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Estimation of the mass of low-lying baryons and ground state pentaquarks

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Baryon mass spectrum has been studied over decades, but theoretical results are still largely inconsistent with experimental data. No need to mention the higher excited states, even the low-lying resonances, for example, theoretical works in the three-quark picture always predict a larger mass for the Roper resonance $N(1440)$ than for $N(1520)$ and $N(1535)$. In our work Baryon masses are estimated in the constituent quark model with Cornell potential, assuming that baryons consist of the q^3 as well as $q^4\bar{q}$ pentaquark component. Numerical calculations of the multiquark mass spectrum are done with the hamiltonian in equation below. The roper resonance N(1440) and N(1535) and other low-lying q^3 baryons are interpreted, and the theoretical results of charmonium pentaquark states are in line with the candidates $P_c^+(4380)$, $P_c^+(4450)$ proposed by LHCb. Masses of pentaquark states $uudb\bar{b}$ are predicted as well.

\begin{eqnarray}
H_N=\sum_{k=1}^N m^0_k+V0+\sum_{i=1}^{N-1}\frac{\vec\eta_i^2}{2u_i}+\sum_{i<j}^{N}\,\,(-\frac{3}{8}\,\lambda^{C}*{i}\cdot\lambda^{C}*{j})(
r_{ij}-\frac{k}{\vec r_{ij}})+H^{OGE}_{hyp}
\end{eqnarray}

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