

## **Low-energy RHIC electron Cooler (LEReC) progress updates**

**September 12, 2016:**

### **Physics Support:**

- Preliminary optics for extraction beam line established.
- Test bench with cooling section mu-metal shielding: Performed the first tests with the pre-formed and re-annealed shields. The tests have shown the critical importance of having the joints between the shields shielded by several layers of high-mu material. The final design of the CS shielding must minimize the number of joints, that is, we must maximize the length of each shield. With an improvised extra shielding over the joints on the test bench we were able to suppress the external fields down to 1 mG level.
- Started work on the on-line model based on analytical formulas that can be used for LEReC commissioning. Respective high level application will integrate the live readings of the LEReC diagnostics with the live model predictions.

### **DC gun and cathode system:**

- The DC Gun Conditioning start at Cornell continues to slip. Cornell did complete the gun assembly during the month of August; but, as of the end of the month the DC gun was still in the cleanroom not on the testing floor. BNL is sending technical and engineering support to Cornell to help with the move, vacuum bakeout, gun and power supply final assembly and bakeout.
- Responded to most of the Action Items from LESHG 16-05 Review on the LEReC DC Gun Chambers. Waiting for the pressure test results on the ceramic break and on the feedthru, which are to be done at Cornell U.
- Finished an OPM draft to fill/extract SF6 gas into/from the Gun pressure chambers. Updating the draft in accordance with reviewers' comments.
- Continued fabricating components for the cathode puck insertion system in the shop. Started to receive machined parts from the shop.
- Continued working on the transporter designs for the cathode puck insertion system. Finished 80% of the preliminary drawings.

### **Cathodes:**

- The LEReC cathode puck coating R&D system is being assembled. This will allow coating of single LEReC using production coating sized deposition components.

## Laser:

- Finalized three optical tables. One, 5x12x2 ft<sup>3</sup>, is for the laser trailer, one, 2x4x1 ft<sup>3</sup>, for the relay optics, and one, 4x6x1 ft<sup>3</sup>, for the gun table with some extension.
- Mirrors, lens, and position feedback parts ordered.
- Working with the vacuum group to order the vacuum pipe, flange, and the vacuum pump.
- Other small issues are enclosures for tables, support for the vacuum pipe, temperature & humidity control if it is needed.
- Working on the motor controls and the feedthrough for the gun tables.
- Develop the parts of the laser control, such as two ultrafast pulse pickers, spatial shaping, temporal shaping, and 1:1 imaging.
- Laser was moved to R&D area to allow implementation of civil construction for laser trailer. Work on laser tests resumed.

## RF cavities:

- **2.1 GHz Warm RF Cavity**

- Cavity has been delivered
- The custom copper vacuum waveguide delivery has been delayed by vendor and is schedule to be delivered by the end of October.
- Tuner actuator has been delivered
- Tuner plunger was delayed by vendor and is scheduled to ship 9/12/16
- All the waveguide components that were ordered are in house. A few components on the amplifier side still needs to be ordered.
- The custom waveguide transition from Jlab C100 dimension to WR430 has been delivered.
- Design of the cavity support is completed. The stand is in the shop and the drawings for the plates are underway.
- Cold bench test of the 2.1 GHz is completed
- All the components for the high power test of the RF window are in house except for the amplifier. We are troubleshooting a malfunctioning humidity sensor so that we can do a low power test until the amplifier arrives.

- **704 MHz Warm RF Cavity:**

- The design of the 704MHz is completed. Fabrication is underway. Due to some issues during fabrication, the delivery has been delayed to mid-November.
- The tuner actuator PO has been placed.
- Tuner plunger PO has been placed.
- Design of the vacuum FPC waveguide adapter is complete and PO has been placed
- Design of the cavity support is underway

- Coax layout is underway. Standard components are being ordered.
- Custom vacuum port for tuner has been placed.

