RCNP EXPERIMENT E271

PROPOSAL FOR EXPERIMENT AT RCNP

21 July 2005

Measurement of A_{zz} in pd radiative capture at $E_{\vec{d}} = 200$ MeV

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RUNNING TIME: @	Setup with beam	2 days
@	Development of the P_{zz} beam	1 day
@	Data runs	6 days
	Total	9 days
BEAM LINE:	Ring, WS course, LAS	
BEAM REQUIREMENTS:	Type of particle	polarized d
@	Beam energy	200 MeV
@	Beam intensity	≤10 nA
@	Any other requirements	P_{zz} beam
BUDGET:	Experimental expenses	1,500,000 yen

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SUMMARY OF THE PROPOSAL

Introduction of a 2π-exchange 3N force (2π3NF) has succeeded in excellently eliminating large discrepancies between 3-nucleon (3N) experimental data and calculations based on 2-nucleon forces (2NF). Recent calculations reproduce 3N binding energies, the differential cross section arround minima of the vector nanalyzing power of Nd scattering at intermediate energies quite well. However, remarkable A_y puzzle in Nd scattering below 30 MeV and some discrepancies in vector and tensor observables in Nd scattering above 60 MeV can not be explained by 2π3NF, indicating the existence of ingredients other than 2π exchange processes, for example new 3NF's or new reaction mechanisms. To elucidate the origins of those discrepancies, more experimental data are highly required including spin observables in a plenty of 3N systems as elastic scattering, brakeup processes and radiateive capture.

In our previous experiments (E126 and E206), we found a very large discrepancy in A_{xx} of pd radiative capture at $\mathrm{E}_{\vec{d}} = 200$ and 140 MeV. It appears in the whole angular range and is much greater than the contribution of 2π3NF, and is the largest and clearest discrepancy in tensor observables so far found in 3N experiments. The radiative capture reaction is an interesting channel since it involves a large momentum transfer and probes high-momentum components of the wave functions. The coupling with a photon makes this reaction sensitive to electromagnetic currents involved in the 3N system. To investigate the effects of the short distance collision, i.e. large momentum transfer process, an expriment (E233) was proposed to measure A_{xx} of dd radiative capture. On the other hand, new experimental data were recently taken at the KVI on vector and tensor analyzing powers of the pd radiative capture at 55, 66.5 and 90 MeV/nucleon. They reported their data are described well by the Faddeev calculations. They measured A_{yy} and A_{zz}. From our data of A_{xx} and A_{yy}, A_{zz} is evaluated from the relation, $A_{xx} + A_{yy} + A_{zz} = 0$. There are discrepancies of almost factor two between RCNP and KVI results. Our data are being carefully reanalyzed independently and the first result is consistent with the previous one. It is badly required to experimentally clarify the origins of the discrepancies among data.

In the present proposal, we measure A_{zz} of the pd capture at $\mathrm{E}_{\vec{d}} = 200$ MeV. Beam is longitudinally polarized and recoiled ^{3}He particles are detected by using LAS set at 0°. Since the cross section of the pd capture is very small, less than 0.3 μb/sr, we increase the counting rates of ^{3}He and reduce backgrounds by using a liquid hydrogen target with thin windows. The tharget is 1.5 mm in thickness. A_{xx} is measured in the same geometry with the vertically polarised beam to confirm the consistency of the detection system. A_{yy} and A_{zz} of the dp elastic scattering are also measured to calibrate the beam line polarimeter by refering data taken at RIKEN. This experiment makes it possible to resolve the contradictions in experimental data and to establish the methods to make versatile measurements with polarized deuterons at intermediate energies at the RCNP.