A 200 keV Wien Filter Spin Rotator Design and High Voltage Evaluation

G. Palacios1, 2, P. Adderley2, H. Baumgart2, J. Benesch2, D. Bullard2, J. Grames2, C. Hernandez-Garcia2, A. Hofler2, D. Machie2, M. Poelker2, M. Stutzman2 and R. Suleiman2

1Old Dominion University, Dept. of Electrical Engineering. Norfolk, Virginia 23529, USA

2Thomas Jefferson National Accelerator Facility Newport News, Virginia 23606, USA

High-energy nuclear physics experiments at the Jefferson Lab Continuous Electron Beam Accelerator Facility (CEBAF) require highly spin-polarization electron beams. The electron beams are produced from strained super-lattice GaAs photocathodes, activated to negative electron affinity in a photogun operating at 130 kV direct current. The orientation (direction) of the electron beam polarization at the end station experiment target is defined by a pair of Wien filter spin rotators located in the injector. An upgrade of the CEBAF injector to better support the upcoming Moller experiment requires increasing the electron beam energy to 200 keV, to reduce unwanted helicity correlated beam intensity and beam position systematics and provide precise control of the beam polarization orientation.

Our contribution describes electrostatic and magnetostatic modeling and simulations for upgrading the Wien spin rotator design to increase the electric field from 1.6 to 2.7 MV/m and the magnetic field from 9.1 to 13 mT. This required detailed modeling of the Wien filter using Solidworks, CST and Opera, improving the high voltage vacuum feedthroughs, as well as assembly techniques for improving electrode alignment. The electric and magnetic field components required by the Wien condition and the successful high voltage characterization under vacuum conditions will also be presented.

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