

Accelerator Systems Division Highlights for the Week Ending January 31, 2003

ASD/LANL: Warm Linac

HIGH-POWER RF (WBS 1.4.1.1)

Accomplishments: (1) The first 5-MW 805-MHz Thales klystron is in the socket in the LANL test stand. Connections are complete and it has been brought up to ready for high voltage. We will hook up the converter modulator on Feb 3 and start work. The second klystron is in its factory acceptance test and looking good. (2) We are near completion of the 96-hour heat run on the E2V 2.5-MW, 402.5-MHz klystron. We expect to be completed during today's second shift. (3) Four tested 550-kW, 805-MHz CPI klystrons and magnets were shipped to ORNL. (4) We finished the test of a 402 MHz load. (5) We completed traveling-wave tests of a pair of 402 MHz DTL windows. Standing-wave tests are scheduled for late next week or early the following week. (6) Factory acceptance tests of the first production SC linac transmitter continue.

HIGH-VOLTAGE POWER CONDITIONING (WBS 1.4.1.2)

Accomplishments: (1) The prototype high-voltage converter modulator is back to high power operation; we have supported test stand operations as much as possible. Operation has been nearly perfect over the last 8 shifts. Concerns & Actions: (1) In getting the converter modulator back to high power operation after the multi-week shutdown, we experienced several glitches. The IGBT switch plate failed Sunday morning due to assembly problems with the bolts on the IGBT buss plate "lamb-chops". A faulty water-cooling quick disconnect caused multiple over-heating trips before the problem was localized. In chasing the overheating trip problems, we extensively examined the IGBT driver board as the main possible cause of thermal trips. We have learned the driver board is very robust, even with 300% overload. System protects also work as designed. (2) Some of the recent improvements (capacitors, *etc.*) appear to have brought the desired result. The modulator ripple is now within specification, giving ~1% peak-to-peak klystron output RF phase shift (ripple). We need to confirm the measurements with a spectrum analyzer.

DRIFT-TUBE LINAC (WBS 1.4.2)

Accomplishments: (1) All tank three drift-tube cap weld ring repairs have been completed through the welding stage (Milestone DTL 3-1 Complete) and the drift tubes returned to CMI for clean-up profile machining (Fig. 1). Two units have been finish machined and inspected with a further five finish machined. The drift tube final leak checking, flow testing, magnet mapping and cleaning operations are set-up and have begun processing repaired tank 3 drift tubes. (2) Thirty additional tank one diverters are being prepared for first brazing step; braze is scheduled to begin January 31. (3) The first ten tank one drift tube bodies with diverters brazed in place have all been leaked checked with 100 psi helium internal pressurization; all passed and have been dispatched to CMI for internal cavity machining or final profiling in the case of the solid empty units. (4) An additional nine tank one drift tubes with diverters fitted to bodies have been received for brazing; these units will be prepared for brazing scheduled on Feb 3. (5) Tank one "Fast prototype" 1TAR1-1 DT diverter braze and water channel welds have been vacuum leaked checked (post cap weld) with 100 psi helium internal pressurization. No leaks were detected. In addition, the contained PMQ was mapped; the G1 product and harmonics were found to be nominal. The fast prototype has been returned to CMI for final profile machining (6) Machining continues at CMI on the internal features for the two halves of Iris/RL waveguide for tank one. Waveguide halves for tanks two, four, five and six are in various stages of rough machining. (7) All tank-3 DT mount "top hats" are at the plating vendor; five have been plated. Twenty-four tank-1 top hats have also been sent to the plating vendor. (8) The fitting of the first batch of tank three post couplers was delayed but it is now projected they will be dispatched on Monday, Feb. 3 to ESCO for final e-beam welding (stems to body). (9) Leak checking of the tank-3 drift tubes will proceed over the weekend; flow checking, magnet mapping and final cleaning will commence Feb. 3. We will endeavor to ship out four DT's by COB Feb. 5 with four or more shipped each following day. We will continue until complete. The last one shipped will likely be the dummy BPM 3-2 as it is still being built; it may not arrive in Oak Ridge until the week of the Feb. 24. Concerns & Actions: (1) The attempt at electroless nickel-plating repair of the temporary tank 3-iris/RL waveguide that developed the water to vacuum leak during final cleaning was completed and was unsuccessful. The leaks are apparently too large to repair with the electroless nickel-plating method; other approaches to sealing the leaks are being considered.



Fig. 1: DTL fabrication (clockwise starting at upper left): (a) iris/ridge loaded wave guide being rough machined; (b) ring weld repaired tank 3 drift tube being finish machined; (c) batch of tank one drift tube bodies prior to diverter brazing preparation; (d) tank one drift tube body being prepared for diverter brazing.

