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

- 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 and Costs

1. Year 1: Generate non-magnetized beam. Design, procure and install cathode magnet, pucks and slits.
2. Year 2: Generate magnetized beam. Measure mechanical angular momentum and benchmark simulation.
3. Year 3: Measure photocathode lifetime vs magnetization up to 32 mA.

Materials and Supplies:

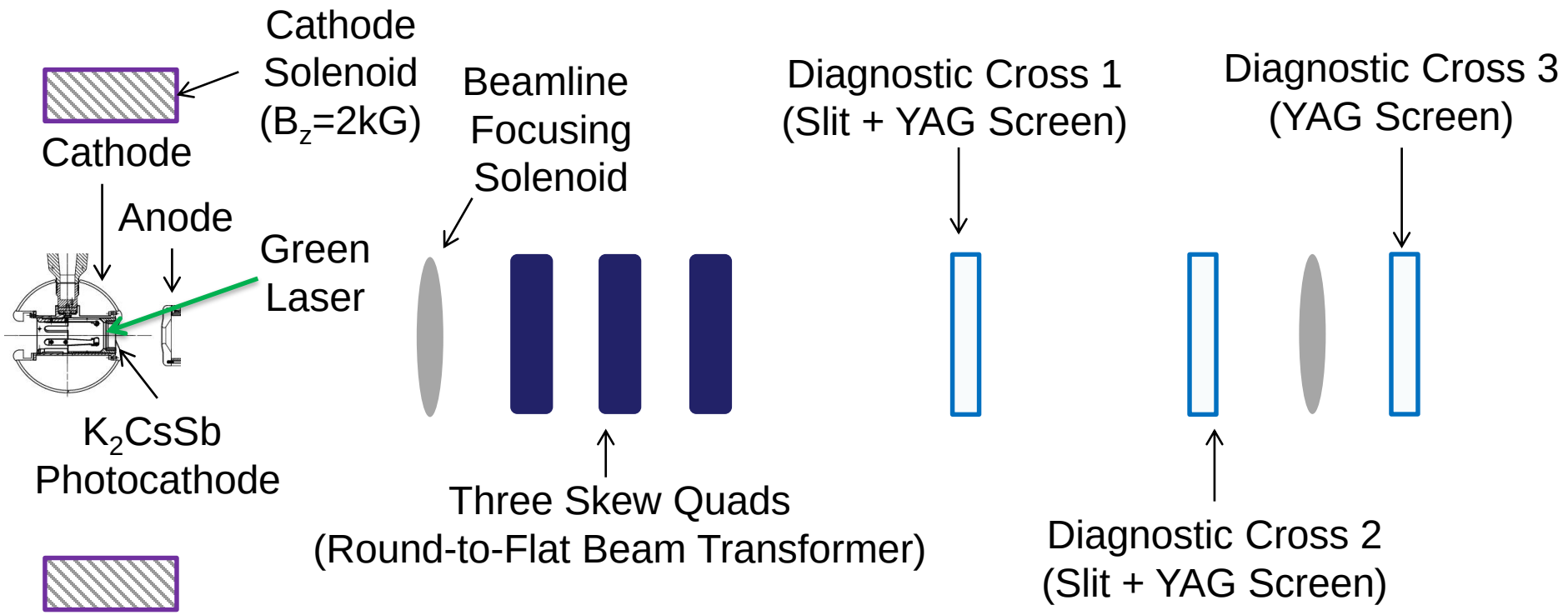
1. Cathode solenoid magnet and pucks
2. Three skew quadrupoles
3. Beamline hardware
4. Laser components

FY16	$339,211
FY17	$265,850
FY18	$212,025
Total	**$817,086**

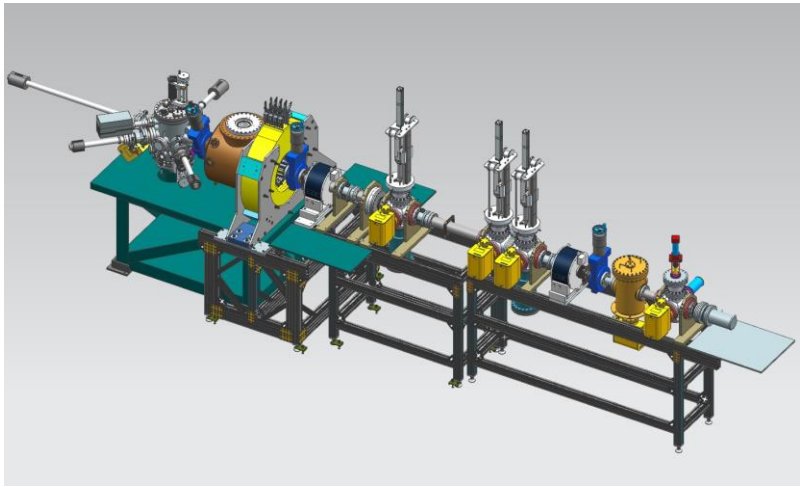
Labor:

