Masses of the $[\mathbf{70}, \ell^+]$ Baryons in Large N_c QCD

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The large N_c limit of QCD suggested by 't Hooft [1] and the counting rules of Witten [2] lead to the powerfull $1/N_c$ expansion method to study baryon spectroscopy. The method is based on the result that the SU($2N_f$) spin-flavor symmetry, where N_f is the number of flavors, is exact in the large N_c limit of QCD. For $N_c \to \infty$ the baryon masses are degenerate. The mass splitting starts at order $1/N_c$. The method has been applied with great success to the ground state baryons. Although the SU(6) symmetry is broken for excited states, the $1/N_c$ expansion can still be applied.

The masses of the positive parity nonstrange and strange baryons belonging to the $[\mathbf{70}, 0^+]$ and $[\mathbf{70}, 2^+]$ multiplets are calculated by considering the most dominant operators in an $1/N_c$ expansion. The approach is based on the introduction of an excited core, obtained after the last particle (an excited quark) has been removed. Configuration mixing is neglected, for simplicity. Although being a sub-leading $1/N_c$ order, we find that the spin-spin interaction plays a dominant role in describing the data like in constituent quark models. We show how the contribution of the linear term in N_c, of the spin-spin and of the spin-orbit terms vary with the excitation energy [3, 4].

As an intermediate step, we have derived explicit formulae for the matrix elements of the SU(6) generators for totally symmetric flavor-spin states needed for the calculation of matrix elements of operators acting on the core. General analytic formulae for some isoscalar factors of SU(6) obtained for arbitrary N_c [5].

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[2] E. Witten, Nucl. Phys. **B160**, 57 (1979).
[3] N. Matagne and Fl. Stancu, Phys. Lett. **B631**, 7 (2005).
[4] N. Matagne and Fl. Stancu, in preparation.
[5] N. Matagne and Fl. Stancu, *Matrix Elements of SU(6) Generators for Baryons at Arbitrary N_c*, in preparation.

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