PHYSICS & DIAGNOSTICS (WBS 1.4.5)

Accomplishments: (1) Work continues on transforming the ring injection stripper foil transverse acceptance back to the DTL. Initial results indicate a restriction in the horizontal acceptance at the DTL entrance. The vertical acceptance is less affected. (2) We are performing beam PIC simulations with errors to analyze the consequence of relaxing the longitudinal position of the DTL PMQs. If acceptable, it will reduce manufacturing costs.

ASD/JLAB: Cold Linac

In spite of vendor confirmation of its performance, in the electropolish cabinet, the acid pump still fails to provide the required flow. The vendor has agreed to supply larger diameter valves and piping to reduce system pressure drop. The new components are expected to arrive early next week.

The component thought to be needed to repair the eddy current scanner is expected from the vendor by the end of next week.

Primary and secondary charcoal bed heaters for the purifier have been powered up and successfully tested.

Cryomodule M-1 assembly continues with completion of superinsulation, insertion of the cold mass into the thermal shield and attachment of nitronic rods in preparation for transfer of the module load from cavity string tooling to the space frame. See photo.



Figure 1 Production Cryomodule M-1 in Assembly.

Three cavities were qualified, and M-2 string assembly has been completed. A problem with the sealing surface on the all-metal valve at one end was resolved by replacing the valve. We are presently correcting a small leak at the central Fundamental Power Coupler port.

Three cavities are tuned and have helium vessels completed in preparation for qualification for cryomodule M-3.

ASD/BNL: Ring

Project and Division Directors from the SNS Project Office were at BNL this week. Visitors included T. Mason, C. Strawbridge and N. Holtkamp. In addition to BNL/SNS facility tours, T. Mason gave an SNS status/update presentation to all BNL/SNS project staff.

Project Office personnel are assisting the Group Leaders develop their ETC inputs and schedule changes. Spreadsheets further defining pending PCRs were developed and forwarded to BNL and ORNL personnel to assist in final decisions.

Bob Lambiase and Steve Savatteri (BNL electrical tech) have made plans to travel next week to our vendor, IE Power, located in Toronto, Canada. The purpose of their visit is to test the 1st article Medium Range PS and help the vendor on remediation of read-back noise and output ripple.

Danfysik reported that they shipped their first article RF Tune PS to BNL earlier this week.

Field measurements continue on the 21Q40 magnets. A total of eighteen magnets are now fully measured (18/29).

Our new large aperture harmonic measuring coil was cross calibrated with a 41CDM30 magnet earlier this week. Coil and readouts work fine.

36CDM30 – our vendor (NETC) asked that we return this rejected magnet to their facility for rework. The magnet was crated this week and is due to be shipped today.

Chicane #4 field mapping – first iteration with a “z” bump is complete.

Half-cells – assembly of units #2, 3 and 4 are in progress. At least one of these assemblies will be shipped to SNS/OR in February.

Weekly meetings continue with our production vendors: BINP (quads), Tesla (quads), SDMS (collimators), Alpha Magnetics (sextupoles and corrector magnets) and Stangenes (quads).

- BINP is planning to ship quad magnets in March.
- Tesla is working on Ph II quad production and Ph I spare parts.
- SDMS - agreements have been reached on the geometry of Ring #2 and #3 collimator beam pipes. Work continues on the HEBT collimators; work planning is underway on RTBT collimator #1.
- Alpha – testing of the 1st article 26S26 is underway at the factory. They plan to ship this magnet to BNL next week.
- We are working with Stangenes to resolve “out of tolerance” issues related to the 26Q40 magnets. QA data and assembly options are being reviewed at BNL.

Controls

Installation

Craft Snapshot 1/29/03

ASD craft workers	48.0
Foremen, ES&H, etc	9.0
Less WBS 1.9 controls	2.0
Less absent	4.0
TOTAL	51.0

A major Maintenance/Rework period will begin at 0800 on 2/3/03 when the current Operations run on the FES is completed. Focus of this work early in the shut down is the DTL water systems for ASD and the first DI Water Room for CF. Rework the RFQ water system from hose to hard piping down was authorized this week. It had not been planned for this is period.

Waveguide installation continues to progress at a rapid pace. Work is currently in process on the SCL_MB6 waveguide system. This work and the CCL system work are being impacted by the lack of tested circulators and RF loads.

The Division Director's Weekly Installation Meeting on Friday 1/31/03 was a detailed review of the schedule and planning for DTL #1 and DTL #3 installation. The plan presented meets the IPS Activity ID DTLNK31 "Install and Test DTL Tank (#1)" EF date of 21MAY03.

