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1.93 Comparison of the Spin-Orbit Potential of Proton with the Potential of Triton

T. Wada and H. Horiuchi
Department of Physics, Kyoto University, Kyoto 606, Japan

According to the optical model analyses of the scattering data of ^{3}He and t, the spin-orbit (l·s) potentials of these projectiles are a few times stronger than the l·s potential obtained by folding the l·s potential of proton[1). The purpose of this contribution paper is to report the results of the comparison of the microscopically calculated l·s potential of t with that of proton, both on the target ^{40}Ca.

The calculations of the l·s potentials of proton and t are performed by using the resonating group method (RGM). The explanation of the procedure to derive the l·s potential by RGM is given in another contributed paper by us[2). After calculating the proton l·s potential $V^P_{ls}(r)$, we fold it by the triton density $\rho_t(r)$. We denote the resulting folded l·s potential for t as $V^F_{ls}(r)$;

$$V^F_{ls}(r) = f_{so}\cdot(1/3)\int d\vec{x}\,\rho_t(|\vec{x}-\vec{r}|)\frac{(\vec{r}\cdot\vec{x})}{r^2}V^P_{ls}(x)\ ,$$

$$f_{so} = 43/120 = (40+3)/(40*3)\ . \qquad (1)$$

We compare this folded l·s potential $V^F_{ls}(r)$ with the l·s potential $V_{ls}(r)$ of triton obtained directly by RGM.

In making the comparison of $V^F_{ls}(r)$, it is convenient to use the r^2-weighted radial integral J_4 defined by

$$J_4(V) = (1/40)\int_0^\infty r^2 V(r)\, r^2 dr\ . \qquad (2)$$

When V(r) is the double-folding l·s potential $V^D_{ls}(r)$ constructed from the two-nucleon spin-orbit force $v^{NN}_{LS}(r)$, $J_4(V^D_{ls})/f_{so}$ is equal[3) to $J_4(NN)$ defined by

$$J_4(NN) = \int_0^\infty r^2 v^{NN}_{LS}(r)\, r^2 dr\ . \qquad (3)$$

Furthermore $J_4(V^F_{ls})/f_{so}$ is equal to $J_4(V^P_{ls})$.

The value of the oscillator parameter and the effective two-nucleon force used in the calculation are the same as those in Ref.2. Since the $V^P_{ls}(r)$ shows somewhat large parity-dependence for the low incident energy, we adopt as $V^P_{ls}(r)$ the simple average, $((V^P_{ls}(r))_{l=1}+(V^P_{ls}(r))_{l=2})/2$. In Fig.1, we compare $V_{ls}(r)$ with $V^F_{ls}(r)$ at E= 10 MeV/u. Next in Table 1, we compare $J_4(V_{ls})$ and $J_4(V^F_{ls})$ at several incident energies. It is seen that the energy-dependence of $J_4(V^F_{ls})$ is fairly weaker than $J_4(V_{ls})$. The value of $J_4(V_{ls})$ is seen to be surely larger than $J_4(V^F_{ls})$, but even the maximum value of the ratio $J_4(V_{ls})/J_4(V^F_{ls})$

which is about 1.3 is somewhat smaller than the observed value[3] of $J_4(V_{ls})/J_4(V_{ls}^F)$ as seen in Table 1.

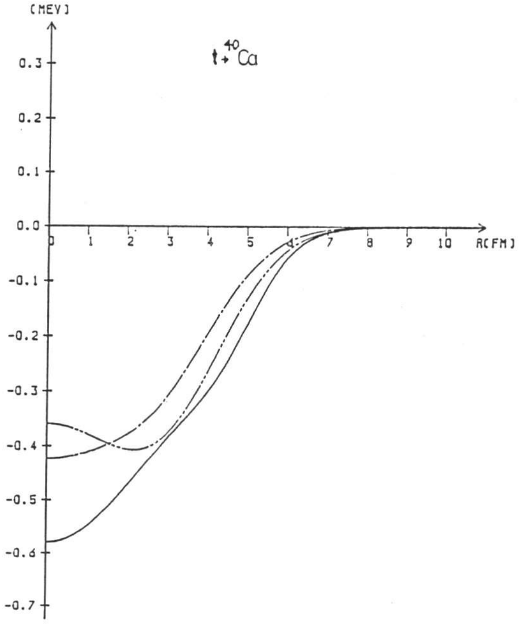

Fig.1 The exact l·s potential $V_{ls}(r)$ (solid line), the folded l·s potential $V_{ls}^F(r)$ (dash-dot-dotted line) and the double-folding l·s potential $V_{ls}^D(r)$ (dash-dotted line) are shown for t+^{40}Ca at E= 10 MeV/u.

Table 1 The r^2-weighted radial integral J_4 of $V_{ls}(r)$ and $V_{ls}^F(r)$ at several incident energies.

E (MeV/u)	5	10	15	20	Exp.
$J_4(V_{ls})$	9.29	8.45	8.05	7.80	20±5
$J_4(V_{ls}^F)$	7.09	6.84	6.83	6.87	6±1

References

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