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Quasi Free Collision with Polarized Proton

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There have been reported several versions of the effective nucleon-nucleon(N-N) interactions, which are successfully used in the calculation of nucleon scattering with nucleus. In the present paper, two different effective N-N interactions are used to calculate both cross sections and analyzing powers for the $^{16}O(\vec{p},2p)$ reaction at E_p=200 MeV. The transition amplitude $T_{j\ell m}$[1] for the reaction A(a,ab)C in the distorted wave impulse approximation(DWIA) on the factorization assumption is

$$T_{j\ell m}(\mu'_a\mu'_b:\mu_a\mu_b) = \sum_{\tilde{\mu}_a\tilde{\mu}'_a\tilde{\mu}'_b} \int d\vec{r}\, \chi^{(-)*}_{\tilde{\mu}'_a\mu'_a}(\vec{k}_{aC},\vec{r})\; \chi^{(-)*}_{\tilde{\mu}'_b\mu'_b}(\vec{k}_{bC},\vec{r})$$
$$\times\; G(\tilde{\mu}'_a\tilde{\mu}'_b:\tilde{\mu}_a\mu_b;r)\; \chi^{(+)}_{\tilde{\mu}_a\mu_a}(\vec{k}_{aA},\alpha\vec{r})\; \Phi_{j\ell m}(\vec{r}) ,$$

where $\chi^{(\pm)}$ is the distorted wave function including the spin-orbit distortion and G is the antisymmetrized off-shell transition matrix for the proton-proton scattering given by

$$G(\tilde{\mu}'_a\tilde{\mu}'_b;\tilde{\mu}_a\mu_b;r) = \sum_{kiST} V^{ST}_{ki}(E',\rho(r))\, \langle\tilde{\mu}'_a\tilde{\nu}'_a,\tilde{\mu}'_b\nu'_b;\vec{k}^{(f)}_{ab}|t_{ki}(r_{ab})R_kS_kP^SP^T|\tilde{\mu}_a\nu_a,\mu_b\nu_b;\vec{k}^{(i)}_{ab}\rangle_A .$$

Numerical calculations were carried out for the reaction $^{16}O(\vec{p},2p)$[2] at E_p=200 MeV. The calculated DWIA results of the analyzing powers and the cross sections are shown in Fig. 1 for the knock-out of protons from the j=3/2 and 1/2 states and for the angle combinations sets of ($\theta_1 = \theta_2 = 30°$) and ($\theta_1 = 30°$ and $\theta_2 = 65°$). The transition matrix G is calculated by making use of the density-dependent Hamburg potential[3]. The optical potential parameters are adopted from the paper of Comfort et al.[4]

The experimental data are reproduced much better in terms of the effective N-N interaction compared with the calculated results by Kitching et al.[2] The effective N-N interaction by Love-Franey[5] provides almost identical results as the Hamburg potential except the magnitude of the cross section. It was found that the contribution from the central force of the effective N-N interaction is negligibly small and the contributions from the spin-orbit and tensor forces are of the same magnitude and important. We will give the calculated results of the reaction $^{40}Ca(\vec{p},2p)$ at E_p=200 MeV. Finally, we will discuss the factorization corrections[6] and the effect of the non-locality of the optical potential.

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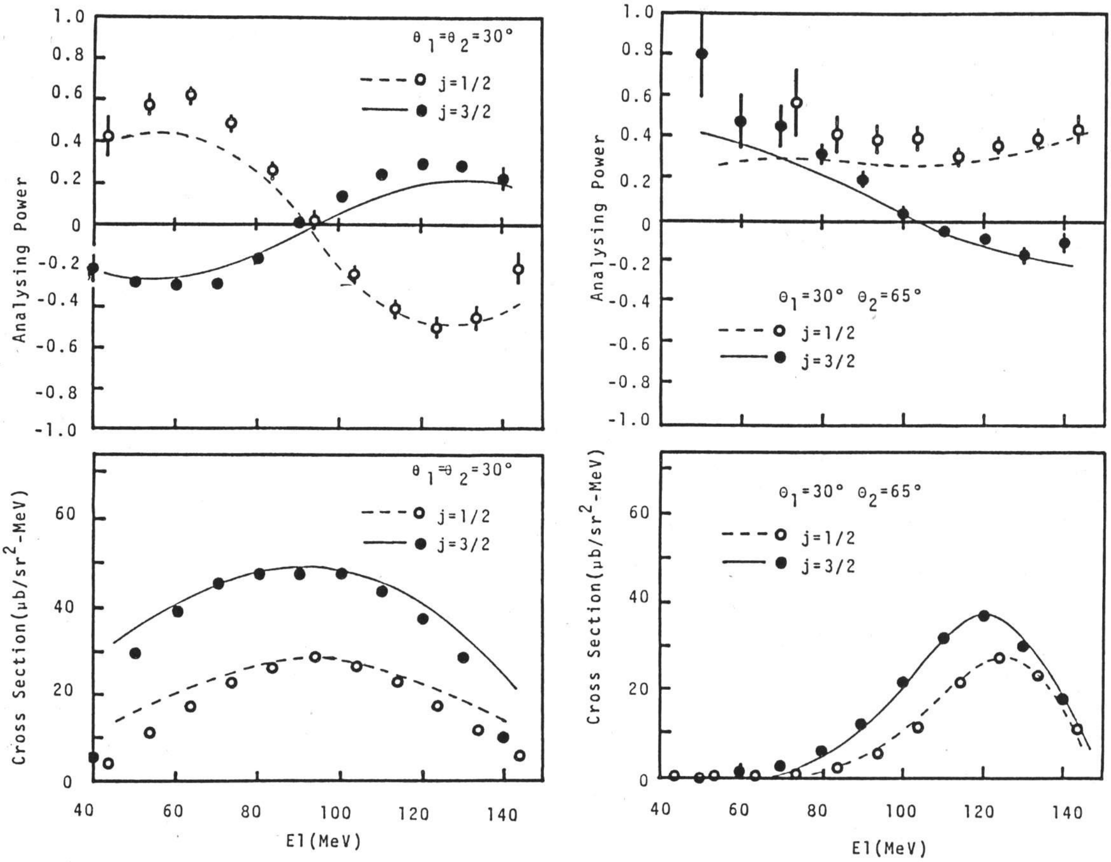

Fig. 1. The $^{16}O(\vec{p},2p)$ reaction at E_p = 200 MeV. The calculated DWIA results of the analyzing powers and cross sections, together with the experimental data.[2] The absissa is the kinetic energy of one of the final state protons.