- **704 MHz Deflecting Cavity**

- Design of the tuner is underway
- Drawings for the bid package is being checked.
- SOW and specs has been modified.
- Plan is to send the bid package by first week of October

### **Magnets:**

- DC gun test beamline correctors are under construction. First article was measured and component of sextupole field did not meet requirements and was significantly off from the design values. Detailed study was performed to understand origins of this strong sextupole term, and tolerance guidance for manufacturing of such correctors was produced. Several of such correctors are needed already this Fall for the DC gun tests where sextupole component is not critical. As result, in house manufacturing of correctors will continue even the quality of such correctors will be as in the first article. Meanwhile it will be evaluated how to produce remaining correctors which satisfy design requirements.

### **Vacuum elements:**

- Vacuum group is helping with DC gun tests at Cornell.

### **Power Supplies:**

- Have all the ERL ps's removed from their racks but they are still sitting in the ERL ps room because 1002D racks are not ready yet for installation.
- Waiting for the electricians to finish wiring up the ac power to the racks in 1002D. Once the electricians are done we can start installing the dc ps's in 1002D.
- Starting to order DC cables for the ps's in 1002D.
- We are building the current monitors required for the MPS for the gun injection test.
- The 180 degree ps testing is going well. The temperature controller appears to be working but we need to do more testing with the temperature controller.
- Prepared to go to Cornell to help with the conditioning when they are ready.

## Beam Instrumentation:

- **Profile Monitors:** Drawings complete & parts ordered for 2 of 3 PM's – 1 PM complete.
- **Emittance Slit:** Design finalized & material orders begun.
- **BPMs:** chambers in-house, 1st article buttons passed acceptance testing & balance due this month. 1st article electronics passed acceptance testing & balance due early next month.
- **Current Transformers:** 2 of 4 FCTs on order to be installed in December. Balance order planned after upcoming commissioning tests.
- Design of **Faraday Cup** electronics complete and construction of chassis underway.
- **NMR probe** under construction, witness testing planned for next week with shipping to follow by end of the month.
- **Radiation detectors** for gun conditioning are designed with COTS components with material orders expected to go out next week.
- **Halo Monitors** extracted from ERL and new chamber on order for installation in November.
- **Motion control** chassis design complete for gun commissioning tests, construction underway
- Instruments for **Longitudinal Phase Monitor** in diagnostic section are finalized with profile monitor detailed design pending.
- Upgrade of **PMT loss monitors** from ERL with scintillating fibers under development for use after low power commissioning in spring 2017.

## Controls:

- The core parts of the remote software interface for the new AMP motion controller have been developed.
- An initial version of the DC Gun remote interface software is available. Additional functionality may be needed.
- Software development of the hot cathode gauge controller remote interface is underway.

## Cryogenics:

- Cryogenic transfer line system for Booster cavity cryostat:  
Procurement department has issued the RFQ to vendors and is out for bid.
- Booster cavity cryostat internal piping modifications:  
Tubing run layout complete.  
Tubing/fittings ordered.
- 5 x Return heaters for the 5K intercepts cooling circuits: quotes returned.  
Jacketed assembly drawings to be completed to go out for quotation.  
UL Heater 5 zone control panel for the 5K circuit return heaters quote received and on order.  
Large return heater for 4.5K subcooler vapor has been ordered.  
Pressure transducers and temperature sensors ordered.  
Misc Rack parts ordered.

## Commissioning:

- Commissioning plans in preparation.

### **Installation and other Design work summary:**

- The concrete support blocks and the laser tables for the laser building, relay table, and DC tunnel table have been designed and ordered. The laser building has been moved off its foundation in preparation for installation of large steel blocks in the ground to provide a more stable support foundation for the laser building table.
- The DC gun/Booster cavity work platform/cleanroom frame components have been ordered and should be in house in November.
- The DC gun transport line solenoids are being wound by the magnet vendor with scheduled delivery in the middle of October. The stands, vacuum chambers, windows, laser mirror, and other hardware for the DC gun transport line have been ordered. The vacuum drive stage for the DC gun transport line has also been ordered.
- An additional designer was added to the design room staff to work on component stands for the DC gun test beamline.