Mechanical Engineering has completed an upgraded Klystron Hall General Arrangement Drawing which incorporates lessons learned on the early systems, actual dimensions of racks, cooling carts, etc., and future maintenance considerations. The drawing will be issued for comments in anticipation of Group Leader approval late next week.

Accelerator Physics

Operations Group

We have been running commissioning studies. The schedule is on the Operations website as is the Operator Schedule. The scheduled running is one day late on published schedule. We are still on schedule for a shutdown Monday the 3^d at 08:00. We will complete high current emittance scans and will move to a High Power test.

Problem areas include:

- Timing/MPS system
- LEBT Choppers
- Timing parameters lost with reboots

Problems with EPICS Screens, problems to be solved by Archiver.

A Commissioning Lessons Learned meeting was held on Thursday at 3:30. Minutes will be published.

An ARR Action Tracking report was submitted to DOE

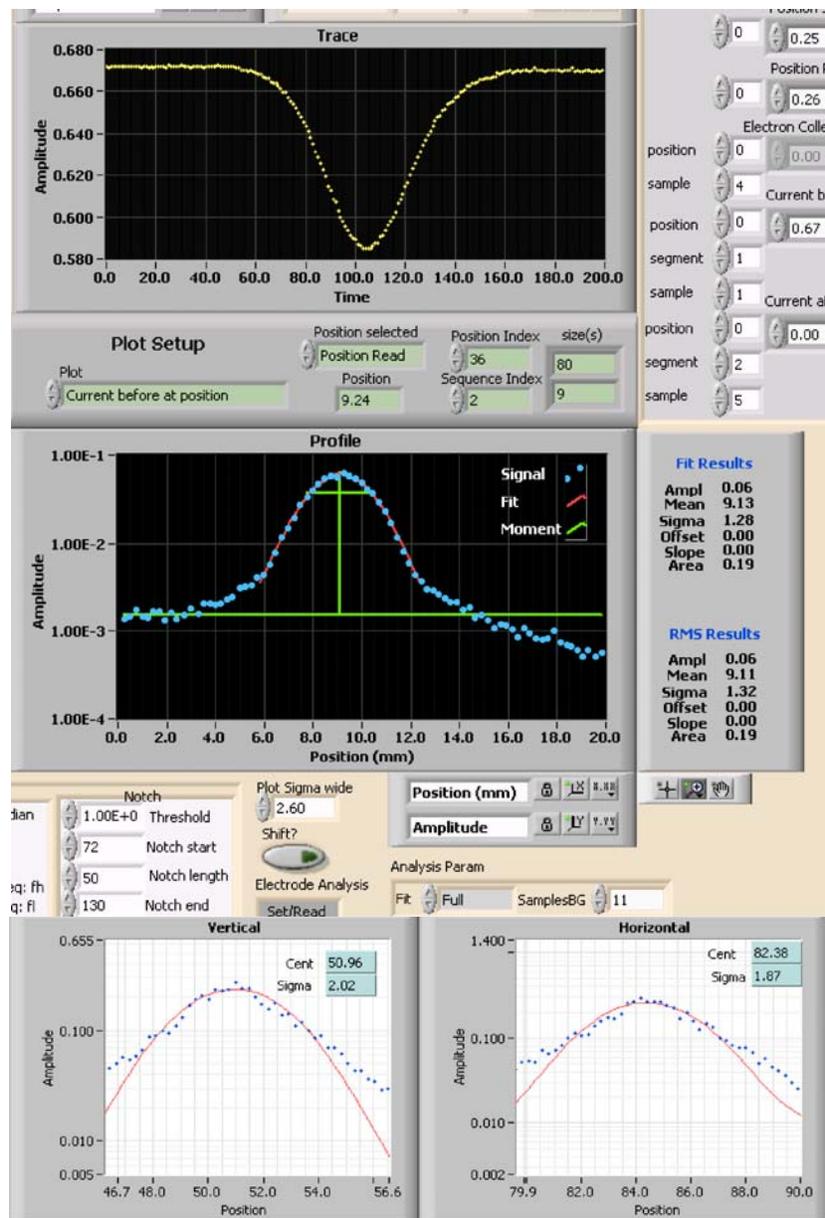
A revised ARR Plan of Action (Rev 1) was approved by DOE

A revised CLO Laboratory and office allocation plan, by floor plan layout was distributed to the to Group Leaders for comment.

