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3.27 Polarizations in low energy n-d scattering by a two-body local potential

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Polarizations in low energy n-d scattering are investigated by making use of the Faddeev integral equation with a two-body local potential. After the decomposition of the Faddeev integral equation into partial waves, the three-body T matrix of the n-d elastic scattering can be described as follows,

$$T(m_f', m_j'; m_i, m_j) = 2 \Sigma \Sigma' \, C(l_f', j_f', m_f', m_j', J, M') \, C(l_i, j_i, m_i, m_j, J, M) R^J_{I', I} \, d^J_{M'M}(\theta), \quad (1)$$

where

$$C(l_i, j_i, m_i, m_j, J, M) = \sqrt{(2l_i+1)/4\pi} \langle j_i, m_i, 1, m_j | j_i, 1, J, M\rangle \langle l_i, 0, \tfrac{1}{2}, m_i | l_i, \tfrac{1}{2}, j_i, m_i\rangle, \quad (2)$$

$$R^J_{I', I} = \langle J, \alpha', I', \phi | G_0^{-1} | J, \beta, I, \phi\rangle + \langle J, \alpha', I', \phi | U_\beta^{(2)}, J, I\rangle. \quad (3)$$

The vector $|U_\beta^{(2)}, J, I\rangle$ must satisfy the following type of two dimensional integral equation,

$$\langle J, \alpha' | U_\alpha^{(1)}, J, I\rangle = 2 \langle J, \alpha' | t_\alpha | J, \beta, I, \phi\rangle + 2 \langle J, \alpha' | t_\alpha G_0 | U_\beta^{(2)}, J, I\rangle. \quad (4)$$

I and I' are the set of quantum numbers in the initial and the final states, respectively.

The $R^J_{I', I}$ is a symmetric reduced T matrix in three-body scattering system and is calculated from eq.(4). The two dimensional Faddeev equation has two singular integrands; one is Green function pole and the other the two-body t matrix pole, which comes from the two-body bound state. In order to integrate such a singular function numerically, the singular function in certain small area is replaced by a mean value. In practical calculation of the reduced T matrix $R^J_{I', I}$, two realistic local potentials have been assumed; one is de Tourreil, Rouben and Sprung (dTRS)[1] potential and the other Hamada and Johnston (HJ)[2] potential. The $R^J_{I', I}$ has been obtained by making use of the two-body interaction states $^1S_0$, $^3S_1$, $^1P_1$, $^3P_{0,1,2}$, $^1D_2$, $^3D_{1,2}$ and $^3F_2$ and of Pade approximation. The three-body T matrix has been calculated for the total angular momentum J from 1/2 to 11/2.

Polarizations can be given as follows,

$$P(\theta) = Tr(T^\dagger \sigma_y T)/Tr(T T^\dagger), \quad (5)$$

$$iT_{11}(\theta) = i \, Tr(T^\dagger T_{11} T)/Tr(T T^\dagger), \quad (6)$$

$$T_{2q}(\theta) = Tr(T^\dagger T_{2q} T)/Tr(T T^\dagger), \ (q=0,\ 1 \text{ and } 2). \quad (7)$$

In order to directly compare with experimental data, the following quantities are calculated in here,

$$Q(\theta) = \sqrt{1/8} \, (T_{20}(\theta) + \sqrt{6} \, T_{22}(\theta)), \quad (8)$$

$$R(\theta) = \sqrt{1/8} \, (T_{20}(\theta) - \sqrt{6} \, T_{22}(\theta)). \quad (9)$$

The polarizations $P(\theta)$, $iT_{11}(\theta)$, $Q(\theta)$ and $R(\theta)$ together with experimental data are shown in Figs. a) ~ d). The solid line is the result for dTRS potential and the dashed line is that for HJ potential.

