Measurements of Single and Double Spin Asymmetries in *pp* Elastic Scattering in the CNI region with Polarized Hydrogen Gas Jet target

H. Okada[1,2], I. Alekseev[3], A. Bravar[4], G. Bunce[4,5], S. Dhawan[6], K.O. Eyser[7], R. Gill[4], W. Haeberli[8], H. Huang[4], Y. Makdisi[4], I. Nakagawa[1,5], A. Nass[9], N. Saito[2], E. Stephenson[10], D. Sviridia[3], T. Wise[8], J. Wood[4], and A. Zelenski[4]

[1] RIKEN, Wako, Saitama, 351-0198, Japan; [2]Kyoto University, Kyoto 606-8502, Japan
[3] Institute for Theoretical and Experimental Physics (ITEP), 117259, Moscow, Russia
[4] Brookhaven National Laboratory, Upton, NY 11973, USA
[5] RIKEN BNL Research Center, Brookhaven National Laboratory, Upton, NY 11973-5000, U.S.A.
[6] Yale University, New Haven, CT 06520, USA; [7] University of California, Riverside, CA 92951, USA
[8] University of Wisconsin, Madison, WI 53706, USA; [9] University of Erlangen, 91058 Erlangen, Germany
[10] Indiana University Cyclotron Facility, Bloomington, IN 47408, USA

A precise measurement of the single spin asymmetry, A_N, in *pp* elastic scattering in the region of four-momentum transfer squared $0.001<|t|< 0.032$ $(\mathrm{GeV}/c)^2$ has been performed using a polarized atomic hydrogen gas jet target and the 100GeV/*c* RHIC proton beam ($\sqrt{s}$=13.7GeV). This kinematic region is known as the Coulomb Nuclear Interference (CNI) region. The interference of the electro-magnetic spin-flip amplitude with a hadronic spin-non-flip amplitude is predicted to generate a significant A_N of 4-5\%, peaking at $|t|\approx 0.003$ $(\mathrm{GeV}/c)^2$, and the presence of a hadronic spin-flip amplitude would modify this calculable prediction.

The hydrogen gas jet target system provides highly polarized atomic hydrogen, $P_t = 0.924 \pm 0.018$. The system performance meets the design specifications. The recoil spectrometer, which consisted of the three left-right symmetric pairs of silicon detectors, was newly developed for this experiment. We have collected 4 million elastic *pp* events in the region of $0.001<|t|<0.032$ $(\mathrm{GeV}/c)^2$.

We present the first precise results of A_N in the CNI region as a function of |t| which were measured in 2004 ($\Delta A_N/A_N \sim 0.05$). Our data are well described by the CNI prediction with the electro-magnetic single spin-flip amplitude alone and do not support the presence of a large hadronic single spin-flip amplitude.

At the same time, we have also accomplished the precise measurement of the double spin asymmetry, A_{NN}, in the same |t| region for the first time. A_{NN} measurement in the CNI region. Since there is no purely one photon exchange contribution to this asymmetry, A_{NN} is sensitive to the hadronic double spin-flip amplitude. However there is no solid theoretical prediction for its energy dependence nor magnitude. The new results of A_{NN} for each measured points are consistent with zero within the errors.

A_N and A_{NN} results in the CNI region provide significant constraints to determine the magnitude of poorly known hadronic single and double spin-flip amplitudes at this energy.