Baryon resonances at large N_c and prediction of new exotic baryons

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Abstract

We suggest a new point of view according to which baryon resonances can be understood as collective excitations about intrinsic one-quark or quark-hole excitations in a mean field of definite symmetry. This approach is justified in the limit of large number of colours N_c, and is similar to the physics of large-A nuclei.

The key point is the symmetry of the mean field. We argue that the original flavour and rotational symmetry $SU(3)_{\text{flav}} \times SO(3)_{\text{space}}$ is *spontaneously* broken in the ground state down to the $SU(2)_{\text{isospin+space}}$ symmetry of simultaneous rotations in isospin and ordinary spaces. This statement alone predicts the number and the character of the flavour multiplets of baryon resonances, and numerous relations between them.

The resulting baryon resonances exhibit an hierarchy of scales: the crude mass is $\sim N_c$, the intrinsic quark excitations are ~ 1, and each intrinsic quark state entails a finite band of collective rotational excitations that are split as $\sim 1/N_c$. We build a new theory of those collective excitations. Although in the real world N_c is only three, we obtain a good agreement with the observed resonance spectrum of light baryons up to 2 GeV, and of lowest charmed baryon multiplets.

A by-product of the scheme is the prediction of new exotic charmed (and bottom) baryons that may be stable against strong decays.

References

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