2015-LDRD-1a: Generation and Characterization of Magnetized Bunched Electron Beam from DC Photogun for JLEIC Cooler

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JLEIC bunched magnetized electron cooler is part of Collider Ring and aims to maintain ion beam emittance and extend luminosity lifetime. ***Because the cooling rate is estimated to increase by two orders of magnitude in a solenoidal field, generating a magnetized electron beam (to avoid emittance growth when injecting into the solenoid) is desired.***

LDRD Scientific Goals:

1. Generate magnetized electron beam and measure its properties
2. Explore impact of cathode magnet on photogun operation

LDRD Benefits:

1. Simulations and measurements will provide insights on ways to optimize JLEIC electron cooler and help design appropriate electron source
2. JLab will have direct experience magnetizing high current electron beam

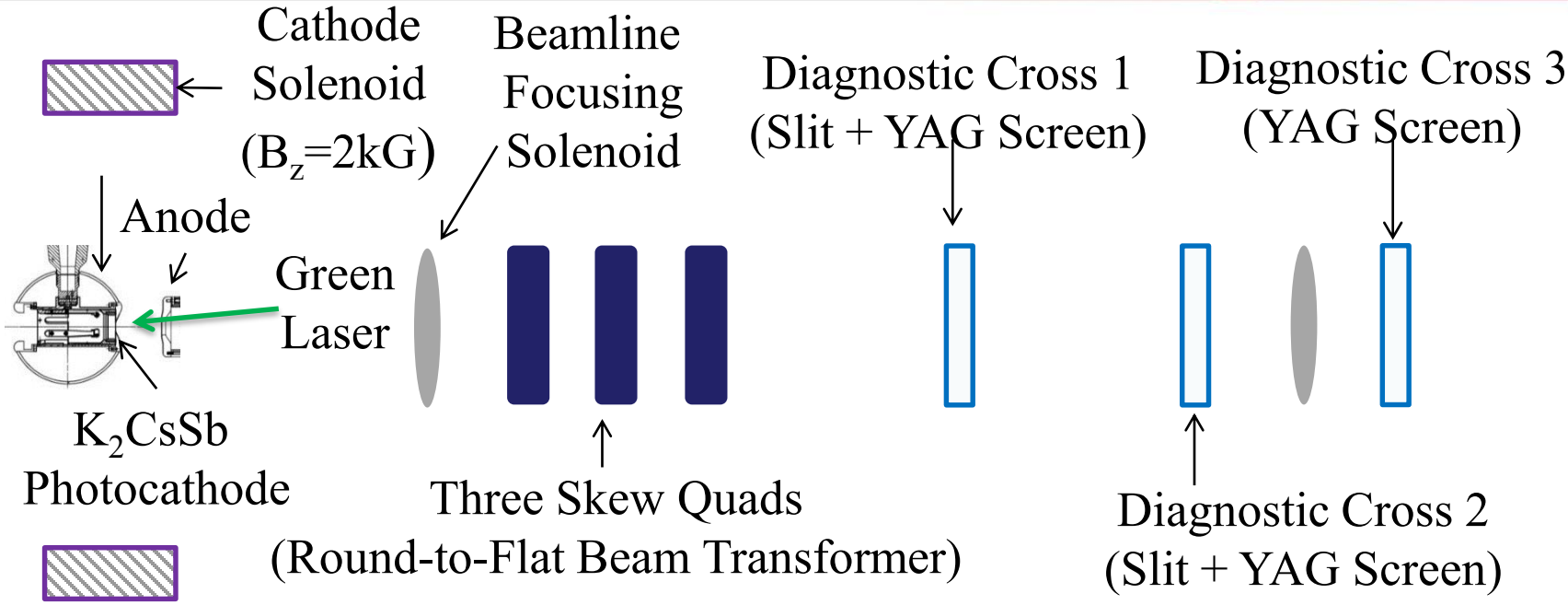
Milestones

Year 1: Generate non-magnetized beam. Design, procure and install cathode magnet, pucks and slits.
(nearing completion)

