ELECTRON BEAM ION SOURCE

MONTHLY REPORT

March 1-31, 2009

Performing Organization:	Brookhaven Science Associates
Location:	Brookhaven National Laboratory Upton, New York 11973-5000
Contract Period of Performance:	FY2005 – FY2010

BROOKHAVEN NATIONAL LABORATORY

Brookhaven National Laboratory
EBIS MONTHLY PROGRESS REPORT
March 2009

I. Contractor Project Manager's Assessment

Technical Progress and Accomplishments

The Linac fabrication remains on track and initial low level rf measurements performed at the manufacturer PINK,confirmed the design parameters. Good progress is being made on the installation of the power distribution, water and rf systems. TestEBIS continues to be used as a resource to "proof" components that will be used at the RHIC-EBIS and resolve any identified problems.

Issues and Concerns

The repair at BNL of the ACCEL superconducting solenoid continues to be the major problem to be resolved. ACCEL is responsive to our concerns and will send support staff in April to complete the repair with parts manufactured in Germany.

II. Detailed Status by WBS

WBS 1.1 – Structural components

1.1.6 EBIS Hardware

Superconducting Solenoid

Due to the appearance of a cold spot on the warm bore during the acceptance test cool down, the test was stopped and the magnet system was warmed up for inspection. Internal damage during shipment from Germany to BNL was suspected. On Sunday, 1 March, inspection of the cold mass suspension rod ends revealed that the two top rods were broken at one end. The heat shield tube between the vacuum vessel inner bore and the cold mass winding body was found to be slightly deformed due to the cold mass dropping onto it. ACCEL departed on Wednesday, 4 March. ACCEL has remanufactured the suspension rods at their factory, and is having the heat shield bore remanufactured by an external company. ACCEL plans to send two technicians to BNL to install the parts and realign the magnet, and then the ACCEL engineer will return for final acceptance testing, presently planned for the end of April.

The design of the spare superconducting solenoid by Cryomagnetics is currently in process. The preliminary design is due in early May. Teleconferences are conducted weekly. The magnet system is expected to be delivered in October 2009.

Electron Collector

The manufacture of the beryllium copper electron collector by Brush Wellman is complete. The unit was delivered in early March. A vacuum leak test was performed and no leaks were found. The water manifold will be installed next and a flow test will be performed. The iron shield and internal electrostatic lenses are currently being fabricated at BNL.

Central Drift Tube

Central shops has begun fabricating the drift tube NEG rail. The remainder of the drift tube assembly is complete.

LEBT and External Ion Injection

Many of the the components in the external ion source line are either purchased or in the shop for manufacture. The designs of the switch chamber and its internal electrostatic components have been completed; the switch chamber is

in the shop. The manufacture of the electrostatic quadrupole quadruplets (3 assemblies) is about 50% complete. The cylindrical deflectors near the ion sources have been designed and are also in the shop.

RF Structures

IH-Linac

After completion of the Linac fabrication at PINK, low power rf measurements were made, including field distribution using bead pull down the axis. The field strength met the requirements, and the resonant frequency was within the desired range, so the next steps are now to vacuum leak check the cavity, and then send it to GSI for copper plating. During the measurements, a dummy drift tube was used in place of the internal quadrupole triplet being manufactured by Bruker instruments.

RFQ

No activity this reporting period.

Buncher Cavities

Manufacture of rebuncher cavity (C-1) was completed and shipment is scheduled for the first week in April.

Test EBIS

Component improvement for RHIC EBIS:

At TestEBIS we have identified and solved problems with several components that will be used on RHIC EBIS. During the past month, these items include:

1) Noise interference in the impedance measuring circuit controlling the HV platform shorting relay has been eliminated.

2) Magnetic and electrostatic interference causing faulty function transmission in the power supply interface modules (PSIs) controlling the electron gun anode of a fast bipolar 60kV lens power supply.

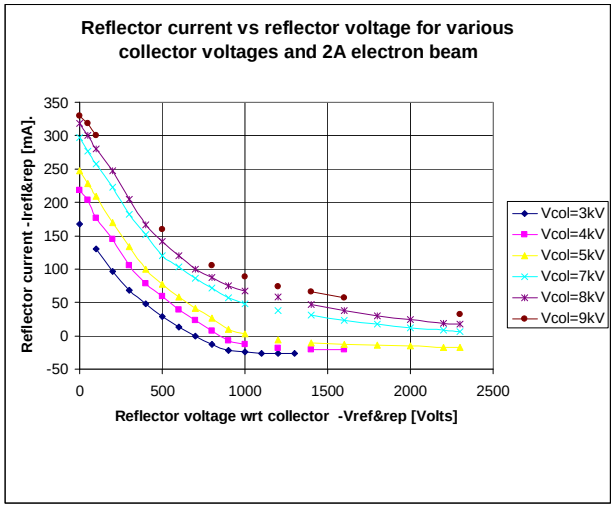
3) Spurious tripping of the electron beam and anode interlock circuits has been greatly reduced. Some noise spikes were suppressed by adding capacitive filtering, and it was noted that increased internal filtering and better interfacing between 3.3v circuit board logic and 5v external logic needs to be addressed.

