ONE MODEL OF THREE-PARTICLE NUCLEI

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ABSTRACT

This paper shows an application of the three-particle bound state equations proposed by author. The numerical results for H^3 bound state are also given here.

INTRODUCTION

The three-particle eigenvalue problem in the frame of the Faddeev theory[1] has been treated by many authors[2,3]. Another approach to three-particle quantum-mechanical problem,equivalent to Faddeev's, has been proposed by author[4], and applied to three-particle scattering in success[5].

The three-particle bound state equations in mommentum representation are:

$$\psi(\vec{k}_\alpha,\vec{q}_\alpha) = \sum_\beta \int d\vec{q}_\beta' \langle \vec{k}_\alpha \vec{q}_\alpha | \upsilon_\beta | \phi_\beta \vec{q}_\beta' \rangle \times$$
$$\times (E-\varepsilon_\beta - q_\beta'^2/2\nu_\beta)^{-1} \Phi_\beta(\vec{q}_\beta') \tag{1}$$
$$(\alpha,\beta = 1,2,3)$$

Where k_α is a coordinate between particles β and $\gamma;\beta,\gamma \neq \alpha$, and q_α is a coordinate of the particle α relatively to their CM, ε_β - deuteron binding ebergy, $\nu_\beta=2/3$, ϕ_β- deuteron bound state wave function. The potential υ_β is an interaction of the particle β with the others. For example $\upsilon_1=V_{12}+V_{13}$ etc. The functions Φ_β may be derived from the following system of integral equations:

$$\Phi_\alpha(\vec{q}_\alpha) = \sum_{\beta\neq\alpha} \int d\vec{q}_\beta' I_{\alpha\beta}(\vec{q}_\alpha|\vec{q}_\beta')(E-\varepsilon_\beta - q_\beta'^2/2\nu_\beta)^{-1}\Phi_\beta(\vec{q}_\beta'), \tag{2}$$

where,

$$I_{\alpha\beta}(\vec{q}_\alpha|\vec{q}_\beta') = \int d\vec{k}_\alpha d\vec{k}_\beta' \phi_\alpha^*(\vec{k}_\alpha)\phi_\beta(\vec{k}_\beta)\langle \vec{k}_\alpha \vec{q}_\alpha | \upsilon_\beta | \vec{k}_\beta' \vec{q}_\beta' \rangle . \tag{3}$$

AN APPLICATION TO H^3 BOUND STATE

In this case the system (2) reduces to one integral equation. Further, by using the Yamaguchi separable potential[6] this equation can be solved in a pole approximation giving:

$$\Phi(\vec{q}_2) = Cq_2^{-2}(\beta^2-\varepsilon+q_2^2)^{-1}(\beta^2-4\varepsilon+q_2^2/4)^{-1}+ \qquad (4)$$

$$C(q_2^2/4-3\varepsilon)^{-1}(\beta^2-4\varepsilon+q_2^2/4)^{-1}(\beta^2-\varepsilon+q_2^2/4)^{-1}$$

C - normalization constant,

and an algebraic equation:

$$1 = 1.26\times10^{-22}y_1(4\varepsilon-y_1^2)^{-1}(4\beta^2-y_1^2)^{-1} \qquad (5)$$

$$y_1^2 = 2\nu(E-\varepsilon),\varepsilon=2,225\text{MeV},\beta=1.45\times10^{13}\text{cm}^{-1}.$$

From equation (5) we get $y_1^2=4\varepsilon$ and thus

$$E = 4\varepsilon = 8.89 \text{ MeV}, \qquad (6)$$

which is a sudden agreement with the experimental value E=8.49 MeV. The triton binding energy according to Faddeev equations with Yamaguchi potential is 11.24 MeV and with Yukawa 12.76 MeV.

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