SRF linac transmitters was held at the vendor's facility. Both LANL and ASD personnel were present. Results were satisfactory. While there, we were able to monitor progress on the RFQ/DTL transmitter production (Fig. 2).

Replacement SCRs for the prototype high-voltage converter modulator (HVCM) have been received and are being installed. (WBS 1.4.1.2)

The build-to-print converter modulator RFP package is complete, approved by management, LANL QAR, ASD, and it was submitted to procurement. (WBS 1.4.1.2)

Rick Martineau was at SNS-ORNL this week to come to closure on action items recommended by the DTL FDR Committee. (WBS 1.4.2.2)

Fig. 2: SNS 402.5 MHz klystron water cart (left) and high-voltage enclosure (right). Aluminum Box on top right of the enclosure is a high-voltage resistor housing that simulates the impedance of a klystron. Box on top left is the interface box where all signals enter and leave the tank.

Kirk Christensen was at SNS-ORNL this week to discuss acceptance criteria for the CCL mechanical systems developed by ASD, and also to present the LANL response to the CCL PDR. (WBS 1.4.4).

SNS-ORNL staff, including D. Jeon, E. Tanke, and S. McKenzie, visited LANL this week to conduct dark current radiation measurements around the LANSCE DTL. Data will be used to implement personnel protection controls on SNS, and to estimate radiation damage effects on elastomer seals. (WBS 1.4.2 and 1.4.5)

In preparation for commissioning activities, the ORNL visitors and the LANL physics team received code writing training from the LANL EPICS control group. (WBS 1.4.5)

The 3-D space charge routine from Saclay, PICNIC, has been incorporated into the PARMILA linac simulation code. (1.4.5)

We received a new, improved beam distribution from the Berkeley group, which utilizes an apertured LEBT. We are beginning TOUTATIS simulations of this beam. (WBS 1.4.5)

John Mashburn from the SNS QA Office visited LANL for two days to conduct a QA audit of our records and document practices. (WBS 1.4.6)

The LANL project controls team, in careful coordination with their SNS-ORNL counterparts, successfully implemented all LANL PCRs approved through June 29. This accomplishment has ensured that the ETC baseline is consistent with LANL expectations. (WBS 1.4.6)

ASD/JLAB: Cold Linac

The Final Design Review for the Warm Compressor and Gas Management System was held, as was the second of a series of meetings with ASD on installation, commissioning and operations planning. The 100% design documents for the CHL were reviewed and comments provided to the A&E.

Fabrication of transfer line components continues.

The 2nd prototype medium-β cavity assembly is complete, after the end groups were modified to provide supports for additional cavity stiffening.

Fundamental Power Coupler preparations are complete for modification of the length of the inner conductors of the first pair of prototype couplers, and welding of the second set of inner conductors, on schedule for the next series of coupler tests at LANL in August.

Tests of the HOM coupler orientation in the high-β copper cavity are complete, having shown that the optimum orientation is the same as that found for the medium-β cavities.

Design of the HOM cabling is complete.

First article magnetic shields, multi-layer insulation blankets and cavity string vacuum valves have been received. The first article end can heat exchanger passed its cold-shock test and has been sent to the end can manufacturer for incorporation into the first article.

The manufacturers of the He-vessel, space frame, thermal shield and vacuum vessel were all visited during the week.

ASD/BNL: Ring

Efforts are underway to provide a bottoms up “ETC” (up to equipment handoff) for all electrical and mechanical systems.

RF Systems and Diagnostics are being reviewed as possible candidates for additional early handoff between BNL and SNS/OR.

Power supplies for the chromaticity sextupoles have been added to the procurement package for the medium range power supplies.

An order has been placed for the (8) HEBT dipole magnet stands. Delivery should match magnet production.

A request for best and final bids has been issued for the Ring System collimators.

Bids for the BPM production contract have been received and are being evaluated.

Magnetic field quality measurements were completed on the pre-production 17D120 Ring dipole with and without its welded stainless steel vacuum chamber assembly. Similar measurements are underway for the 21Q40 with its vacuum pipe and BPM assembly.

Scott Seberg and Joe Tuozzolo conducted a pre-production meeting to address half-cell assemblies. The assembly of production dipoles was officially started this week at BNL.

Completed a final design review of the Injection Dump Septum Magnets.

The bid package for the 30Q44 and 30Q58 Ring quadrupoles is complete but on hold awaiting the addition of a foreign vendor, per the direction of the SNS Project Office.

