Observed forward-angle cross section for the pion SCX reactions (π^+,π^0) on spinless nuclei leading to the isobaric analogue states exhibits a clear mass-number dependence (A-dependence) expressed as $(d\sigma/d\Omega)/(N-Z) \propto A^{-\alpha(E)}$ [**?**]. Around the energy region E=400-600 MeV, the $\alpha(E)$ decreases with the increase of the incident pion energy. For the isobaric analogue transition for spinless nuclei, relevant transition density is expressed, under the isospin-space rotation, as the difference of the neutron and the proton densities of the target nucleus $\delta\rho(r) = \rho_p - \rho_n$ and the plane-wave impulse calculation leads to $\alpha(E)$ =0 (*no* A-dependence). The observed prominent A-dependence comes from the pion distortion or from the higher-order effects. Though the monotonical decrease of $\alpha(E)$ with incident energy E is believed to be the consequence of weaker pion absorption at high energies, no theoretical calculation has been done so far.

We examined the A-dependence and its energy dependence using the conventional distorted wave impulse approximation with the first-order optical potential of the $t\rho$ type. We adopt the nuclear isovector densities calculated by the relativistic Hartree model [****].

To see the dependence on the pion-nucleus optical potential U, we have multiplied factors s_R and s_I to the real and the imaginary parts as $s_R\mathrm{Re}(U) + s_I\mathrm{Im}(U)$ and have varied s_R and s_I at 500MeV. As seen in Fig.(a) and (b), $\alpha(E)$ is highly *sensitive* to imaginary part of U while is quite *insensitive* to its real part (s_R).

In Fig.(c), we have shown the results of DWIA calculation at various incident energies. The dotted lines represent the fit to experimental data taken from ref. [**?**]. The trend of the A-dependence and the monotonical decrease of $\alpha(E)$ with the increase of the incident pion energy is well reproduced by the DWIA calculation. The calculated coefficient $\alpha(E)$'s are slightly smaller than the experimental values. The $\alpha(E)$ is also sensitive to the r.m.s. radii of the isovector density $\delta\rho(r)$ and the $\delta\rho(r)$ with smaller r.m.s. radius gives larger $\alpha(E)$.

A clear mass-number dependence of the forward-angle cross section for the pion SCX reactions (π^+,π^0) on spinless nuclei $(d\sigma/d\Omega)/(N-Z) \propto A^{-\alpha(E)}$ are explained within the conventional DWIA calculation. The coefficient $\alpha(E)$ is found to be sensitive to the imaginary part of the pion-nucleus optical potential and also the r.m.s. radii of the isovector density of the target nucleus.

References

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