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THE EFFECTIVE TWO-MESON-EXCHANGE POTENTIAL DERIVED FROM THE QUARK-ANTIQUARK PAIR CREATION MODEL

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Whether the medium-range attraction could be given or partly given by considering the effective two-meson exchange potential in the quark-antiquark pair creation model is a interesting problem. By using the matrix element of the hadron-meson vertex for the $B_1 \to B_2 M$ proces[1,2], we obtain the interaction transition potential for the process in which two baryons B_1 and B_2 change to two baryons B_3 and B_4 via the exchange of meson M. Since the effect of the isobar (Δ) is important in the N-N interaction, we should consider the contributions of intermediate states $N\Delta$ and $\Delta\Delta$ during constructing the effective two meson exchange potential. By making the adiabatic approximation for the intermediate states, we express the effective two meson exchange potential as

$$V^{2M}_{NN,NN}(r) = V^{M}_{NN,N'\Delta}(r)\,\frac{1}{E_\Delta+E_{N'}-2E_N}\,V^{M}_{N'\Delta,\,NN}(r) + V^{M}_{NN,\Delta\Delta}(r)\,\frac{1}{E_\Delta+E_\Delta-2E_N}\,V^{M}_{\Delta\Delta,NN}(r) \quad ,$$

where $V^M_{NN,N'\Delta}$, $V^M_{N'\Delta,NN}$, $V^M_{NN,\Delta\Delta}$ and $V^M_{\Delta\Delta,NN}$ are effective one-meson exchange potentials for processes $NN \to N'\Delta$, $N'\Delta \to NN$, $NN \to \Delta\Delta$, and $\Delta\Delta \to NN$, respectively.

The result shows that the general features of this potential and the phenomenological σ-meson exchange potential obtained from the $\sigma, 6$ model[3] are the same. At $r<0.4$ fm, our potential curve is lower, and, at $r>0.5$ fm, our curve goes to zero faster. Thus, the medium-range attractive feature of our potential is weaker than that of the phenomenological one. If we further combine the contribution of the six-quark bag effect to the medium-range attraction, we may obtain the correct phase shift of the N-N scattering without any artifitial σ-meson exchange.

1) Yu You-wen and Zhang Zong-ye, Nucl. Phys. A426(1984)557.
2) Yu You-wen, Nucl. Phys. A455(1986)737.
3) K. Erkelenz, Phys. Rep. 13C(1974)193.