Danfysik reported that they have completed the winding of a first article coil for the 27CDM30 corrector magnets. We expect vendor delivery of a first article magnet in August.

Tesla reported that a first article HEBT dipole core is set up for final machining and a wound coil is being prepared for epoxy potting.

Recent photos:

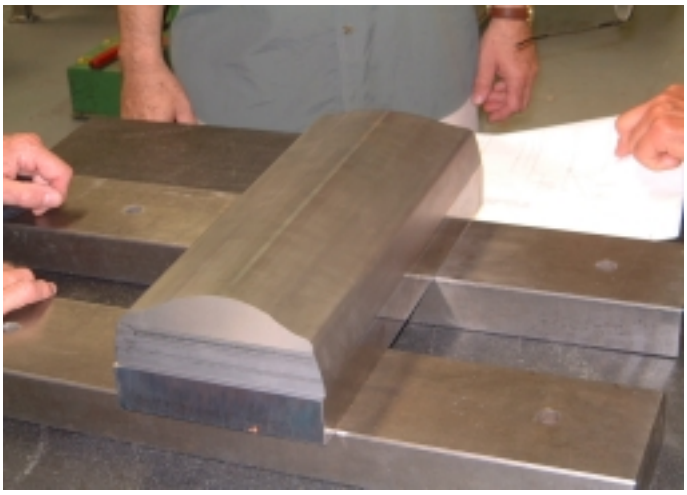

Photo #1: 21Q40 “test” pole piece (Tesla) – July 01

Photo #2: Three wound coils B4 epoxy impregnation (8D533, Tesla)
July 01

Photo #3: First article coil for 27CDM30 (Danfysik) – July 01

Controls:

The Final Design Review for the Warm Compressor and Gas Management portion of the CHL Integrated Control System was held at Jefferson Lab on July 11, 2001. Comments from the previous review were satisfactorily addressed. Design information including descriptions of interlock logic and sample EPICS control screens was presented. No serious concerns or issues were raised. Approval was given to proceed with procurement and fabrication. Procurement of hardware was started.

The Programmable Logic Controllers (PLCs) provided by the Central Helium Liquefier Warm Compressors are to communicate status and control information to the SNS provided Warm Compressor and Gas Management (WCGM) PLC via ControlNet. In the December 2000 Warm Compressor Design Review, the Vendor agreed to supply information concerning the transfer of data via ControlNet. This data is needed to complete the WCGM PLC software design. After numerous requests, the data was finally received.

Sverdrup submitted cabinet fabrication and wiring drawings for the Ring Injection Dump utilities. We plan to complete the Target Utility drawings by the end of August.

The transition module for the MPS P2 connector to MPS chassis is complete and in house. The printed circuit board was designed and built at LANL. Testing of the PMC board for the MPS system using an MVME2773PPC board has been successful using factory test software. Problems still persist using the MVME2100PPC board.

A Linux console was set up at Berkeley, and all EPICS tools demonstrated on it. Began process of migrating from DM2K to EDM.

Group 3 drivers were demonstrated on the MVME-2100 PowerPC VME board. The balance of Group 3 hardware for MEBT rebuncher 402.5 MHz 20kW amplifiers was ordered.

The interface to all models of Ion Pump for RFQ and MEBT through PLC/EPICS/Flex-I/O was tested.

Modifications are being made to the hot model at LANL to verify the model of the resonance cooling loops.

A Fortran interface to EPICS Channel access was completed, and training was given to Accelerator Physicists at LANL.

A vendor site visit was made to Maxwell. The June, then July software integration test will now be made in September.

Large array support is working in EPICS 3.14 for the EPICS database. This does not support any portable server application yet.

A series of aiming meetings were held to resolve the issue of parsible signal names. A revised database table schema will be available this coming week. A tool for importing into Oracle and verifying names is operational. It is also available to build names directly into the relational database. This tool is capable of taking a name and giving a report of the meaning of the name. Long EPICS database names have been tested and appear to work in EPICS base. Each client will need to be tested and verified individually. The archiver and EDM have been tested – some issues remain.

ASD/ORNL: Integration

Installation Support

Hand-off Planning: Draft acceptance criteria for the high voltage converter modulator was sent to LANL for review/comment. ASD personnel reviewed the proposed CCL criteria with LANL personnel, and everyone was in agreement regarding the proposed criteria and process. Criteria for the cryomodules was drafted and sent to JLab for review and comment.

The CM QA manager briefed ASD personnel on discuss current inspection & review activities on the construction site. ASD will identify those items requiring additional confirmation for incorporation into an acceptance criteria listing (ACL). Weekly site walkthroughs also will begin.