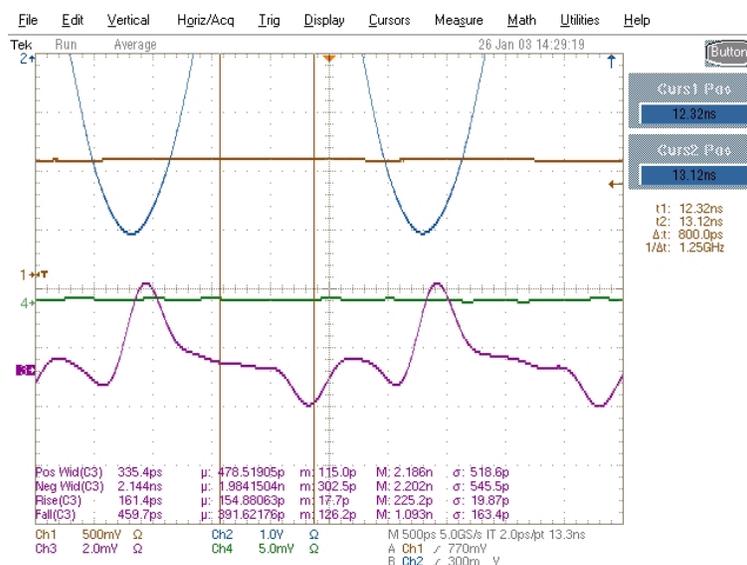
A Maintenance Planning template was sent out to group leaders. There was some objection to its being organized by BARCODE number. However, it was discovered that the ETS Report by Technical Contact could be exported into EXCEL from ETS. This can be sorted by Group, subgroup, sub-subgroup and filled out. Maintenance plans are due by Feb. 10.

Commissioning Progress Starting Friday January 24, 2003:

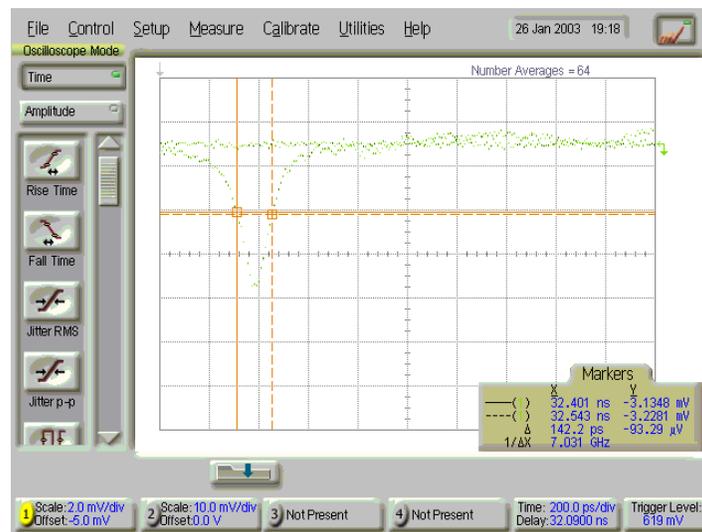
- Laser Wire studies were conducted on Friday until 08:00 when installation of the fast Faraday Cup began. The revised LLRF system was installed for a first test. There were difficulties in the LRF installation and in restoring the beam. LEPT and other sparks hindered beam delivery to the Diagnostic Group. Some problems were encountered with rebooting IOCs and loss of timing gate information.
- Early Saturday, the beam was stable and MEPT Orbit studies were done. The day shift was devoted to Laser Wire and Faraday cup studies. This is a picture of a 4-sigma fit averaged over 10 pulses from data taken on Thursday the 23'd. Shown are comparisons between the laser wire and a plot of WS14 vs. the laser wire on a log scale. They are not in the same location so the widths are different.



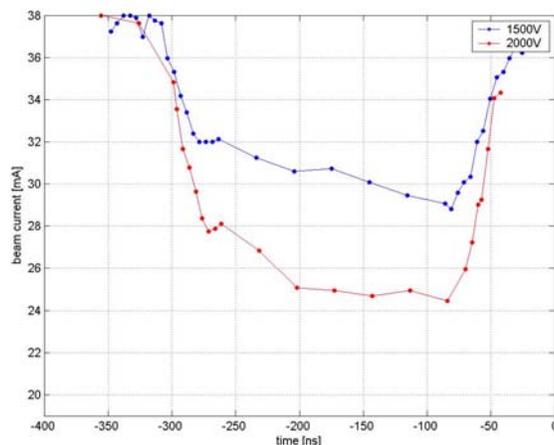
- The new LLRF on the RFQ never resulted in stable operation, so it was replaced with the original controller so that Larry Doolittle could fix it. A number of problems were found and fixed on the bench. Timing system problems continued.
- The new LLRF system was reinstalled. It functioned, though there are still operability and performance problems.
- Fast Faraday cup measurements were very successful.



