QUARK MODEL STUDY OF NN*(1440) COMPONENTS ON THE DEUTERON

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During the last decade an important effort has been made towards a quantitative understanding of the NN interaction based on quark degrees of freedom. Among the different models, the chiral constituent quark model has provided a systematic way to study any baryon-baryon interaction from a basic quark-quark Hamiltonian. This model, widely discussed in the literature [1,2], considers as basic interactions a perturbative one-gluon exchange, and SU(2) Goldstone-boson exchanges (pion and sigma) generated by the spontaneous breakdown of chiral symmetry. Pauli principle at the quark level plays a relevant role at short distances, providing an explanation for the short range repulsion of the nuclear force.

The dynamics of the two-baryon system is conveniently described within the resonating group method (RGM) formalism. Usual RGM calculations consider a Hilbert space made out only of NN, $\Delta\Delta$ and hidden color-hidden color components, the last two ones being almost negligible. However, it has recently been shown that the inclusion of particular configurations, like $N\Delta$, results of a tremendous importance to reproduce the NN low angular momentum partial wave experimental data. It arises therefore the question of the role played by the N and Δ excitations in the NN interaction.

This problem has already been partially undertaken. Possible effects of a larger Hilbert space were considered in ref. [3] through the formation of six-quark bags at short distances. In ref. [4] an alternative formulation in terms of quark-shell configurations projected later on onto physical channels has been proposed.

Our model provides an adequate framework to study the influence of enlarging the Hilbert space in a parameter free way. Previous studies of low energy S-wave scattering have found that the most important channels are those including a ground state baryon, i.e., NN^*, $N\Delta$. As a consequence we have studied the deuteron problem including explicitly those channels that have been previously pointed out as the most relevant ones [5].

In our calculation NN, $NN^*(1440)$, and $\Delta\Delta$ channels are considered. In particular, the partial waves included are ${}^3S_1^{NN}$, ${}^3D_1^{NN}$, ${}^3S_1^{NN^*}$, ${}^3D_1^{NN^*}$, ${}^3S_1^{\Delta\Delta}$, ${}^3D_1^{\Delta\Delta}$, ${}^7D_1^{\Delta\Delta}$. The results show that NN^* channels have a comparable contribution to $\Delta\Delta$ ones, improving the description of some observables, i. e., mixing parameters.

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