

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

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Project Description

To maintain ion beam emittance and extend luminosity lifetime, the Jefferson Lab design of the Electron Ion Collider includes a bunched magnetized electron beam cooler as part of the Collider Ring. This 3-year (FY16/17/18) project aims to generate and characterize magnetized electron beams using a 350 kV inverted-insulator DC high voltage photogun. Measurements of beam magnetization at different bunch charge as a function of laser beam size and magnetic field at the photocathode are planned. The magnetized beam will be transformed into a flat beam using three skew quadrupoles and the transverse emittance ratio will be measured. Results will be compared to particle tracking code simulations. Photocathode lifetime at beam current up to 32 milliamperes will be compared to beam lifetime with no magnetization, to explore the impact of the magnetic field on photogun operation. Combined, these measurements and simulations will benchmark our design tools and provide insights on ways to optimize the electron cooler and choose the appropriate electron source and injector layout.

Accomplishments

Started FY16 with an empty room and built a photogun, an alkali-antimonide photocathode preparation chamber and a diagnostic beamline. The gun was HV conditioned and non-magnetized beam was generated at 1mA and 300 kV. The cathode solenoid magnet was designed, procured, mapped and installed in the front of the gun chamber. The magnet is powered by the new spare Jefferson Lab accelerator dogleg supply. The field at the cathode is 1400 Gauss when using a standard molybdenum photocathode holder, or puck. A carbon steel puck and molybdenum + carbon steel hybrid puck were designed to increase the field at the cathode to 2000 Gauss. Four new pucks were made – two steel and two hybrid. The solenoid field was mapped with these new pucks positioned at the location of the photocathode.

Simulations of the magnetized beam have been used to determine the beamline layout, the design of the emittance and magnetization measurement diagnostics and the concept of a round to flat transformer.

The focus of FY16 work is to be ready to generate magnetized beam in the first quarter of FY17. First, the plan is to upgrade the photocathode preparation chamber to enable photocathode fabrication using a mask, to limit the photocathode active area and reduce beam halo, and to upgrade HV chamber with a new doped ceramic insulator and newly designed HV triple-point shield which will enable photogun operation at 350 kV.

Publications

None

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>

Questionnaire

Question	Answer
Will follow-on funding (post-LDRD project) be applied for?	Yes
Source of support for follow-on funding?	DOE SBIR
Has follow-on funding been obtained?	No
Amount of follow-on funding (\$K)?	N/A
Number of Post Docs supported by LDRD project?	0
Number of students supported by LDRD project?	0
Number of scientific staff/technical staff hired with LDRD funding?	0
Number of copyrights filed (beyond publications)?	0
Number of invention disclosures filed?	0
Number of patent applications filed?	0