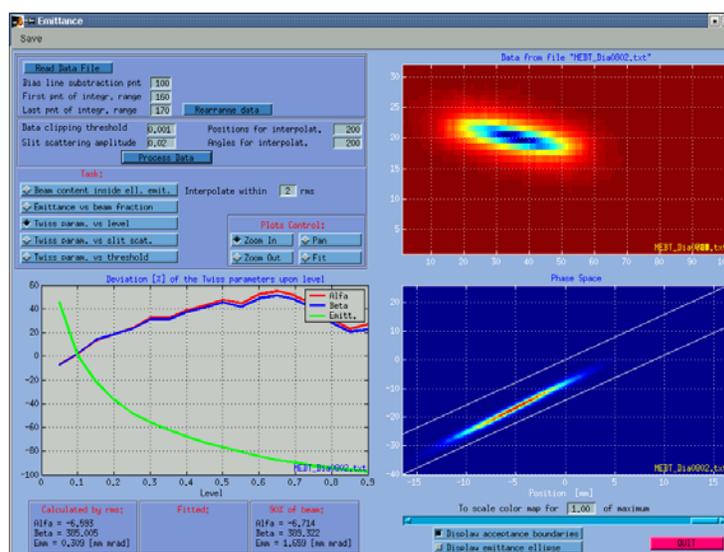
This measurement of a single micropulse shows a FWHM to be 142 psecs.
The risetime of the pulse is about 150psecs



Chopping was attempted but only one chopper power supply functioned resulting in a partially chopped beam. The following picture was made with the laser wire system of the time profile of the partially chopped beam.



- Following chopping, we reinstalled the emittance scanner to measure the emittance in both planes at high current. This is a sample file.



- Following the emittance scans, the high power dump was installed and systems are being prepared for the high power run.

Ion Source Group

Over the weekend there were three additional cesiations attempted with the hybrid source. Even the final attempt with 60 Hz of 1.15 ms long 25 kW RF pulses did not bring the desired output enhancement. All facts point to the 2.5 times larger filter field which may have prevented the plasma from properly heating the cesium collar. The removed source did not show signs of cesium.

Using spares from the hot spare stand, the 13-MHz system was restored and works nicely.

Charged with new cesium cartridges, parts from the original source were combined with parts from the hybrid source to reassemble the original source. The source was installed, conditioned, and successfully cesiated. Thursday night it delivered a beam of 51 mA measured by both current transformers and 49 mA measured in the Faraday cup. This record was accomplished with only 30.4 kW of RF power.

Mechanical Group

DTL Installation

The vacuum pumps have been reinstalled on DTL-3 in the tunnel and the tank re-leak tested. The tank is still leak tight, as it was in the RATS building before the move.

The cooling connections between the DTL-3 manifolds and the facility are complete. Jumper connections between the supply and return lines for individual components (not currently available) have been installed. Initial water-cooling system testing is planned for next week.

CCL Installation

Nathan Bultman and Mike Collier were in OR this week to discuss CCL assembly and installation plans. A new plan was discussed and accepted where CCL modules would be moved directly from ACCEL to the tunnel. Reassembly directly in the tunnel (bypassing RATS) reduces manpower requirements and eliminates transport risks.

Nathan Bultman will be sending a CCL segment from the Hot Model to RATS so that fiducialization testing can begin. These tests will confirm techniques being considered for the segments being assembled at ACCEL.

Magnets

Mapped and fiducialized another 12Q45. Welded fiducials on 12Q45's.

Installed the 8D406 on it's stand so that Error's group can fiducialize it.

Opened up an 8D533 for beam chamber installation.

Helped with water fittings on DTL Tank 3 (two days)

Started review of the 21Q measurement coil

Reviewed drawings for the DTL EMD's

Magnet Task

Linac HPRF

The RF group has been busy supporting operations especially in areas of LLRF and HVCM.

The backup LLRF system is installed and operators are becoming familiar with its controls.

Problems were solved on the HVCM, a blown resistor was found.

Chip Piller presented the reference line design and installation is ready to begin.

Plans for the shutdown are finalized, and work begins on the 3rd.

Linac LLRF

ORNL

The ORNL team continued to support FE commissioning. The new 2nd generation control chassis from LBNL has been used all week for RFQ operations. There is larger than desired 20 kHz ripple on the RFQ fields; it's not clear why the ripple is greater now compared to two weeks ago. It's either due to inadequate RF control or increased ripple on the output of the high voltage converter modulator.

Chip Piller gave an Accelerator Systems Division seminar on the reference system on Jan. 30.

Two Wenzel Associates frequency references were ordered this week. They will provide the following reference signals: 2.5, 10, 352.5, 402.5, 755 and 805 MHz. These frequency references are intended for installation as part of the reference system and will replace the Roscoe chassis presently in use.

We continue to plan for testing of the LLRF control system with the first production cryomodule at Jlab beginning the week of Feb. 24. Mark Crofford and Hengjie Ma will travel to Jlab next week to install and setup all hardware necessary to carry out the tests. EPICS support will be provided concurrently by Kay Kasemir and Ernest Williams.

