

1.0 Generation and Characterization of Magnetized Bunched Electron Beam from a DC Photogun for MEIC Cooler

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Project Status

*****Provide a summary of scientific or technical progress and accomplishments over the last two quarters.*****

Project work started with the focus to be ready to generate non-magnetized beam in the second half of FY16 and with the preparation to generate magnetized beam on Oct 1, 2016.

Accomplishments of the past 6 months include:

- ✓ Finished HV conditioning the gun and ready to make beam at 325 kV. *
- ✓ Assembled the K₂CsSb Preparation Chamber and ready to grow photocathodes. *
- ✓ Connected beamline to gun, baked and instrumented with steering coils, ion pumps and viewers. *
- ✓ Lasers are ready and LOSP has been approved. *
- ✓ Gun Test Stand (GTS) OSP is approved for only 10 nA – now working with Radiation Control Group for approval at high currents (32 mA). *
- ✓ Designed the cathode solenoid magnet and procured on March 31. Magnet will be on site by July 8, 2016. The magnet will provide 1.4 kG at cathode (with a standard molybdenum puck).
- ✓ Designed a molybdenum and carbon steel hybrid puck to enhance field at cathode to 2.0 kG.
- ✓ Identified the power supply for cathode solenoid magnet as the new CEBAF spare Dogleg magnet power supply (500A, 80V) and got permission to use it at GTS.
- ✓ Used ASTRA and GPT simulation to design beamline and to locate magnets and diagnostics at optimum positions.
- ✓ Performed virtual experiments in simulation to measure beam emittance and magnetization.
- ✓ Recruited a Ph.D. student to work on this project (Gabriel Palacios – Supervisor: Prof Geoff Krafft, ODU). The student is supported by ODU/JLab and will work on this project during this summer and start full time in fall 2017.
- ✓ Hired a postdoc (Dr. Mamun Md Abdullah). He will be funded by this LDRD starting Oct 1st, till then he is funded by Injector Group.

Project Plan

*****Provide a brief explanation of what you will be doing for the remainder of the year. If there is a project re-plan provide an explanation for the re-plan focusing on changes from the proposal, future milestones, and anticipated results.*****

Work in the remainder of FY16 will focus generating non-magnetized beam (May – July) and to be ready to generate magnetized beam on Oct 1, 2016. This includes:

1. Generate non-magnetized beam and commission the exiting beamline. *
2. Work with Radiation Control Group for approval at high currents. *
3. Measure photocathode lifetime up to 5 mA (not magnetized). *
4. Measure beam emittance using the solenoid-viewer method. *
5. Design and procure slits for beam emittance and magnetization measurements.
6. Relocate the new CEBAF spare Dogleg power supply to GTS.
7. Procure the hybrid carbon steel puck.
8. Map the field of cathode solenoid magnet with and without the hybrid carbon steel puck
9. Design the support structure for the cathode solenoid magnet.
10. Design and procure three skew quads. Perform RTFB transformation virtual experiments in simulation.
11. Install slits and cathode solenoid. We will use this opportunity to replace a leaky valve, replace the HV ceramic insulator and the HV shed and add more pumping to gun chamber. These planned changes will enable us to reach 350 kV with minimal HV conditioning. For the preparation chamber, the plan includes adding moly and carbon steel hybrid pucks and modifying the tip of the long manipulator. All this is planned in the first half of August. The bake of preparation chamber, gun and beamline is scheduled in the second half of August.
12. HV conditioning is planned in September.
13. Mark the magnet 5 G field region and establish procedures to operate the magnet safely.
14. Be ready to generate magnetized beam on Oct 1, 2016.

* These tasks are not funded by this LDRD but part of the milestones and pre-requisite to LDRD work.

Budget

Note: Absent a complex project re-plan, the project Status and Plan material should sum to of order one page.

We worked with the budget analyst to move \$50k from Materials and Supplies to Labor. Last year when we budgeted \$60k for solenoid magnet, I mistakenly put all the cost as "Materials and Supplies". Part of the cost was labor, so we wanted to fix this. Actually, we have already procured the magnet for \$20k, hence we want to move the remaining \$40k to labor where it is needed to map and install the magnet and its power supply. We also budgeted \$20k for beamline components, and again there is labor so I want to move \$10k from this to Labor.

Publications

N/A

Workshops/Conferences

R. Suleiman, M. Poelker, J. Benesch, F. Hannon, C. Hernandez-Garcia and Y. Wang, *Generation and Characterization of Magnetized Bunched Electron Beam from a DC High Voltage Photogun*, APS April Meeting, Salt Lake City, Utah, April 16–19, 2016.

<http://meetings.aps.org/Meeting/APR16/Session/D1.37>