Present status of data analysis of $\vec{p}-{}^{6}$He elastic scattering

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In the summer of 2016, we conducted an experiment at the RIKEN RI-beam factory (RIBF) on the elastic scattering of spin-polarized protons from unstable ^{6}He nuclei at 200A MeV to probe its spin-orbit potential. The experiment was performed at the BigRIPS beamline using the SAMURAI spectrometer and a spin-polarized proton target system.[1] Data obtained from this experiment should help us understand how an exotic structure of neutron-rich nuclei affects spin-orbit coupling owing to its extended neutron density distribution. Details of the experimental setup are presented in another report.[2] The current status of the data analysis will be presented here.

To cleanly select p-^{6}He elastic scattering events, mainly two contributions should be discriminated: inelastic channels, where incident ^{6}He breaks up into ^{4}He + 2n, and quasi-free scattering (QFS) of a proton from carbon nuclei contained in the target material ($C_{10}H_8$). For the first part, the SAMURAI spectrometer was used as it can easily discriminate ^{4}He and ^{6}He particles by Bρ analysis. Figure 1(a) shows the distribution of events at a plastic scintillator hodoscope, where ^{4}He and ^{6}He are clearly separated.

Figure 1(b) shows a PID spectrum from proton detectors. The solid line shows the simulated ΔE-E curve for a proton, which corresponds suitably well with the obtained data. On this spectrum, a separate locus of deuteron particles can also be observed, and it can be discriminated with ΔE-E cut on proton events.

Figure 1(c) shows the polar-angle correlation of recoil and scattered particles for the cases of polarized proton (upper panel) and carbon target runs (lower panel). In the upper panel, one can find a locus along the solid line that represents the kinematical correlation of elastic scattering. It overlaps with a thinner locus in the smaller $\theta_{^{6}\mathrm{He}}$ region, which corresponds to QFS from carbon, as can be seen in the lower panel. Figure 1(d) shows the projection of Fig. 1(c) along the solid line. The QFS contribution is normalized with the target thickness. It is found that the QFS contribution is as small as 10% of the elastic scattering and can be adequately subtracted.

After the event selection and background subtraction, the elastic scattering yield can be obtained with a high S/N ratio. At present, the analysis is ongoing to deduce p-^{6}He cross section and analyzing power.

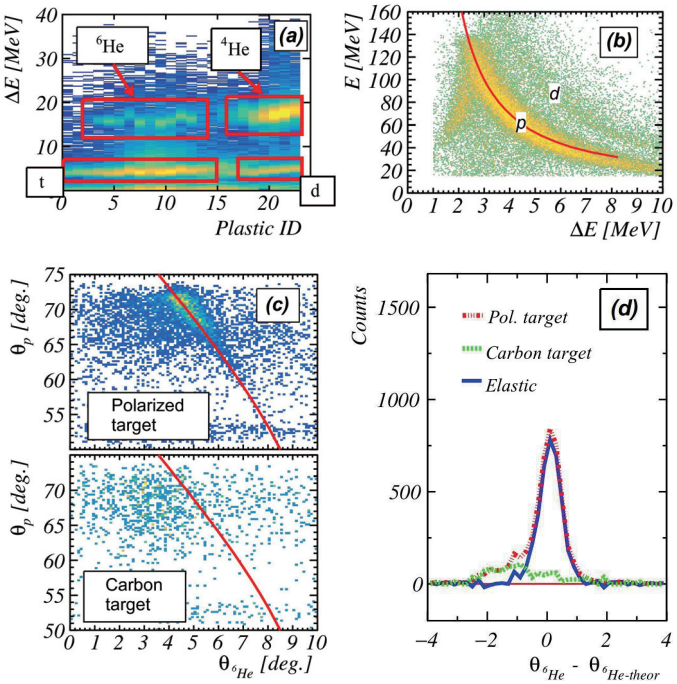

Fig. 1.: Plots showing the PID of (a) scattered and (b) recoil particles. (c) Polar-angle correlations. (d) Carbon background subtraction.

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