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Exotic Hadrons and Large Nc QCD

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While QCD is the theory underlying hadronic physics, much of our intuition about hadronic states has been developed in the context of the constituent quark model. Exotic states—ones that cannot be described in the simplest version of the quark models with mesons as a quark-antiquark state and baryons as a three quark state—are important since they clarify the limitation of the quark model as a description of QCD. Recently, there has been considerable excitement in the spectroscopy of hadrons containing heavy quarks: pentaquarks containing a charm and anti-charm quarks have been discovered and there is strong evidence that at least some of the observed X, Y, Z states are exotic tetraquarks. However, the question of whether exotics composed of light quarks exist remains murky. This talk uses the theoretical perspective of large Nc QCD to focus on the possibility of light quark exotics. A world where the number of colors is large simplifies many of the issues that make the phenomenology of light quark states so complicated. The status of light quark exotics at large Nc will be briefly reviewed. A key result stressed in this talk is that there exists a variant of the large Nc limit in which quarks are in the two-index symmetric representation of color. In this limit, tetraquarks composed of light quarks are shown to exist as narrow resonant states. Minimally, this proves that there is nothing generic in the structure of gauge theories that prevents light-quark tetraquarks from existing.

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