The LLRF Team has issued its written response to the reviewer comments from the Dec. 17 hardware design review at Los Alamos.

Hengjie Ma has completed a first draft of a jitter and drift error analysis of the LLRF control system.

LBNL

Several software and firmware revisions have been made in the wake of the installation and testing of the 2nd generation controller at ORNL last week.

Production and checkout of new LLRF control chassis continues. The 805 MHz chassis for use in the Jlab tests was completed this week and shipped to Jlab for installation next week.

LANL

Work continues on producing the Rev 0 of the new hardware platform for the LLRF system. The schedule so far is being met:

- a) The Analog Front-end. Hamid Shoaee (and Tom Shea) visited Bergoz (France) last week and reviewed their production facility quality control practices. The chief engineer Klaus Unser assured us that the specifications will be met and the two initial prototypes will be ready by the end of February, one week earlier than originally expected
- b) The Digital Front-end. We have received comments from the reviewers of the schematic and are incorporating changes in the final layout. The final review will be on February 10 and we will proceed to fabrication and assembly on February 19. The two initial prototypes are expected mid March.
- c) The RF Output module: The board layout is in progress and will be sent out for review next week.
- d) The Motherboard: The schematic capture will start on Monday February 3.

The above three boards are expected to go into fabrication and assembly February 24 and with a lead-time of three weeks we expect a prototype platform in the middle of March.

One REV D HPM board has been modified in order to receive the 5V Vacuum Permit signal from Tom Powers input, rather than the designed-for 24V PLC input for the "final" design and has been calibrated to support the JLAB tests. It was ship this week to Christiana Grenoble for Mark Crofford to install on Monday.

Received three new REV D HPMS from Suntron. They will be tested and calibrated next week.

The first HPM test stand has been reworked and is now fully functional. The remaining two will be certified next week. These test stands will be used for the calibration and checkout of all future HPMS.

An LO Distribution chassis was also shipped to JLAB for the February test setup.

Work continues to develop a credible error budget for the entire LLRF system. There is also an updated set of requirements for the AFE, RFO and the VXI motherboard.

The interface control document (ICD) is in progress to completely specify the firmware specifications including interface between the hardware, firmware and software. The first draft will be ready on February 7. The LBNL

application firmware will be retrofitted to the new platform by the end of February and the entire set of phase I functionality will be verified in March.

We have also identified an FPGA engineer with the NIS-3 group at LANL who will be available to work on the application firmware. She will start with the group during the first half of February.

Work has also started on implementing NC resonance control in an EPICS IOC.

Work started this week on developing a comprehensive test plan for the entire hardware, firmware and software module. This will include module testing as well as integration testing and commissioning.

Electrical Systems Group

Survey and Alignment Group

The Survey and Alignment group met with Beam Line #4 engineers and scientist from Argonne for a one-day mini workshop. The topic was alignment of the neutron guides and choppers. Several methods of alignment were presented and discussed. A small demonstration was given to the attendees on the Laser Tracker.

The prototype cryomodule was surveyed at the RATS building. An analysis was performed on the data comparing the measurements taken at JLAB in November 2002 and measurements taken in the RATS building.

The prototype vector bar, which will be used for alignment of drift tubes, is almost complete.

Monuments were installed in the Front End area. These monuments, once measured and adjusted into our coordinate system, will assist in various LEBT/RFQ measurements that have been requested.

The Laser Scanner device was successfully aligned, tested, and removed. The emittance scanner has been reinstalled and aligned.

Work is continuing on the interim re-observation of the monuments in the upstream portion of the Linac. Laser tracker observations are complete, and differential leveling is almost complete. Observations from both sources are being reduced and processed as they arrive in the office for quality checking.

Mapped HEBT conduit locations prior to the sealing of the floor

The S & A Group has continued with the fiducialization of 12Q45 magnets.

We are in the process of testing our new fixture designed to enhance the alignment of drift tube magnets, via the slug tuner port. Initial tests are encouraging.

Cryogenics Group

Leak testing of the LN2 dewar continues. Repairs have been made to the main evacuating valves and the instrument readout. New leaks have been discovered on the threaded portions of the main vacuum pump out valves.

High pressure testing of some of the compressor piping will be accomplished tomorrow. Seasonal weather continues to hamper the assembly of the outside piping.

Work continues on installing the warm gas piping in the tunnel. The 6" inner pipe of the west return line has been cold shocked and leak tested. The line is now being superinsulated and prepared for the installation of the 8" clamshells.

