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

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In our previous experiment on *pd* radiative capture at $E_d = 200$ MeV [1], we found (1) $A_{xx}$ largely disagrees with theoretical predictions even if three-nucleon force is introduced and (2) $A_{xx}$ is nearly equal to $A_{yy}$ contrary to theoretical predictions. At 17.5 MeV [2], we found (1) $A_{yy}$ and $A_y$ are fairly well reproduced by calculations and (2) $A_{xx}$ is nearly equal to $A_{yy}$. From these facts we assume that $A_{xx}$ and $A_{yy}$ are nearly the same at any energy, whereas calculated $A_{xx}$ and $A_{yy}$ are nearly the same at low energy and largely different at higher energy. To examine the assumption, we made a new *pd* capture experiment at $E_d = 140$ MeV at RCNP.

Experimental setup was nearly the same as the previous one at 200 MeV: A vertically-polarized d-beam and an unpolarized *d*-beam were accelerated alternately, and the beam polarizations ($p_{yy}$ and $p_y$) were measured during the experiment by a beam-line polarimeter using *pd* scattering. The beam was incident on a liquid hydrogen target of 11 mg/cm$^2$ (=1.5 mm) in thickness having aramide window foils of 0.6 mg/cm$^2$ in thickness. The target thickness was monitored by detecting scattered *d* and recoil *p* from the target in coincidence in the scattering chamber.

From *pd* radiative capture, $^3$He is recoiled out at forward angle within 3.8° in the laboratory frame . Recoil $^3$He were detected using LAS (Large Acceptance Spectrometer) which has an acceptance of ±3.4° in the horizontal plane and of ±5.7° in the horizontal plane.

First, LAS was set at 0° and the magnetic field of LAS dipole was set to guide the *d*-beam to LAS Faraday cup. Happily, LAS in the magnetic field could analyze all the $^3$He recoils from *pd* capture. By using a vertical slit for $^3$He recoils, angular distribution of *pd* capture $A_{xx}$ was measured in one shot. Second, LAS was set at 2.5°, and the *d*-beam was stopped on the Faraday cup in the scattering chamber. By using a horizontal slit for $^3$He recoils, angular distribution of $A_y$, $A_{yy}$, and cross section of *pd* capture was measured.

Preliminary experimental results at 140 MeV are shown in Figure 1. Analysis of $A_y$ data is in progress. Large disagreement in $A_{xx}$ between experiment and calculations [3] was found also at this energy. Energy dependence of $A_{xx}$ and $A_{yy}$ at $\theta_{cm} = 90°$ is shown in Figure 2. The figure indicates that relation $A_{xx} \approx A_{yy}$ holds in a wide energy range below, say, 300 MeV, and that $A_{xx}$ anomaly exists above 60 MeV.

Introduction of $2\pi$-exchange 3NF can not explain the $A_{xx}$ anomaly. A possible origin of the $A_{xx}$ anomaly and the $A_{xx} \approx A_{yy}$ relation may be short-range force. Calculatons with heavy-meson exchange 3NF's may give some hints to solve the problem.

## References

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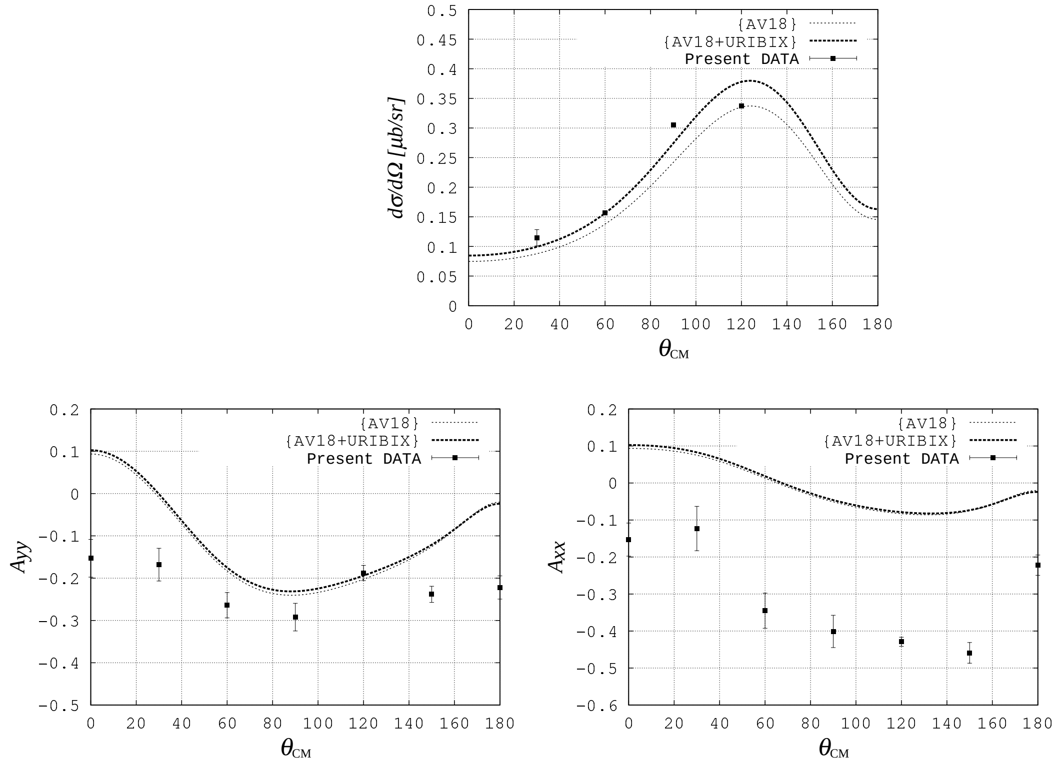


Figure 1: Preliminary data for *pd* radiative capture at $E_d = 140$ MeV. Thick and thin curves are calculations by Kamada using AV18 NN potential with and without 3NF(URBIX), respectively.

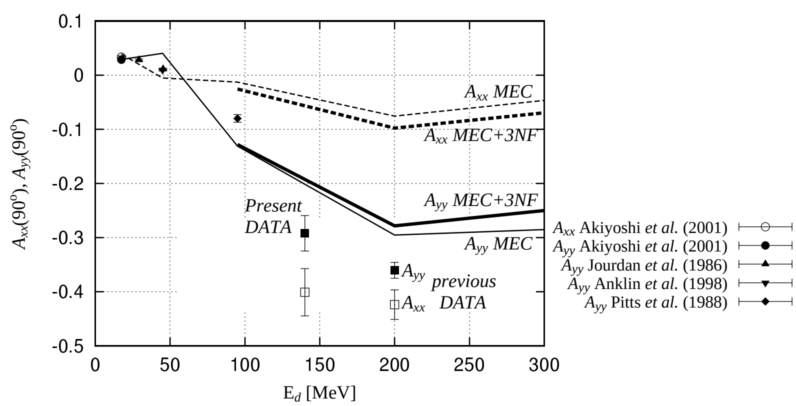


Figure 2: Energy dependence of $A_{xx}$ and $A_{yy}$ at 90° [1, 2, 4, 5, 6]. A relation $A_{xx} \approx A_{yy}$ holds in the experiment while $A_{xx} \neq A_{yy}$ in calculations above 60 MeV.