Generation and Characterization of Magnetized Bunched Electron Beam from DC High Voltage Photogun for JLEIC Cooler

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Motivation

Jefferson Lab Electron Ion Collider (JLEIC) bunched magnetized electron cooler is part of Collider Ring and aims to counteract emittance degradation induced by intra-beam scattering, to maintain ion beam emittance during collisions and extend luminosity lifetime

Magnetized Cooling

Ion beam cooling in presence of magnetic field is much more efficient than cooling in a drift (no magnetic field):

- Electron beam helical motion in strong magnetic field increases electron-ion interaction time, thereby significantly improving cooling efficiency
- Electron-ion collisions that occur over many cyclotron oscillations and at distances larger than cyclotron radius are insensitive to electrons transverse velocity
- Cooling rates are determined by electron longitudinal energy spread rather than electron beam transverse emittance as transverse motion of electrons is quenched by magnetic field
- Magnetic field suppresses electron-ion recombination





- Using spare CEBAF Dogleg magnet power supply (500 A, 80 V)
- Learned that gun solenoid can influence field emission
- First trials with gun at high voltage and solenoid **ON** resulted in new field emission and vacuum activity
- Procedure to energize solenoid without exciting new field emitters



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- B_z : solenoid field at photocathode

Summary & Plans

- K₂CsSb Photocathode Preparation Chamber, Gun HV Chamber, Gun Solenoid and Beamline are all operational Photogun operates reliably at 300 kV Cathode solenoid can trigger field
- emission but we have learned how to
- Have successfully magnetized electron beam and measured rotation angle Delivered 1.5 mA DC magnetized beam
- Preparing to install a mode-locked drive laser, to generate mA magnetized beam
- Build and install TE_{011} cavity to measure
- Switch to 32 mA 225 kV HV power supply

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