The Polarized-Target System for the SpinQuest Experiment at Fermilab

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Abstract

The SpinQuest experiment at Fermilab aims to measure the Sivers asymmetry for the $\bar{u}$ and $\bar{d}$ sea quarks in the range of $0.1 < x_B < 0.5$ using the Drell-Yan production of dimuon pairs. A nonzero Sivers asymmetry would provide evidence for nonzero orbital angular momentum of the sea quarks. The proposed beam intensity is 1.5×10^{12} of 120 GeV unpolarized proton/sec. The experiment utilizes a target system consisting of a 5T superconducting magnet, transversely polarized NH_3 and ND_3 targets, a ^{4}He evaporation refrigerator, a 140 GHz microwave source and a large pumping system. The expected average target polarization is 80% for the protons and 32% for the deuterons. The polarization will be measured with three NMR coils per target cell. A quench analysis and simulation in the superconducting magnet are performed to determine the maximum intensity of the proton beam before the magnet become resistive. The simulation of quenches in the superconducting magnets is a multiphysics problem of high complexity. The heat transfer from metal to helium goes through different transfer and boiling regimes as a function of temperature, heat flux, and transferred energy. All material properties are temperature dependent. A GEANT based simulation is used to calculate the heat deposited in the magnet and the subsequent cooling processes are modeled using the COMSOL Multiphysics. In this presentation, I will describe the polarized-target system installed for the SpinQuest experiment at Fermilab