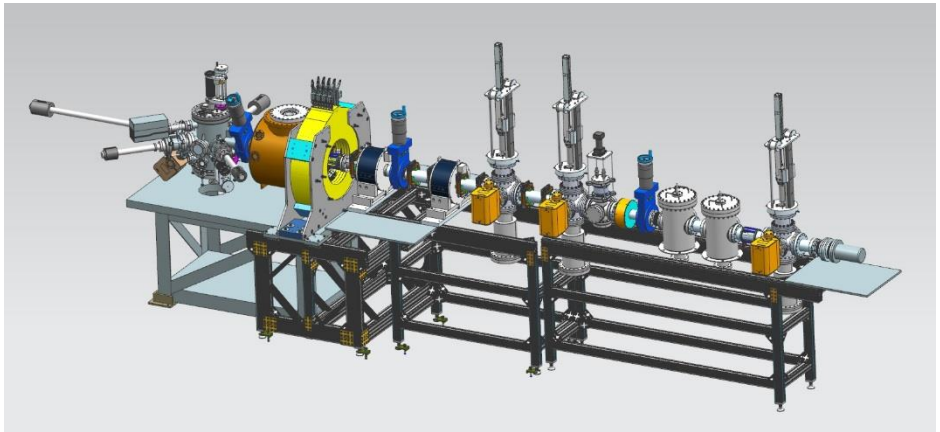
Year 2: Generate magnetized beam. Measure mechanical angular momentum and benchmark simulation.

Year 3: Measure photocathode lifetime vs magnetization up to 32 mA.

Experimental Overview: Gun Test Stand



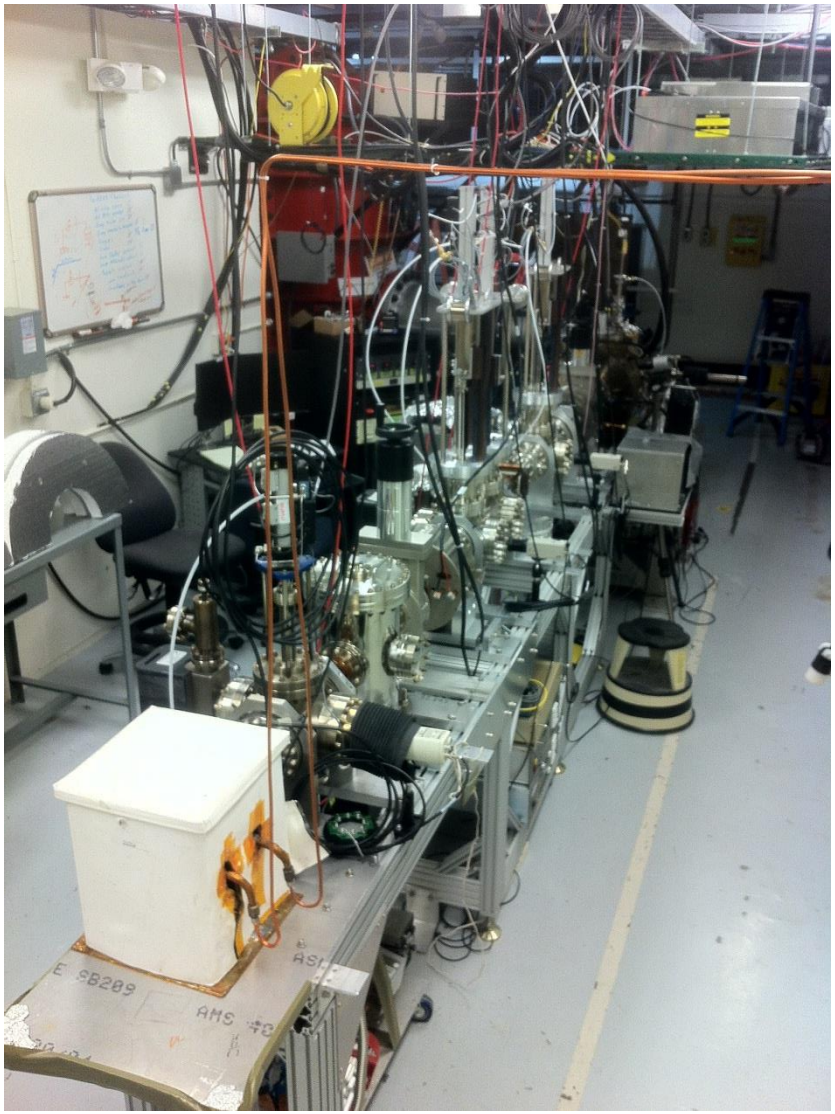
- Generate magnetized beam:
  - Laser size: 1– 5 mm, B_z = 0 – 2 kG
  - Bunch charge: 1 – 500 pC
  - Frequency: 15 Hz – 476.3 MHz
  - Bunch length: 10 – 100 ps
  - Average beam currents up to 32 mA
  - Gun high voltage: 200 – 350 kV