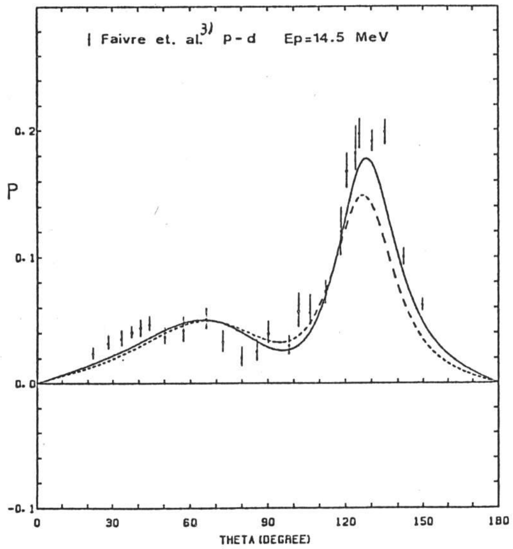

Fig. a)

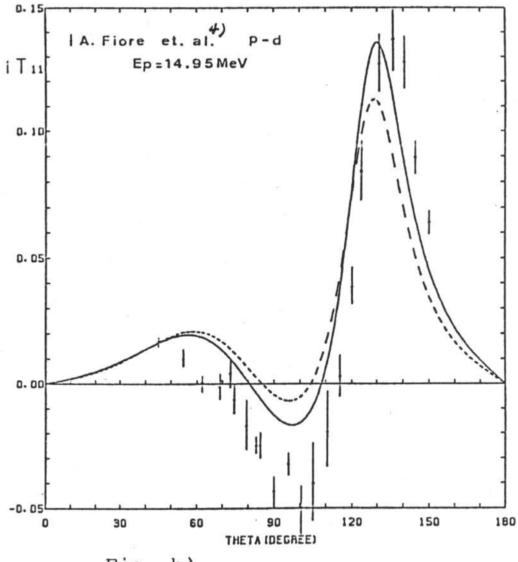

Fig. b)

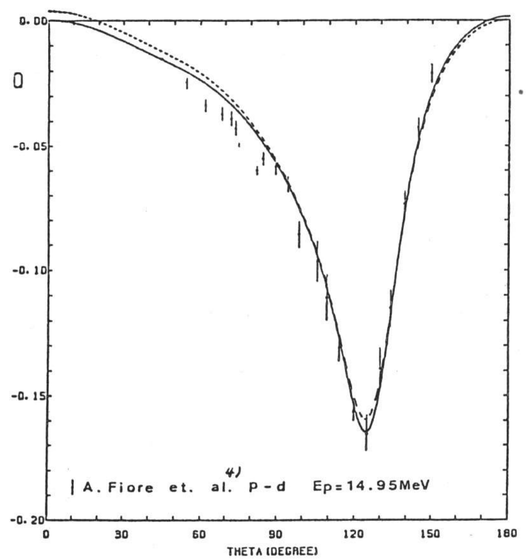

Fig. c)

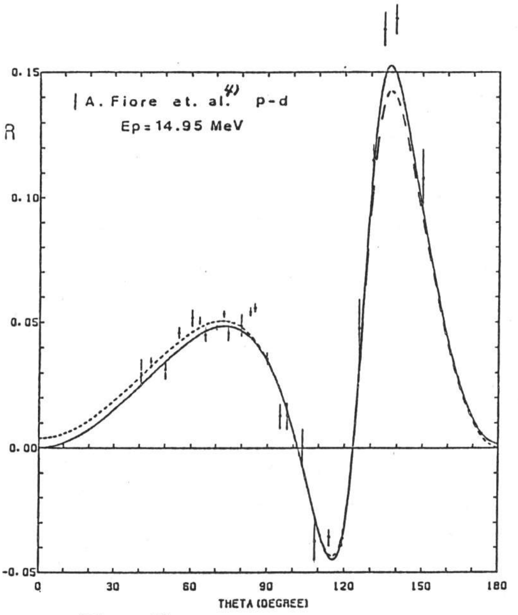

Fig. d)

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