RCNP EXPERIMENT E206

PROPOSAL FOR EXPERIMENT AT RCNP

26 January 2003

TITLE:

Energy dependence of A_{xx} discrepancy in pd radiative capture

SPOKESPERSON:

Full name	Kenshi Sagara
Institution	Department of Physics, Kyushu University
Title of Position	Professor
Address	Hakozaki 6-10-1, Higashi-ku, Fukuoka, 812-8581 Japan
Phone number	+81-92-642-2546
Fax number	+81-92-642-2546
E-mail	sagara@kutl.kyushu-u.ac.jp

EXPERIMENTAL GROUP:

Kenshi Sagara	Department of Physics, Kyushu University	(P)
Tetsuo Noro	Department of Physics, Kyushu University	(P)
Takashi Kudoh	Department of Physics, Kyushu University	(M1)
Masato Shiota	Department of Physics, Kyushu University	(M1)
Shinsuke Simomoto	Department of Physics, Kyushu University	(M1)
Takashi Ishida	Department of Physics, Kyushu University	(D1)
Takahisa Yonemura	Department of Physics, Kyushu University	(M1)
Shun Asaji	Department of Physics, Kyushu University	(M1)
K. Hatanaka	RCNP, Osaka University	(P)
Y. Sakemi	RCNP, Osaka University	(AP)
T. Wakasa	RCNP, Osaka University	(A)
H. Yoshida	RCNP, Osaka University	(RA)
J. Kamiya	RCNP, Osaka University	(D3)
Y. Shimizu	RCNP, Osaka University	(D1)
K. Fujita	RCNP, Osaka University	(M2)
Y. Tameshige	RCNP, Osaka University	(M1)
A. Tamii	Department of Physics, University of Tokyo	(A)
H. Kuboki	Department of Physics, University of Tokyo	(M1)

RUNNING TIME:	Installation time without beam	3 days
	Development of device	1 days
	Test running time for experiment	1 days
	Data runs	5 days
BEAM LINE:		Ring:WS course
BEAM REQUIREMENTS:	Type of particle	polarized d
	Beam energy	140 MeV
	Beam intensity	$\leq$10 nA
	Any other requirements	no hallo
BUDGET:	Experimental expenses	750,000 yen
	(including travel expenses of 400,000 yen)	

TITLE:

Energy dependence of A_{xx} discrepancy in pd radiative capture

SPOKESPERSON: Kenshi Sagara

SUMMARY OF THE PROPOSAL

Introduction of a 2π-exchange 3N force (2π3NF) has succeeded in excellently eliminating large discrepancies between 3-nucleon (3N) experiments and calculations based on 2-nucleon forces (2NF) in 3N binding energies and in the cross section minimum of Nd scattering. However, remarkable A_y puzzle in Nd scattering below 30 MeV and small discrepancies in vector and tensor observables in Nd scattering above 70 MeV can not be explained by 2π3NF, indicating the existence of origins other than 2π3NF, for example new 3NF's or new reaction mechanisms. To elucidate the origins, typical discrepancies are highly desired.

In our previous experiment (E126), we found a very large discrepancy in A_{xx} of pd radiative capture at $E_{\vec{d}} = 200$ MeV. The discrepancy appears in the whole angular range and is much greater than the contribution of 2π3NF. The A_{xx} discrepancy is the largest and clearest discrepancy in tensor observables so far found in 3N experiments. Before E126, no A_{xx} had been measured with cyclotron beams. We measured A_{xx} by detecting ^{3}He recoils from pd capture in the vertical plane by using LAS, with the polarization axis of the beam from the Ring cyclotron being in the vertical direction. Since the cross section of pd capture is very small as below 0.3mb/sr, we increased the counting rate of ^{3}He and reduced background level by using a liquid hydrogen target having thin window foils. The pd capture A_{xx} and A_{yy} measured at $E_{\vec{d}} = 200$ MeV have nearly equal values. Below $E_{\vec{d}} = 17.5$ MeV where pd capture experiments were made with tandem accelerators, the pd capture A_{xx} and A_{yy} have also nearly equal values. It is natural to expect that pd capture A_{xx} and A_{yy} have nearly equal values in a wide energy range, although experimental confirmation is necessary. Theoretically, pd capture A_{xx} and A_{yy} are nearly equal below 50 MeV, however, they become different to each other above 50 MeV. The theoretical predictions are essentially the same regardless of 2NF models and reaction models (meson-exchange model or Siegert approximation). Therefore A_{xx} discrepancy is expected to appear above 50 MeV.

In order to see energy dependence of the A_{xx} discrepancy, new measurements at around 100 MeV and at around 300 MeV are necessary. Our proposal is the experiment at the former energy. We choose the energy of 140 MeV because the analyzing powers of pd scattering have been measured at this energy at RIKEN and the data necessary for the beam polarimeter have already been prepared. A liquid hydrogen target of about 1.5-mm in thickness was used in our previous experiment at 200 MeV, and an about 1-mm thick target is necessary in the proposed experiment at 140 MeV. We have already developed the about 1-mm thick liquid target having thin (4μm-thick) window foils. The experimental setup and method at 140 MeV are almost the same as those at 200 MeV.