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Study of baryons in a combination of large-N_c QCD and constituent approach

The large-N_c and constituent approaches are two well-known tools to probe QCD at the hadronic level. In the large-N_c approach, as developed by 't Hooft and Witten, one considers hadrons in the gauge group $SU(N_c)$, with $N_c(\to \infty)$ the number of colour, and where quarks live in the fundamental representation of the group. Then, observables can be expanded in powers of $1/N_c$. In the constituent approach, one describes a baryon as a system of three valence quarks interacting by a potential modelling the exchange of virtual gluons.

Both methods give interesting and concluding results about baryons and other hadrons. It would then seem interesting to combine the two methods. However, in the large-N_c limit, a baryon becomes a state composed of N_c quarks, which implies to deal with an Hamiltonian of N_c particles.

The envelope theory (ET) is a useful approximation method with a nice property: the number of particles N is a simple parameter, which allows to easily deal with large systems. The ET, combined with large-N_c QCD, has already been able to describe baryons as in [1-4]. Recently, the ET has been generalised to systems with N identical particles plus a different one, allowing the study of new states such as baryons with heavy quarks or hybrid baryons. The latter are exotic states composed of three valence quarks and one constituent gluon.

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Primary author: CIMINO, Lorenzo

Co-authors: Dr WILLEMYNS, Cintia (Université de Mons); Prof. SEMAY, Claude (Université de Mons)

Presenter: CIMINO, Lorenzo

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