High Energy Physics - Lattice

Parallelizing the QUDA Library for Multi-GPU Calculations in Lattice Quantum Chromodynamics

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Graphics Processing Units (GPUs) are having a transformational effect on numerical lattice quantum chromodynamics (LQCD) calculations of importance in nuclear and particle physics. The QUDA library provides a package of mixed precision sparse matrix linear solvers for LQCD applications, supporting single GPUs based on NVIDIA's Compute Unified Device Architecture (CUDA). This library, interfaced to the QDP++/Chroma framework for LQCD calculations, is currently in production use on the "9g" cluster at the Jefferson Laboratory, enabling unprecedented price/performance for a range of problems in LQCD. Nevertheless, memory constraints on current GPU devices limit the problem sizes that can be tackled. In this contribution we describe the parallelization of the QUDA library onto multiple GPUs using MPI, including strategies for the overlapping of communication and computation. We report on both weak and strong scaling for up to 32 GPUs interconnected by InfiniBand, on which we sustain in excess of 4 Tflops.

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