Magneto-Optic Kerr Effect in a Magnetized Electron Gun

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DC high voltage photoguns successfully generate electron beams. Magnetized electron beams result from electron production via photoemission within a solenoid magnetic field. As opposed to un-magnetized electron beam sources, magnetized sources have potential to improve ion beam cooling efficiency quite significantly. Beam magnetization depends greatly on the applied magnetic field. The latter has been modeled and will be measured. Due to electron beam specifications, the photocathode will be in a relatively extreme vacuum state. Measuring and monitoring magnetic field at beam source with a probe without disrupting vacuum borders impossibility.

The magneto-optic Kerr effect (MOKE), describes the change operated on polarized light by its reflection off of a magnetized source. The reflection off of the magnetized surface may alter the light’s polarization direction, ellipticity, or intensity. In contrast to the Faraday Effect where magneto-optic effects occur as the wave transverses through bulk matter, MOKE concerns only the magnetized surface. By swapping the photocathode with a magnetic sample such as iron, we may then infer the magnetic field at the source.

A controlled MOKE system has been assembled capable of being reassembled in situ. It consists of a low power laser, polarizers to define and analyze light, a photo-elastic modulator that supplies a high frequency modulation of light polarization to improve signal to noise ratio, and a polished iron foil versatile in controlled and on site tests. Controlled tests use strong rare earth magnets to imitate the solenoid fields. Calibration of the MOKE system on site with the solenoid magnet occurs during field mapping. The “Kerr-mometer” will be available as a diagnostic of the magnetic field strength and uniformity, providing an adequate description of the field at electron beam source. The report summarizes the method and results of controlled tests and on site, field mapping calibration.