Bethe–Salpeter Approach with the Separable Interaction and P-waves for the Deuteron

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We study the analyzed solution for the nucleon-nucleon (NN) T-matrix in the framework of the co-variant Bethe-Salpeter approach [1] for a two spin-one-half particle system with a separable kernel of interaction. The developed expressions allow us to find an explicit analytical connection between parameters of the separable kernel and low energy scattering parameters, deuteron binding energy and phase shifts [2]. Using obtained connection we construct separable kernels for partial channels with total angular momentum $J=0$ (${}^1S_0^+$, ${}^3P_0^+$) and $J=1$ (${}^3S_1^+ -{}^3 D_1^+$, ${}^1P_1^+$, ${}^3P_1^+$).
We study the elastic form factors of the deuteron in the co-variant BS formalism. As a genuine relativistic effect, we get significant contribution from the P-waves amplitudes on the charge and magnetic form factors. We find good agreement with experiment by the inclusion of the P-wave components.

References

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