Analytical forms of deuteron wave function for potentials Nijmegen group and density distribution

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In the short range the structure of a deuteron is visually described by means of density distribution $\rho_d^{M_d}(r', \theta)$ [1] for a projections M_d=0;±1 of full angular momentum

$$\begin{cases} \rho_d^0 = \frac{4}{\pi}\left[C_0(2r') - 2C_2(2r')P_2(\cos\theta)\right]; \\ \rho_d^{\pm1} = \frac{4}{\pi}\left[C_0(2r') + C_2(2r')P_2(\cos\theta)\right]; \end{cases}$$

where $C_0 = R_0^2 + R_2^2$; $C_2 = \sqrt{2}R_0R_2 - \frac{1}{2}R_2^2$ - components of density distribution; $R_0 = u/r$; $R_2 = w/r$ - the radial functions for S- and D- states; P_2 - Legendre's polynom; r' - distance from the center of masses; θ - polar angle to r'; $r = 2r'$ - between partial distance.

Values of density distribution $\rho_d^{M_d}$ and transition density $\rho_{tr}^{\pm1}$ [1] are calculated using the earlier obtained coefficients of DWFs [2, 3] analytical forms in coordinate representation for a nucleon-nucleon potentials Nijmegen group (Nijm1, Nijm2, Nijm93).

Results of similar calculations of density distribution and transition density for Argonne v18 potentials are quoted in paper [4]. Depending on a choice of approximation for DWF the calculated values $\rho_d^{M_d}$ and $\rho_{tr}^{\pm1}$ differ only in the area at 0-0.3 fm. In fact, this indicates, which of the approximations applied is the "best" for beginning of coordinates, despite the absence of redundant knots of the radial DWF.

[1] J. L. Forest et al., *Femtometer toroidal structures in nuclei*, Phys. Rev. C 54 (1996), 646–667.

[2] V. I. Zhaba, *New analytical forms of a deuteron wave function for potentials Nijmegen groups*, Nucl. Phys. Atom. Energy 17 (2016), 22–26.

[3] V. I. Zhaba, *Analytical forms of the wave function in the coordinate space and the tensor polarization of the deuteron for potentials Nijmegen group*, J. Phys. Stud. 20 (2016), 3101.

[4] V. I. Zhaba, *Analytical forms of deuteron wave function and density distribution*, World Scientific News 98 (2018), 206–213.