Beam Heat Load Effect on Polarization in the SpinQuest Experiment

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Abstract

The SpinQuest experiment at Fermilab aims to measure the Sivers asymmetry for light sea quarks in the longitudinal momentum fraction range of $0.1 < x_B < 0.5$ using polarized observables from the Drell-Yan process. This requires polarized NH_3 and ND_3 targets. The experiment employs Fermilab's 120 GeV main injector proton beam, delivering approximately $3x10^{12}$ protons per second over a 4.4-second spill. The SpinQuest target system includes a superconducting split-pair magnet with a 5T magnetic field and 8cm long transversely polarized target cells. During high-intensity spills, the lattice temperature of ammonia can increase due to inter-facial resistance from the heat load of the beam for large solids. The helium-4 evaporation refrigerator, operating at 1 Kelvin with a pumping rate of 17,000 m^3/hr, helps maintain low temperatures but can cool inside of the solid state target material. The short spill may allow the material to be configured in a way that reduces the packing fraction with more polarized nucleons per target load improving the overall figure of merit of the polarized observable measurement. This could only be done if the target material surface area to volume is optimized with respect to the heat load over the duration of the spill so cooling is still possible and thermal depolarization of the target does not occur over the spill. In my presentation, I will discuss the possibility of geometrically enhancing the packing fraction of the target material using a thermal analysis.