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New Perspectives on the Charged Pion Form Factor

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We are about to enter a revolutionary new period in our understanding of the charged pion form factor, F_π. As the lightest meson, it is the particle responsible for the long-range character of the $N-N$ interaction that binds the atomic nucleus. Furthermore, if QCD were chirally symmetric, the pion would be massless. But chiral symmetry is dynamically broken by quark-gluon interactions and the inclusion of light quark masses, giving the pion (and ultimately all other hadrons) significant mass. Thus, the pion is central to many of the key questions of strong-interaction physics. There have been enormous advances in the last several years. Recent F_π calculations have shed much light on the links between dynamical chiral symmetry breaking, quark confinement and the generation of hadron mass. There have also been great advances in lattice QCD calculations, providing for the first time reliable predictions of F_π in the $1Q^26$ GeV^2 region.
Experimentally, there is also much promise. The measurement of F_π is challenging, as it must make use of the dominance of the nucleon's virtual pion cloud in pion electroproduction at low $-t$. With the recent completion of the Jefferson Lab Hall C apparatus, we will (for the first time since the pioneering Cornel data of the 1970's) be able to acquire the high quality data needed to provide rigorous tests of the recent theoretical developments. The new instrumentation will nearly triple the momentum transfer over which F_π is accurately known, probing the regime in which QCD begins to transition from large- to short-distance behavior. It will be an exciting time, and my talk will provide a glimpse into the path ahead.

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