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 – serious problem especially for heavy ions

Magnetization Measurements Beam and beamlet observed on successive viewers 1514 G at photocathode 0 G at photocathode S1-V2 S1-V3 S1-V2 S1-V3 Beam Size and Rotation: Experiment vs GPT simulation ----σ (V2 data) Gun HV: 300 kV, laser RMS = 0.3 mm $-\sigma$ (V2 sim) θ for S1-V2 (data) $-\theta$ for S1-V2 (sim) B, at Photocathode (G) Strong magnetic field of cathode solenoid causes mismatch oscillations, resulting in repeated focusing inside solenoid which affects beam size at exit of solenoid. These mismatch oscillations introduce varying beam profile expansion rates and shearing angles in field free region.

Modelled apparatus using ASTRA & GPT









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