1. Cathode magnet design, procurement, mapping and installation
2. Mechanical designer for cathode magnet support, pucks, slits and beamline
3. ASTRA and GPT modeling (Fay Hannon)
4. Postdoc – years 2 and 3

Experimental Overview: Gun Test Stand

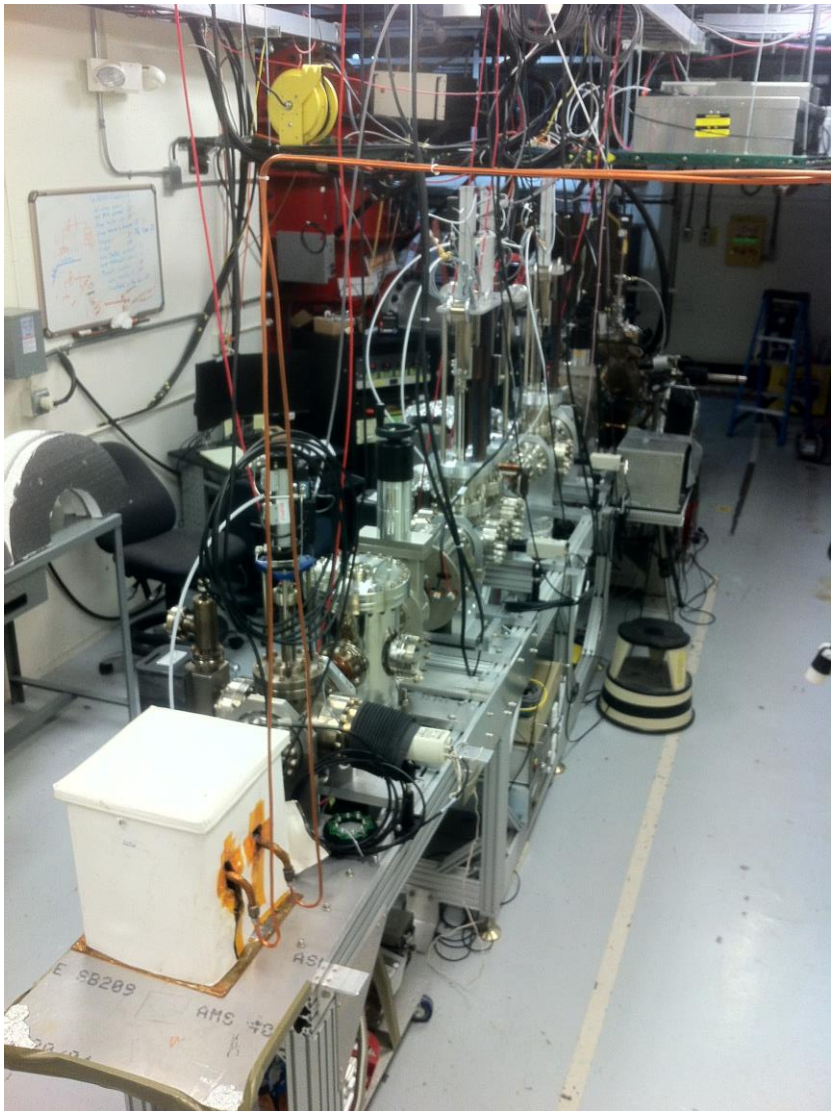


- Generate magnetized beam:
  - Laser size:1 – 5 mm, B_z = 0 – 2 kG
  - Bunch charge: 1 – 500 pC
  - Frequency: 15 Hz – 476.3 MHz
  - Bunch length: 10 – 100 ps
  - Average beam currents up to 32 mA
  - Gun high voltage: 200 – 350 kV



