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Exploring Meson Structure through the Light-Front Quark Model

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The light-front quark model (LFQM) provides a powerful framework for investigating the internal structure of mesons in terms of their partonic degrees of freedom. Its manifest boost invariance and simple vacuum structure make it especially well suited for connecting nonperturbative hadron properties with experimentally measurable observables. In this talk, I present recent studies of meson structure using the LFQM, focusing on three central issues: (1) progress toward constructing realistic light-front wave functions that accurately capture hadron dynamics, (2) addressing covariance and current conservation challenges inherent in light-front approaches, and (3) understanding modifications of meson properties in extreme environments such as nuclear matter. These developments highlight the LFQM as an effective and versatile tool for deepening our understanding of mesons and their role in the nonperturbative regime of QCD.

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