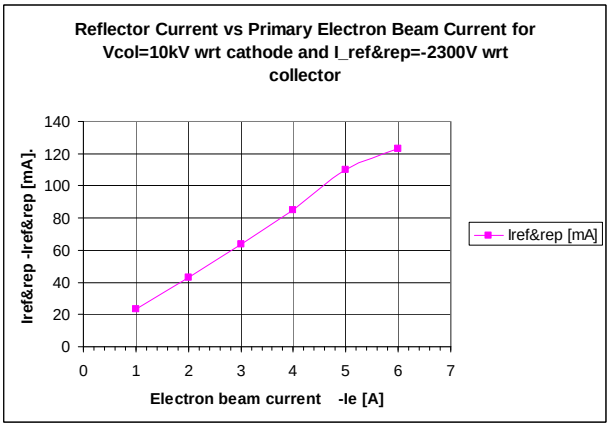
4) Corona problems with the 100 kV platform pulser were detected. These were mitigated by work in the area where the high voltage cable emerges from the electric field stress relief cone.

TestEBIS operation with platform voltages up to 70 kV has been reliable and useful for measurements. However, operation at 95 kV, which is of interest for our present tests of Cu10+ for emittance studies and transmission through the RFQ, has been intermittent during this period. We are continuing to reduce the noise issues, and expect to be able to make the last few studies planned at the TestEBIS. The controls and electronics at the new facility will be considerably less susceptible to noise. In addition, the HV requirement of the platform is expected to be reduced to about 80 kV due to a higher RHIC EBIS drift tube operation during extraction and longer ion confinement times (higher charge state) allowed by the RHIC EBIS collector supply.

Characterization of power dissipated on the collector internal electrodes:

At TestEBIS, it was observed experimentally that power losses on the RHIC EBIS collector reflector and repeller electrodes were higher than anticipated. These electrodes are used in the collector to tailor the deposition profile of the high power electron beam (>100 kW) on the collector surface, by shielding the primary electron beam from the field of the ion extractor. It was shown by experiment and simulation that the measured loading comes from backscattered electrons rather than interception of the primary electron beam. The electrodes were biased negatively with respect to the collector to reduce the power dissipation and experimental data was obtained to characterize the effect. Dependences on primary electron beam current and energy, as well as internal electrode bias voltage was obtained. Further simulations are underway to reduce loading on these electrodes, through a combination of electrode biasing, and shaping which may allow partial penetration of the ion extractor potential.





Controls:

At TestEBIS we have implemented Power Supply Interfaces (PSIs) to control the electron gun anode supply and to become familiar with the device capabilities which are the exclusive control interface at the RHIC EBIS facility. We had previously integrated the PSI control function into our local control system and recently integrated the readback functions. This allows us to observe power supply current and voltage changes at 10 microsecond intervals. Although this represents a significant loss in bandwidth compared to our previous methods, the response appears appropriate and adequate for monitoring purposes during routine operation. Installation of PSI's on all power supplies at the RHIC facility is expected to improve EBIS reliability and will greatly expand our monitoring and recording ability.

Emittance Studies:

The RFQ has been moved back a few meters from TestEBIS to allow emittance studies with both the pepperpot and slit-scan type devices during April.

60 kV EBIS Ion Lens:

It was decided to move the EBIS lens supply onto the EBIS platform instead of the former laboratory ground location. This requires additional power supply hardware, but will reduce control and timing restrictions and is expected to result in more reliable operation by reducing the possibility of source arcing. Installation of this configuration is underway at the TestEBIS facility and rack space has been made available at the RHIC facility.

WBS 1.2 – Controls

Work continued on console software with the addition of a magnet control table to the EBIS Trap page and with implementation of tools to enable on-screen addition of time steps. Timing for scheduling of concurrent power supply waveform changes was also being developed. Work on the design of the printed circuit (pc) board for the EBIS Platform Transceiver Signal Conditioning Unit continued. Design changes were implemented for the EBIS Platform Impedance Measurement Unit in preparation for a pc board artwork creation. The EBIS PLC and Interlock System Block Diagram was updated to include input from the Collector Supply Programmable Logic Controller (PLC).

WBS 1.3 – Diagnostic Systems

All of the integrators for the multiwires have been tested and calibrated for operation. Testing commenced on the current transformer amplifiers and will continue into April. Weekly meetings within the diagnostics group have started being held to discuss installation. Preliminary rack layouts have been generated. The cable pull list was reviewed and modified where necessary to match the present requirements.