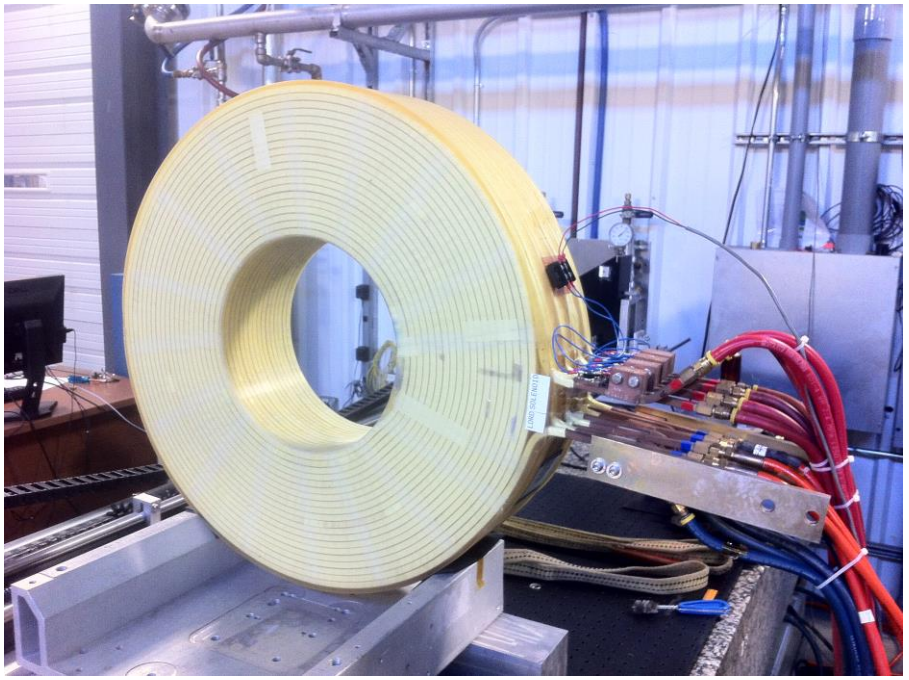
FY16 Accomplishments

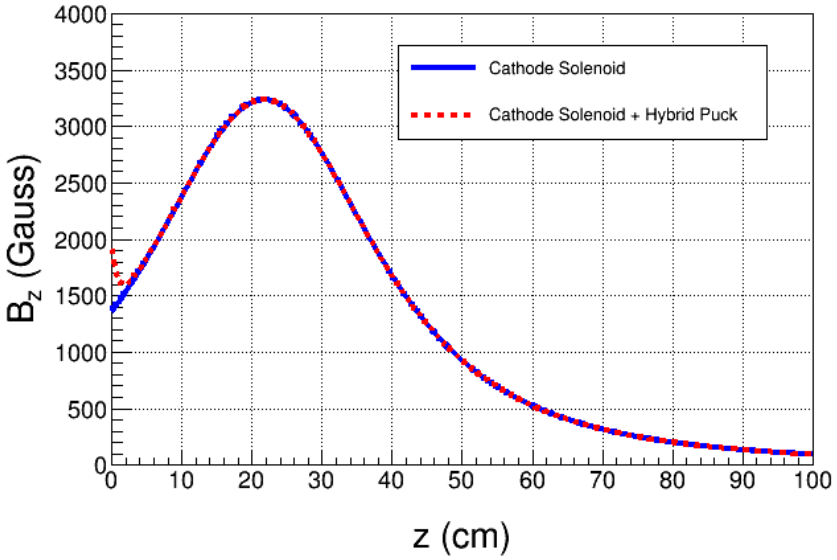
- K_2CsSb Photocathode Preparation Chamber, Gun and Beamline: <u>delivered 1 mA to dump</u> (non-magnetized)

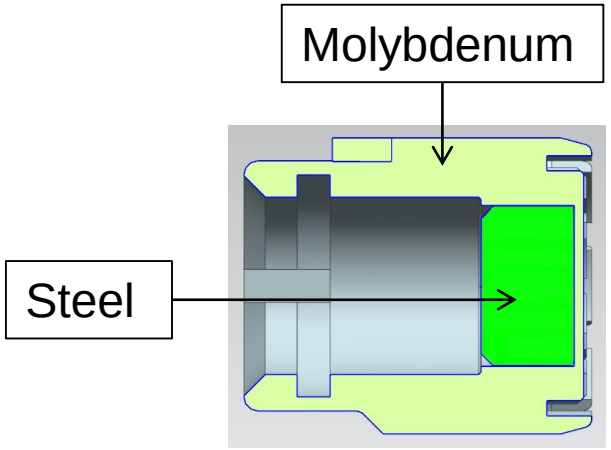


- Simulation (Fay Hannon):
  - Used ASTRA and GPT simulation to design beamline and to locate magnets and diagnostics at optimum positions
  - Simulated magnetized electron beam properties along beamline for various starting conditions
  - Simulated a round to flat transformer

- Cathode Solenoid Magnet
  - Magnet is now at Magnet Measurement Facility to be mapped
  - Magnet Power Supply: Use new spare CEBAF Dogleg magnet power supply (500A, 80V)







- New Pucks
  - Designed to enhance magnetic field at cathode to 2.0 kG