FY16 Accomplishments to date

- K_2CsSb Photocathode Preparation Chamber, Gun and Beamline: <u>delivered 1 mA to dump</u> (non-magnetized)

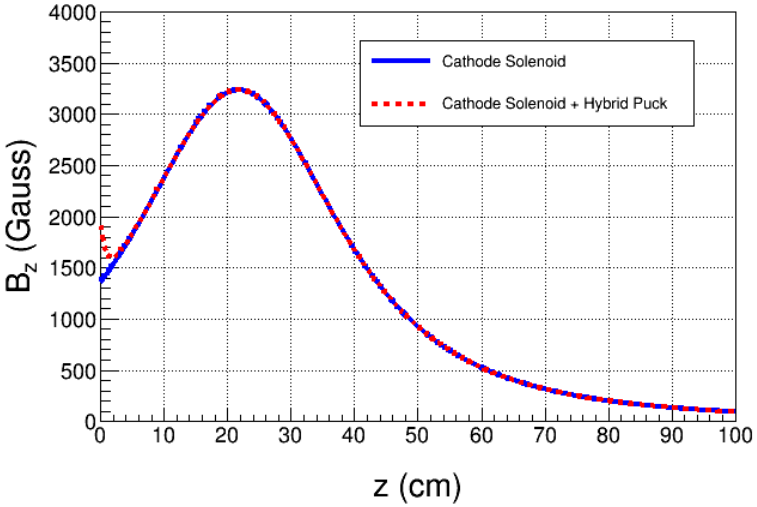
- Simulation (Fay Hannon):
  - Used ASTRA and GPT simulation to design beamline and to locate magnets and diagnostics at optimum positions
  - Simulated magnetized electron beam properties along beamline for various starting conditions
  - Simulated a round to flat transformer

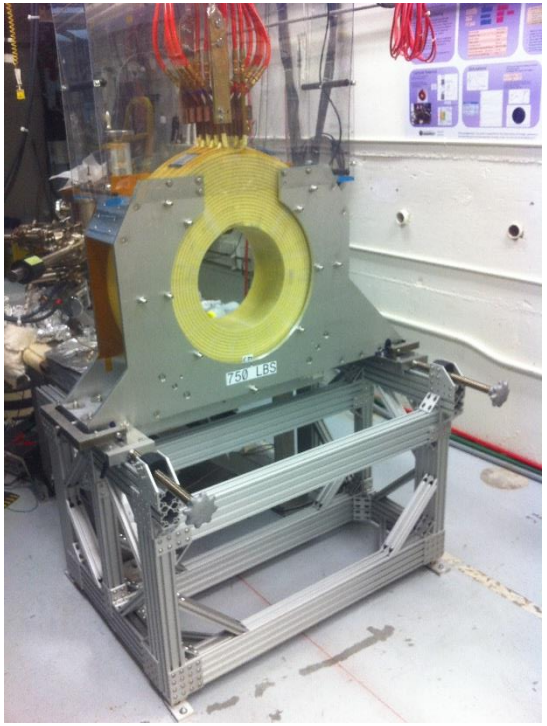


FY16 Accomplishments to date

Cathode Solenoid Magnet

- Mapped and installed at GTS





New Pucks

- Designed to enhance magnetic field at cathode to 2.0 kG