WBS 1.4 – Magnet Systems

MEBT Quads

The coil design and prototype coil have been finished. Based on the required coil clearance, the physics design for the pole shape has been finalized. Preliminary lamination drawings were completed and submitted for a vendor quote. Based on input from lamination vendors, the end chamfers of the magnets will be made up from individual laser cut laminations rather than by machining the lamination stack. Drawings are being finalized to order the laminations and an order should be placed in April. A decision was made to adjust the magnet's position for beam steering versus a separate trim winding on the coil.

Warm Solenoids

The coils for the second electron gun solenoid are being wound.

WBS 1.5 – Power Supply Systems

The evaluation of the fast pulsed quadrupole power supply proposals has been completed. The order for these units should be placed in April 2009.

Electrical tests of a Kepco low noise, high stability power supply with an EBIS HEBT quadrupole have been successfully completed. These will also be ordered in April 2009.

Progress continues at BNL on the construction of the LEBT solenoid pulser, and the installation and PLC programming of the collector power supply system. The vendor of the HEBT dipole "Big Bend" power supply has reported that the unit will be ready for us to witness acceptance tests by the end of May 2009.

Sixteen HV fast power supplies for the external ion source beam lines have been delivered for electrostatic quadrupoles in the external ion source beam line. Eight +4kV supplies and eight -4kV supplies are packaged in two 3-U crates.

WBS 1.6 – RF Systems

Activity reported in Installation section.

WBS 1.7 – Vacuum Systems

The HEBT stands and vacuum pump magnetic shields are being fabricated at Central Shops. Several heating blankets were received and inspected and one had to be returned to the vendor for rework. Only three blankets remain to be received for the project: the titanium pump, one small ion pump and the debuncher cavity in the Booster Ring. The HEBT ion pumps are being rebuilt and the custom cryogenic lines have been received for the HV platform. Vacuum pumps and valves have been ordered for the external ion injection line.

WBS 1.8 – Cooling Systems

Water distribution for RFQ and Linac amplifiers is 95% complete (waiting for scheduled April maintenance of Booster for final tie-in and flow check).

WBS 1.9 – Facility Modifications

No activity scheduled for this reporting period.

WBS 1.10 – Installation

The contract work for installation of cable trays and power distribution has begun with 2 electricians. This will be expanded to deploy up to 5 electricians. Cable tray and bonding of high voltage cage racks was completed and the second floor cable tray and bonding is complete. Installation of high voltage cage power distribution has started.

The power supply layout was redone to relocate power supplies from Electronics Rack 6322 to Rack 6312 (inside High Voltage Cage). The planned layout in the HV cage for mounting the ACCEL cryogenic compressor was modified to also be able to accommodate the spare unit being manufactured by Cryomagnetics. Installation of buncher/debuncher power amplifier racks was completed and the circulator dummy loads were mounted. The RFQ and Linac power amplifiers output coaxial transmission installation is 90% complete. The Linac circulator was returned to vendor after failing to meet specifications but this will not delay amplifier testing.

WBS 1.11 – Project Services

Contingency in the amount of $212k was approved by the Federal Project Director for two Project Change Requests (PCRs). The changes were: the G&A rate used during the PreOps phase was corrected to reflect the rate that will be applied, plus additional hours were added to Structural Components WBS to account for hours spent on major equipment items that exceeded the baseline estimates. We continue to work on a "what if" file of the schedule, incorporating new dates from the group leaders. The major change is expected in Installation.
The monthly telecon with the Office of Science took place on March 12th.

WBS 1.12 – Commissioning

No activity scheduled.

SAFETY

The draft Unreviewed Safety Issue (USI) document for the EBIS Preinjector remains at 90% complete.

PHYSICS

No activity this reporting period.

Financial Status

EBIS Project		Burdened k$					
WBS	Title	March Actuals	FY09 to date	Project to date (PTD) costs*	Commit-ments		Budget at Comple-tion
1.1	Structural components	45	326	3268	562		3395
1.2	Controls	2	96	713	3		756
1.3	Diagnostics/instrumentation	6	159	469	2		696
1.4	Magnet Systems	1	16	491	0		863
1.5	Power Supply Systems	164	500	1974	406		2332
1.6	RF Systems	7	264	2342	-33		2760
1.7	Vacuum systems	65	236	1666	47		1609
1.8	Cooling Systems	0	24	216	0		259
1.9	Facility Modifications	42	55	541	61		550
1.10	Installation	144	595	1140	32		2018
1.11	Project Services	22	165	1039	0		1074
1.12	Commissioning		0	0	0		217
1.13	R&D/CDR		-71	1327	71		1400
	Contingency						1371
	Total	498	2364	15185	1151		19300
* costs through Mar 2009							