Accelerator Physics

John Galambos, Jeff Holmes and S. Henderson attended the Snowmass workshop, to participate in the session on high intensity proton drivers. This participation allows communication with the other world efforts aimed at operating, designing, and building high intensity sources.

D. Jeon and E. Tanke are at LANL to participate in the CCL testing.

The ring injection kicker ceramic pipe coating is being studied and the proposal of using a thin conducting strip of gold appears to be satisfactory for shielding the beam from the kicker impedance and from eddy current induced heat loads.

Tracking studies indicate that he RFQ may not be an efficient filter, and the possibility of using a scraper at the chopper is being considered.

A permeability budget is being collected for the entire machine to monitor anything magnetic.

Operations

Ion Source Group

A microscopic analysis revealed practically no porosity for the two-layer antenna coating obtained from the Knoxville, TN, Cherokee Porcelain Enamel Corporation. We hope that this coating provides extended antenna lifetimes as this coating has performed well in other electrical applications.

We continue to transfer LBNL information to ORNL as needed to develop the hot spare stand. Especially helpful is Sonali Shukla's long list of items which she identified during her LBNL stay, and which were previously overlooked.

Rahul Rauniyar completed several series of ion source model calculations with PBGun. Rahul's results show that the inner diameter of the electron dump could be reduced to approximately 12 mm without significant ion beam losses. The ion beam emittance does not increase if the electron dump voltage is reduced by roughly 10%.
With another calculation Rahul showed that if the voltage of the second Einzel lens is lost, the beam diameter at the entrance to the RFQ would roughly increase from 6 mm to 10 mm, but the ion beam would not hit lens #2.
In addition Rahul made a few calculations that show that optimizing the shape of the extraction aperture can lead to significantly lower emittances, as suggested by Jack Boer.

Jack Boer, the author of PBGun, is in the process of improving his code to minimize the artifact that leads to hollow beams. This is essential for improving emittance estimates.

As a first installment, the RATS building crew has installed the hot spare stand fence and grounding plate, as one can see in the attached picture behind Sonali Shukla and Rahul Rauniyar.

RF Group

Processed PCR and generated requisition for high voltage power supply to support JLab coupler and cavity testing. Anticipate order for supply to be in place in early August.

The rest you'll get in the LANL report (that's why I've not been sending you much since being out here).

Cryo Transfer Line Group

Mechanical Group

Magnet Measurement Group

The first HEBT Dipole is scheduled to arrive in September. Magnet Mapping is busy with manufacturing and assembling a six meter long search coil system that will measure HEBT Dipoles.

We have also done some investigation concerning Rebar and possible problems with magnetized Rebar.

Last week the RATS magnet and power supply water-cooling system was commissioned.

Power Supply Group

Ken Rust visited IE Power in Toronto 27 - 29 June, 2001 to witness the prototype injection kicker power supply acceptance tests. While considerable progress has been made, the power supply was not ready for a formal

acceptance tests due to problems in its control circuits. As this is a prototype of a very complex solid state kicker supply, this is not unexpected. The power supply did operate properly into an inductive load, but without full feedback. We expect a final acceptance test in a few weeks.

The group provided input to the Operations group on expected Mean Time Before Failure for power supplies.

The Front End systems MEBT LLRF Design Review Report (held 5/10/01) was completed.

Below is a progress report on the foil development project at Oak Ridge that started May 1,2001:
Diamond SNS Stripper Foil Progress Report
7/11/01
Robert W. Shaw and Charles S. Feigerle

We have initiated a new project to prepare and test thin chemical vapor deposition (CVD) diamond films as stripper foils for the SNS. Robert Shaw(ORNL) and Charles Feigerle (UTK/Chemistry) are the principal investigators. Preliminary results from Brookhaven National Laboratory (BNL) have indicated that diamond films may serve as stripper foils that survive longer H- beam exposures without failure than traditional carbon foils. The roughly 1 micrometer thickness (350 microgram/cm2) needed is a problem because, for the partially unsupported foil geometry required, conventional diamond films are not dimensionally stable. Several approaches will be investigated to overcome this problem. These include synthesis of nano-crystalline (as opposed to micro-crystalline) films, and growth of ribbed films through the use of micro-machined sacrificial substrates.