Work continues on the supply expansion can. The copper thermal shield has been installed and is now being superinsulated. Return modules HB15/16 and HB17/18 have the anchor bayonets installed and they are now ready for the installation of the expansion bayonets.

Beam Diagnostics

ORNL Beam Diagnostics Progress Report:

This has been another excellent week for the ORNL diagnostic group. We continue analyzing the data we took on MEBT from the SCL laser profile monitor and Fast Faraday cup.

- (1) Fast Faraday cup data, which were obtained by Craig Deibele, Marco Poggi and Jim Pogge is shown below. The FF measurements are made after two meters of drift from the end of the MEBT. Bunch length at that point is reported by Craig to be about 142.2 Pico-sec.

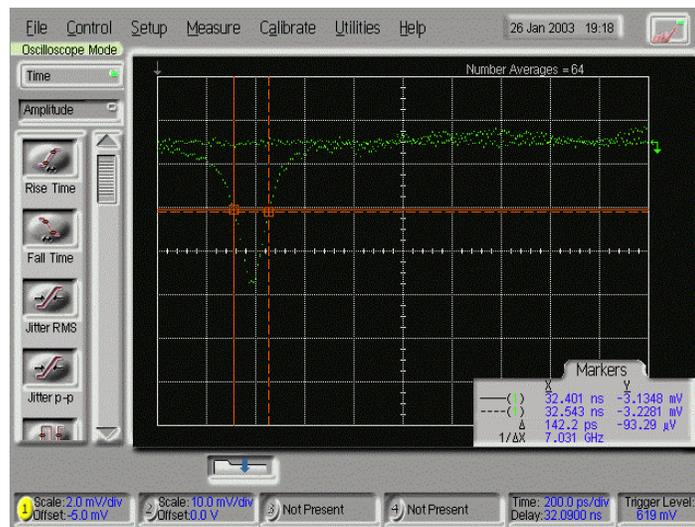


Figure 2-- Micro-bunch length measurements of SNS MEBT. The Fast Faraday Cup dynamic range is better than 15 GHz according to C. Deibele. The spectrum analysis of the bunch length is shown in Figure (2). (2)

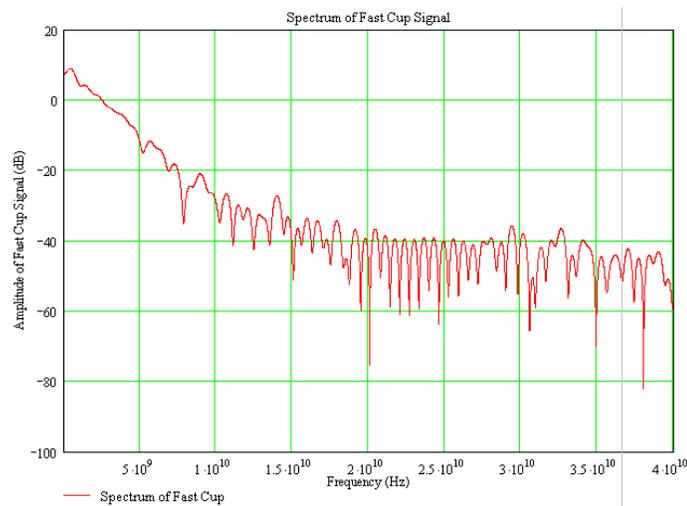


Figure 3 Amplitude.

- (2) The laser profile monitor is tested for the Beam In Gap. Unfortunately, the LEBT Chopper power supplies and the MEBT chopper were not available but we (Sasha, Saeed and Jim Pogge) created an artificial gap in the beam and measured the sensitivity of the Laser diagnostic. The following two figures show our ability

to measure ~ 75 dB dynamic range from the electron collector (H-/laser interaction) in the gap which is sufficient for the future BIG studies.

- (3) We are getting ready for the D-plate installation. The ORNL emittance device group (Controls and diagnostics) is preparing the D-plate electronics, controls and software. This device will be ready for implementation before the end of Feb-2003.
- (4) The ORNL mechanical design group and the diagnostic group is preparing design and implementation schedule for the diagnostics requested from the AP group to be installed in the Anti-Chopper box.

