DNP13-2013-020008

Abstract for an Invited Paper
for the DNP13 Meeting of
the American Physical Society

Spectrum of Excited Baryons from Lattice QCD[1]

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Recent lattice QCD results for the excited states of baryons N, Δ, Λ, Σ, Ξ and Ω are reviewed. Three-quark baryon operators are used that incorporate up to two covariant derivatives. The quark spins and derivatives are combined to obtain operators that transform as representations of continuum spins $J = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}$ and $\frac{7}{2}$. Operators corresponding to continuum J values are subduced to the irreducible representations allowed by the lattice and are used to calculate the excited state spectra. Strong overlaps of a lattice state with the operators subduced from one of the continuum values of J provides the identification of the spin of the state. The dominant flavor of each lattice state is identified in a similar fashion from the definite flavor symmetry of each of the operators. The result is that the flavor structure of the lattice spectrum is found to be in good accord with $SU(6) \times O(3)$ symmetry, e.g., the same number of low-lying excited states is found for each spin and baryon flavor. Information about hybrid baryons is obtained by the use of operators that include a chromo-magnetic gluon field, which allows some lattice states with substantial hybrid content to be identified.

[1]Support from U.S. Department of Energy contract DE-FG02-93ER-40762 is acknowledged.