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The Light-Front Quark Model and Exotic Matter MARTIN DEWITT, CHUENG JI, North Carolina State University — According to the Standard Model of particle physics, much of the matter we see is made up of quarks bound together by the strong force. Although a theory of the strong force, Quantum Chromodynamics (QCD), has existed for many years, it has not been possible to solve it exactly. As such, models based on the essential characteristics of the strong force, which have been gleaned from approximate solutions of QCD, have been very useful in understanding the properties of bound states of quarks. The light-front quark model (LFQM) has generally been successful in predicting the properties of two-body (quark-antiquark) bound states called mesons. While experimental data on mesons with certain quantum numbers have matched well with the model predictions, the $^3P_0$ (scalar) mesons have not. In fact, more scalar states have been observed experimentally than should exist if they were all two-body bound states. It is suspected that other "exotic" forms of matter, which have been predicted by QCD but have never been directly confirmed in experiments, are complicating the scalar meson spectrum. These exotic states have the same quantum numbers as the scalar mesons, and are thus allowed to mix with them. The result is that the states observed experimentally are actually quantum-mechanical superpositions of the scalar mesons and these other exotic forms of matter, thus making them difficult to clearly identify. I will discuss how the LFQM is used to predict the properties of mesons in general, as well as how it can be used to shed light on the more complicated structure of the scalar states.

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