Search for single transverse-spin asymmetry in forward production of photons and neutrons in pp collisions at $\sqrt{s} = 200$ GeV

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The relativistic heavy ion collider (RHIC) at the Brookhaven National Laboratory (BNL) was commissioned for polarized pp scattering during its run in 2001-2002. In this run an exploratory effort was mounted at one of its unused interaction points (RHIC IP12) to see if there exist single transverse-spin asymmetries in the production of photons and neutrons at very forward angles for the RHIC operating center of mass energy $\sqrt{s} = 200$ GeV for this year. Such asymmetries have been observed in the past for lower $sqrtS \approx 20$ GeV, but it remained to be seen if the asymmetries persisted at RHIC energies where the interplay between soft and hard QCD processes is expected to different. Our experiment was motivated by potential use of such asymmetries as a basis for building a polarimeter for RHIC.
The apparatus used for this experiment consisted of a lead tungstate crystal electromagnetic calorimeter, hodoscopes for triggering the DAQ on pp collisions, preshower counters and scintillator counters that served to indicate the presence of neutrons (hence called the neutron counters) behind steel and lead blocks. The neutral pions were observed through the decay photons and were used to control systematics and energy calibration. Various data and run selection criteria were developed to enhance the sample of neutral pion/photon and neutron events. Geant Monte Carlo simulation were tuned to reproduce the calibration experiment done prior to the RHIC polarized proton commissioning at the Stanford Linear Accelerator Center (SLAC) using a 10 GeV electron beam from the Final Focus Test Beam (FFTB) facility. Simulations were also used to understand the acceptance its uncertainty, the particle identification, mainly photon vs.neutron response in our detector and their associated uncertainties. Our experiment and the present status of the data analysis will be presented in this paper.