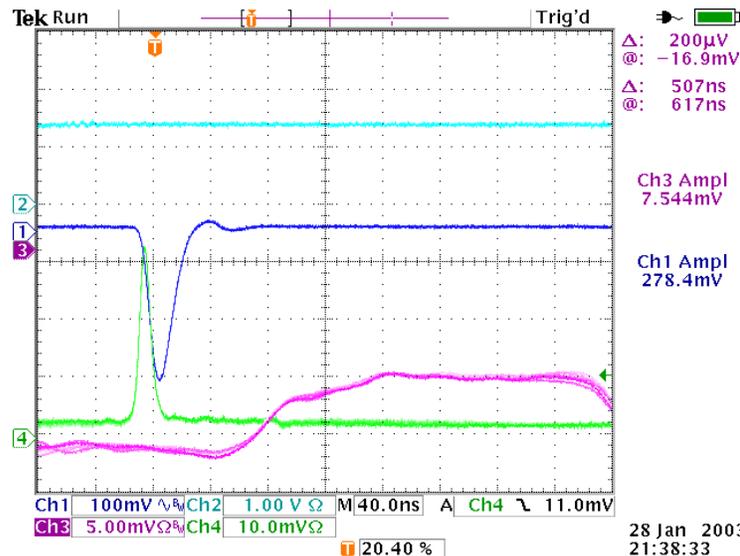


Figure 4-- Blue=electron collector output without any filtering or amplifications, Green=laser photodiode, pink= BCM output of 7.5 mV through a 50 Ohm.

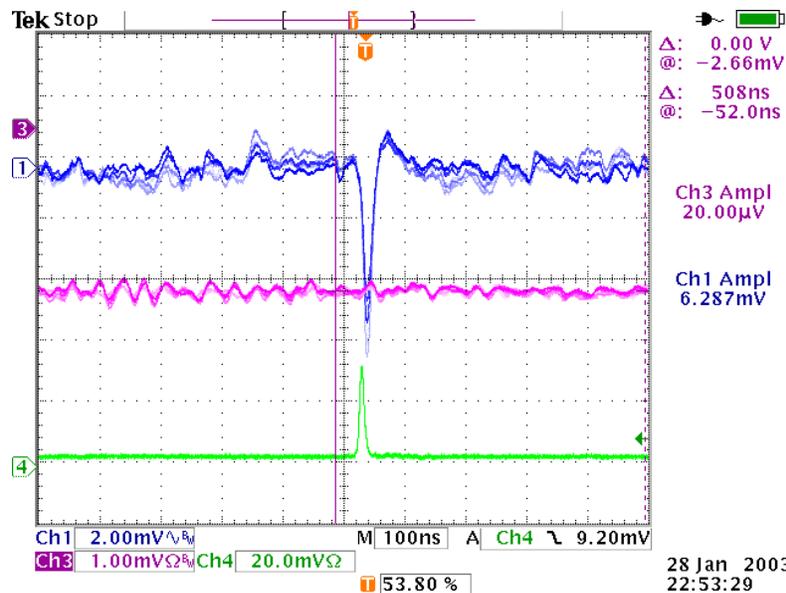


Figure 5-- After adding 20 dB of amplification to the electron collector without filtering, we can still observe a well-defined signal. BCM is in Microvolt range.

Two new embedded timing circuits were received: a universal PCI card and the tiny CardBus version. The CardBus version will fit in laptops and oscilloscopes. JTAG connections need some rework before testing can begin. This should be done within a week.

LANL Beam Diagnostics Progress Report:

BPM pickups: 13 ea. SCL BPMs have been mapped. One other has been found to have insufficient contact pressure of the electrode to the vacuum feedthrough pin. We are preparing to ship 10 ea. SCL BPMs to ORNL on schedule. We are preparing to submit a PCR to fabricate a spare DTL BPM.

WS actuators: The DTL-1 actuator is complete except for an LVDT core extension rod, which will be here next week. We measured the linearity of the LVDT on the prototype 6-inch actuator, and found it to be consistent with the manufacturer's specification of ± 0.38 mm.

WS electronics: The DTL-1 and D-plate signal processor, driver units, and PC's have been fully tested and debugged. We will put some polishing touches on the LabView software, document the systems, and then ship them to ORNL.

D-plate: Good progress was made on the harp actuators this week. They passed the vacuum test, and the harp head connectors were soldered on to the 40 ea. signal wires. The actuators are now complete with the exception of the LVDT core extension rods. The slit actuators were also successfully vacuum tested, and are now ready for the water flow tests. The view screen air actuator has been wired up and is ready for testing.

ED/FC: One actuator has been wired up and is ready for vacuum tests and water flow tests. Wiring is in progress on the other unit. Work continues on the electronics front. We have verified functionality and control of the electronics chassis connected to a PC. We have started writing the Labview application.

Software: Last week during their visit to ORNL, Matt and Lisa succeeded in getting the DMAs working on the new timing card. A new timing card has been sent to us and we are ordering support hardware to set up a development and test stand here in our lab. The problem with BPM 14 installed on the MEBT (the one with the IOC core) was traced to a 'feature' in the EPICS record processing which restricts record updating to one direction, i.e., a record can only be read or written within EPICS. We need bi-directional updating within EPICS so that our DLL, and other clients, share read/write control. We are working with ORNL to settle on an agreeable solution.