



## Heavy Baryons, Solitons and Large $N_c$ QCD or A New Emergent Symmetry of QCD

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In this talk I describe some recent work with C. K. Chow on heavy baryons—*i.e.* baryons with a single heavy quark. In the combined heavy quark and large  $N_c$  limits of QCD a simple physical picture emerges of such states. The system is well described by the collective motion of the light quark and gluon degrees of freedom against the heavy quark. This can be shown by studying commutators of collective operators with the QCD Hamiltonian in the context of a power counting scheme in which both the heavy quark and the nucleon mass is treated as heavy. The power counting parameter is  $\lambda$  where  $\lambda \sim \Lambda/M_Q, 1/N_c$ . Collective excitations have an energy which scale as  $\lambda^{1/2}$  and hence all become degenerate with the ground state in this combined limit—this indicates the emergence of a new symmetry. This new symmetry is contracted  $O(8)$  and is the spectrum generating algebra for the three dimensional harmonic oscillator. One can exploit this symmetry to make model independent predictions of excited state masses, electro-magnetic and weak transitions of these states up to a fixed order in the expansion. Unfortunately, the expansion turns out to be in  $\lambda^{1/2}$  rather than  $\lambda$  so the predictive power of this expansion is not clear. However at next-to-leading order the expansion has only two parameters and several observables (of which only one has presently been measured) so that the possibility of getting semi-quantitative information from this expansion is quite real.

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