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Fundamental Investigations in QCD

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Quantum Chromodynamics is both an integral part of the Standard Model and the archetype for nature's non-Abelian gauge theories. The running coupling constant of QCD allows (requires) the theory to be studied in both the perturbative and the non-perturbative regime. Strongly interacting matter is predicted to have a rich phase structure, which is of particular interest in that QCD is the only fundamental theory with a phase transition that is currently accessible to direct experimental investigation. The intrinsically non-Abelian nature of QCD also leads to intriguing predictions of essentially classical fields in heavy nuclei at low momentum fraction. In addition, seemingly straightforward theoretical questions such as the origin of the proton's spin remain only partially addressed because of complications arising from the strength of the interaction. Answers to those questions will depend on additional experimental measurements to quantify the contributions of the gluons and the sea to the nucleon's spin. The opportunities to explore the rich structure of QCD at existing and future facilities will be presented, the current understanding of recent data will be reviewed, and the emerging connections of QCD to other fields of physics will be discussed.