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Hybrid baryons in a constituent model

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In addition to conventional hadrons, such as baryons and mesons, quantum chromodynamics predict the existence of other hadronic states based on the principle of colour confinement. Among these, hybrid states are particularly intriguing. They arise from excitation in the gluonic field or, in a constituent approach, from the inclusion of a constituent gluon within the system. In recent years, both theoretical and experimental efforts have been dedicated to the study of hybrid mesons. Their identification seems, at first sight, easier since some J^{PC} quantum numbers are forbidden in a $q\bar{q}$ configuration but allowed for $q\bar{q}g$. On the other hand, hybrid baryons do not have such "smoking gun" signature since all quantum numbers J^P can be populated by conventional qqq configuration. On the theory side, hybrid baryons have been studied within the framework of the MIT bag model, flux tube model, QCD sum rules, large-N QCD and lattice QCD. Although these models predict the existence of hybrid baryons, their predictions for the masses and structures differ considerably from each other. On the experimental side, significant efforts are underway at the Jefferson Laboratory to identify these particles.

In this presentation, we propose a constituent model for describing hybrid baryons with heavy quarks. First, the flavour-spin-colour wavefunctions of the core of quarks are computed based on the Pauli exclusion principle. Then, the spin of the core of quarks is coupled to the helicity of the gluon by using the two-body helicity formalism of Jacob and Wick, leading to a series of helicity states with fixed J^P quantum numbers. Eventually, the spectrum of the system is computed by the help of the method of the envelope theory, which was already used in the past for studying conventional baryons and hybrid mesons, with conclusive results.

session

B. Hadron Spectroscopy

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