Absolute Polarimetry for the Proton Beams of the RHIC Spin Collider and HERA

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Abstract

Measurements of spin dependent structure functions in a colliding beam environment will require absolute beam polarimeters.

There is considerable interest in the spin physics community to develop polarimetry methods for beams in the multi-100 GeV/c range. In the beginning of the next century, polarized proton beams in the range, 100-250 GeV, will become available at RHIC used in the p-p collider mode. A workshop at DESY this year studied the option of polarizing the 820 GeV proton beam of Hera to support programs on deep inelastic spin and di-jet physics. Polarized proton beams might become available after the year 2000. Both facilities, RHIC and HERA, would require polarimeters to measure the absolute value of the beam polarization with high accuracy (5 percent at RHIC). Inclusive production of pions exhibits large analyzing power and high count rate at 200 GeV/c^2, an excellent option for measuring relative values of the beam polarization. A polarimeter for measuring the absolute value of the beam polarization should satisfy the criteria: 1. Large analyzing power; 2. Extraction of the beam polarization from the measured asymmetry should not depend on knowledge of hadronic amplitudes subject to theoretical uncertainty. 3. High count rate capability is a desirable but not necessary property since use would be limited to occasional (but essential) periods to calibrate the inclusive pion polarimeter. With these conditions in mind, two types of polarimeters suggest themselves. The first is based on the longitudinal asymmetry in electron-proton (e-p) polarized deep inelastic scattering (PDIS) and elastic scattering. In the case of the former, PDIS asymmetry data[1] at 9.7 GeV provide the analyzing power. For example, the kinematics to produce the same center of mass energy requires the collision of a 250 GeV (RHIC energy) beam with a 19.7 MeV electron beam. The 9.7 Gev data taken at SLAC exhibits a virtual photon asymmetry in the range of 0.05-0.31. The second option of polarimetry is based on the equality of analyzing power and polarization in elastic p-p scattering. The method involves the measurement of the analyzing power (using a polarized target) and the asymmetry at -t = 1.7 (GeV/c)^2, the second maximum in the analyzing power.

[1] K. Abe et al., Phys.Lett.B364(1995)61