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Laser System for Jefferson Lab's Hall C Compton Polarimeter[1]

ERIC HOLLAND, St.Anselm College/ODU/Jlab — At Thomas Jefferson National Accelerator Facility a polarized electron beam is used to study the properties of nuclei. Currently, in Hall C a Møller Polarimeter is used to measure the electron beam polarization. This process is accurate but during measurements the experiment is interrupted (destructive measurement). Since Møller measurements can only be done at low beam current < I microAmp and the experiments typically run near 100 microAmps, one has to assume that the polarization remains constant between measurements. To supplement the Møller Polarimeter, Hall C is constructing a Compton Polarimeter, which performs non-destructive electron beam polarization measurement by Compton scattering. The purpose of this research is to optimize the laser component of the Compton Polarimeter. A fiber optic pulsed laser, with the same radio frequency as the electron beam (499MHz), was chosen to improve the luminosity and thus the number of Compton events. The current choice of laser alone would be adequate for Hall C; however, a higher power system would provide two obvious benefits: the time needed for a measurement would decrease, and the signal to background ratio would increase. A Fabry-Perot optical cavity was proposed to achieve a gain in the laser power. Due to cavity conditions and geometrical restraints, it was determined that a cavity of length 1.2 meters would best satisfy the needs of the Compton Polarimeter. Our results strongly suggest that a gain switched pulsed laser cannot be coupled to an external optical cavity. A possible explanation is that the process of gain switching does not produce a mode-locked pulse train. Within each pulse it is possible that the Gaussian may be coherent but from pulse to pulse the coherence does not held. Mode locking is necessary for realizing a successful optical cavity. .

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