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A 5 MeV Compton transmission polarimeter designed for a SRF photogun

Content

The production of high-current and intense spin polarized electron beams is of great importance in electron-based facilities. Tests are planned to produce such beams in 2023 using GaAs-based photocathodes installed in the Brookhaven National Lab RHIC Coherent electron Cooling superconducting radiofrequency (SRF) photogun [1]. A fast and efficient electron polarimeter operating in the MeV energy range is required to measure the beam spin polarization.

While Mott polarimeters provide larger measured asymmetries, a Compton Transmission polarimeter is well suited in the few MeV energy range. In this work, we report on a relatively compact and cost-effective Compton transmission polarimeter which has been built and calibrated at Jefferson Lab (JLab). First, we present the design of the polarimeter radiator, polarized target analyzing magnet, BGO detector assembly and data acquisition system. Next, results of a two-week commissioning study performed at the JLab Upgraded Injector Test Facility will be described. Here, a well-known polarized electron beam produced from a bulk GaAs photocathode in a dc high-voltage photogun was first measured in a 180 keV Mott scattering polarimeter, then used to characterize and calibrate the Compton transmission polarimeter as a function of the polarized target magnetization and beam properties. Finally, we report an effective analyzing power of the Compton polarimeter and compare experimental results with those produced via Geant4 simulations.

Footnotes

[1] I. Petrushina et al., "High-Brightness Continuous-Wave Electron Beams from Superconducting Radio-Frequency Photoemission Gun" Phys. Rev. Lett. 124, 244801 (2020)

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