Several trial film growths have been undertaken at UTK. These have been centered on hot filament powered reactors, but with reactant gases high in rare gas content. The conventional gas mixture for diamond growth is 0.5 to 1.0% methane in hydrogen. For these experiments, that C/H ratio was maintained, but the reactants were diluted using 80 to 90% argon. This mixture is purported to yield nano-textured polycrystalline diamond, that we suspect will exhibit reduced residual stress and will be more dimensionally stable. Films have been prepared and analyzed using scanning electron microscopy (SEM) and Raman spectroscopy. The former showed particles of <1 micrometer diameter, while the latter exhibited the a phonon mode characteristic of nano-structured material. The films grown to-date are thicker than 1 micrometer (~ 8 micrometer); improved control of nucleation density and growth conditions is required before a thin uniform film of this material can be produced. Currently we are re-designing the growth chamber to be more amenable to the filament and substrate temperatures required for growth in this regime and to improve reproducibility.

The effort at ORNL has centered on substrate preparation for enhanced nucleation density and design work for conversion of a hot filament reactor to a microwave-powered system. CVD diamond films grow by nucleation, followed by particle enlargement until continuous films are attained. Thus to grow thin, nano-textured films as described above, it is critical that the nucleation density be maximized. Nucleation site preparation on growth substrates (typically silicon wafers) is typically achieved by mechanical scratching using diamond paste. We are exploring this and other methods for substrate preparation to enhance nucleation. Approaches include ultrasonic bath wafer treatment in diamond powder slurries and chemical etching. The roughened surfaces that result are analyzed using SEM and atomic force microscopy (AFM). Films will be grown on these substrates to determine nucleation densities.

Many of the nano-crystalline diamond preparation reports have utilized growth reactors excited using microwave power. We are investigating the feasibility of converting the ORNL hot filament reactor to such a system. We visited the Materials Science and Engineering Department at the University of Cincinnati to examine a microwave-driven chamber similar to what we envision here. Contacts have been made with microwave hardware vendors to uncover the modifications of our reactor needed to adapt it for the microwave equipment.

Finally, we have characterized a commercial diamond film that was used for H- beam lifetime testing at BNL. The Raman spectrum of that film showed the band characteristic of crystalline diamond, while the SEM images showed a continuous film exhibiting rounded (i.e., poorly faceted) crystallites in the 250 to 500 micrometer size range. This sample is currently undergoing transmission electron microscopy (TEM) analysis to provide further information about its texture and crystallinity.

Survey and Alignment Group

Beam Diagnostics Group

LANL SNS Beam Diagnostics Report:

BPMs: Matt Stettler returned from his trip to BNL, where he left a working version of the prototype PCI motherboard. Work continues to test the electronics and fabricate the DTL pickups. The DFE rev. 1 has been tested as much as practical without the FPGA's. Testing will continue when the FPGA's are ready. The cable for inside the DTL drift tubes will likely be braided polyethylene. The connectors will be retrofitted with non-Teflon insulating material if they cannot be purchased this way.

SCL inter-segment region: JLab has selected an 80 lps vacuum pump with a 3-inch pipe leading up to the beam box. The beam box design will be enlarged 0.5 inches longitudinally to accommodate the change in pipe diameter (the former diameter was 2.5 inches).

Work continues to prepare for a wire scanner PDR on July 17 and a D-plate PDR on July 18.

BNL SNS Beam Diagnostics Report:

1.5.7.1 BPM: Central Shops has submitted a rebid on the BPM PUE fabrication, evaluation of the response in underway. HEBT BPM first article PUEs returned from the braze house with a golden sheen, result of exposing to atmosphere while still too warm. Parts fit together OK, no deformation detectable due to residual thermal stress from shock. Evaluation of Matt's digital board is progressing

1.5.7.3 BLM: Analog electronics fabrication and testing continues.

1.5.7.4 BCM: A breakout board has been ordered from an outside board maker to improve delivery schedule. Completed boards are expected middle of next week

1.5.7.6a Carbon Wire Scanner: Preparation for the wire scanner review next week. Vibration, repeatability, and accuracy testing continues on the MEBT wire scanner.

1.5.7.6b Laser Wire Scanner: The BLIP 200 MeV Laser Profile Monitor (LPM) has been temporarily delayed by a schedule change at the Irradiation Facility. We are investigating when the next opportunity will open to install the scanner. A group member attended a laser school at MIT this week.

ORNL SNS Beam Diagnostics Report:

Saeed went to LANL to participate in x-ray spectrum measurement studies on the first two LANSCE DTL. The results will be published later. He has also made an arrangement with the Fermilab run coordinator to repeat the same measurements on Fermilab's LINAC. Craig is at LANL and Dave is at LBL to learn EPICS.