RCNP EXPERIMENT E320

PROPOSAL FOR EXPERIMENT AT RCNP

10 July 2008

TITLE:
Measurements of absolute cross section of *pd* scattering at 135 and 65 MeV to pin down three nucleon force effects

SPOKESPERSON:

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RUNNING TIME: 4 days

BEAM LINE: Ring: WS course, Grand Raiden & LAS

BEAM REQUIREMENTS:

Type of Particle	proton
Beam Energy	135 MeV, 65 MeV
Beam Intensity	10 nA
Energy Resolution	$\leq$ 200 keV

BUDGET:

Experimental expenses	200,000 JPY

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SPOKESPERSON : Kimiko Sekiguchi

SUMMARY OF THE PROPOSAL

A current topic of present day few-nucleon system studies is to learn how important three-nucleon forces (3NFs) are and explore their properties. Indication of 3NF effects in three-nucleon scattering first came from study of the cross section for nucleon–deuteron (Nd) elastic scattering at intermediate energies ($E/A \sim 100$ MeV). However so far a serious discrepancy exists in the cross section for proton–deuteron (pd) elastic scattering at an incident nucleon energy 135 MeV between the data taken at RIKEN/RCNP and those at the KVI Groningen. While the data taken at RIKEN and RCNP provide consistent results, the previously reported KVI are systematically lower than 20–40% than our data and their newly obtained data fall down between the RIKEN/RCNP data and the previous KVI data. The 3NF effects are theoretically predicted about 30% for elastic Nd scattering at 135 MeV. Therefore the difference between the RIKEN/RCNP data and the KVI ones is so large and should be resolved, although absolute value measurements are technically very difficult.

We propose the cross section measurement for elastic pd scattering in which scattered protons and recoil protons are detected simultaneously at the laboratory angles $\theta_{\rm lab.} = 13^\circ$–$52^\circ$, by which the cross sections at the forward angles in the center of mass (c.m.) system and those at the backward angles are determined with less experimental uncertainties. The corresponding angles in the c.m. system are 20°–150° for pd elastic scattering. Since the theoretical predictions are insensitive to the nucleon-nucleon (NN) interactions and the experimental data are in good agreement with the predictions at forward angles, one can study how the predictions with and/or without 3NFs at backward angles describe the data by using the obtained ratio. In order to determine the absolute values experimentally we measure the cross section for pd scattering with D_2 gas target and the double slit system.

Also we measure the cross section for elastic pd scattering at 65 MeV. At this energy the newly obtained KVI data are consistent to the RCNP data.