RCNP EXPERIMENT E233

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:

Tensor analyzing powers in *dd* radiative capture

SPOKESPERSON:

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RUNNING TIME:

Installation time without beam	2 days
! Development of device	1 days
! Test running time for experiment	1 days
! Data runs	6 days

BEAM LINE: Ring:WS course

BEAM REQUIREMENTS:

Type of particle	polarized d
! Beam energy	200 MeV
! Beam intensity	$\leq$50 nA
! Any other requirements	horizontal/vertical polarization

BUDGET:

Experimental expenses 500,000 yen
(including travel expenses of 400,000 yen)

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SUMMARY OF THE PROPOSAL

In our measurement of $\vec{d} + p \rightarrow {}^3$He+$\gamma$ reaction at $E_d = 200$ MeV, we found a large discrepancy between the measured A_{xx} and calculated A_{xx}. Recent meson-exchange calculation by Bochum group, calculations in Siegert theorem (long wane-length approximation) and calculation by Hannover group similarly predicted the large discrepancy in A_{xx}. We call the discrepancy as A_{xx} anomaly. There is disagreement also in A_{yy} between the experiment and calculations, but the A_{yy} disagreement is considerably small compared to A_{xx} anomaly.

Last year we made another *pd* capture experiment at $E_d = 140$ MeV (E206). The present very preliminary data indicate that A_{xx} anomaly does exist also at 140 MeV and disagreement in A_{yy} is small. At also $E_d = 17.5$ MeV we measured analyzing powers of *pd* capture using a polarized *d*-beam from Kyushu University tandem accelerator. At this low energy, both A_{xx} and A_{yy} are fairly well agree with calculations. Therefore, A_{xx} anomaly starts from about 50 MeV.

One more curious phenomenon in *pd* capture is the relation of $A_{xx} \approx A_{yy}$ which holds at 17.5, 140 and 200 MeV. In other *d*-induced reactions such as (d, d) (in)elastic scatterings, (d, p) reactions, or $d + p$ breakup, we could see the tendency that A_{xx} and A_{yy} have opposite signs, i.e.. $A_{xx} \approx -kA_{yy}$ approximately holds with k ranging from about 0.5 to about 2. Why *pd* capture alone has A_{xx} and A_{yy} of the same sign?

As well known, d is a widely spread nucleus in which p and n are loosely bound. In d-induced scatterings or stripping reactions, the outer part of d may largely contribute. In *pd* capture reaction, however, d and p make a compact nucleus of ^{3}He, and only the central part of d may contribute. It is reasonable, therefore, to assume that tensor force at the outer part of d and tensor force at the central part of d are different and have opposite signs to each other. The tensor force at the central part may have connection with 3-nucleon forces. If this assumption is valid, the relation $A_{xx} \approx A_{yy}$ holds also in *dd* capture reaction because ^{4}He is a very compact nucleus. This is our motivation of this proposal.

From A_{yy} and A_{zz} data of *dd* capture at $E_d = 50$ MeV (LBL), we can see that $A_{xx} \approx A_{yy}$ roughly holds. To confirm the $A_{xx} \approx A_{yy}$ relation in *dd* capture, we need more precise data on A_{xx} and A_{yy} and energy dependence of A_{xx} and A_{yy}.

Recoil ^{4}He from *dd* capture comes out in a laboratory system at forward angles up to 8.5 ° which is larger than the vertical acceptance of LAS. Therefore, we need a horizontally polarized *d*-beam to measure A_{xx}.