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Atoms in Flight and the Remarkable Connections between Atomic and Hadronic Physics

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Atomic physics and hadron physics are both based on Yang Mills gauge theory; in fact, quantum electrodynamics can be regarded as the zero-color limit of quantum chromodynamics. I review a number of areas where the techniques of atomic physics provide important insight into the theory of hadrons in QCD. For example, the Dirac-Coulomb equation, which predicts the spectroscopy and structure of hydrogenic atoms, has an analog in hadron physics in the form of light-front relativistic equations of motion which give a remarkable first approximation to the spectroscopy, dynamics, and structure of light hadrons. The renormalization scale for the running coupling, which is unambiguously set in QED, leads to a method for setting the renormalization scale in QCD. The production of atoms in flight provides a method for computing the formation of hadrons at the amplitude level. Conversely, many techniques which have been developed for hadron physics, such as scaling laws, evolution equations, and light-front quantization have equal utility for atomic physics, especially in the relativistic domain. I also will present a new perspective for understanding the contributions to the cosmological constant from QED and QCD.

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