

National Computational Infrastructure for Lattice Gauge Theory

A proposal in response to Office of Science Notice DE-FG02-06ER06-04 and Announcement Lab 06-04: Scientific Discovery through Advanced Computing.

Abstract

The long range goal of this initiative is to construct the computational infrastructure needed for the study of quantum chromodynamics (QCD). A very successful start was made under the first phase of the Scientific Discovery through Advanced Computing Program (SciDAC-1). We propose to build on this success to address new challenges that must be met to advance the study of QCD. Under SciDAC-1, a QCD Applications Programming Interface (QCD API) was developed, which enables lattice gauge theorists to make effective use of a wide variety of massively parallel computers. Under this proposal, optimized versions of the QCD API will be created for additional architectures that are expected to be important in future studies of QCD. The QCD API will be used to enhance the performance of the major QCD community codes and to create new applications. A QCD physics toolbox will be constructed that will contain sharable software building blocks for inclusion in application codes, performance analysis and visualization tools, and software for automation of physics workflow. Software tools will be created for managing the large data sets generated in lattice QCD simulations. In addition to these software projects, research on components for commodity clusters will be carried out in support of the Lattice QCD Computing Project, and the design of a fully customized computer for lattice QCD will be undertaken. Research made possible by the infrastructure created under this proposal will advance our understanding of QCD, providing important theoretical insights and vital support for the DOE's large experimental programs in high energy and nuclear physics.