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Measurements of the differential cross sections for pd inclusive breakup reactions at 230MeV for the study of elementary process of deuteron knock-out reactions

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The effects of three-nucleon force (3NF) have been actively studied by using the nucleon-deuteron (Nd) scattering states. The differential cross sections of the elastic Nd scattering at the energy below 150 MeV can be well reproduced by the Faddeev calculation based on modern nucleon-nucleon (NN) interactions and 3NF. On the other hand, the data at 250 MeV was underestimated by the calculations with 3NF by 50%. And this large discrepancy between the data and the theory was also shown in the $2H(p, p)pn$ inclusive breakup reaction at forward angular region [1].

Now, we are working on the ONOKORO project, which aims to understand the formation of various clusters (d , t , $3He$, α) within nuclei. In this project, a detailed understanding of knockout reactions is important, and the measurement of the pd breakup reaction as an elementary process plays an important part because deuteron cluster is rather fragile [2]. We had carried out new inclusive pd breakup reaction measurements at RCNP, Osaka university as part of this project.

We injected 230MeV proton beam onto the deuterated poly-ethylene (CD_2) target which is used as a deuteron target, and detected scattered protons by using Grand-Raiden spectrometer (for $\theta_{LAB} = 27 - 61$ degree) or LAS spectrometer (for $\theta_{LAB} = 27 - 98$ degree). We got the numbers of yield of breakup reaction which is summed up to 10MeV excitation energy, and then deduced the angular distributions of the differential cross sections of inclusive breakup reactions. From the comparison, the theoretical calculation [2] was shown to reproduce experimental data well.

[1] S. Kuroita, et al., Few-Body Systems 50, 287 (2011).

[2] Y. Chazono, et al., PRC 106, 064613(2022).

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