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Using GPUs in Lattice Chromodynamics[1]

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Lattice quantum chromodynamics (QCD) calculations were one of the first applications to demonstrate the potential of GPUs in the area of high-performance computing, because the nature of lattice QCD calculations matches well the GPUs' computational model. In this talk, we will discuss ways to effectively use GPUs for lattice calculations using the overlap operator, a discretization that preserves chiral symmetry even at nonzero lattice spacing and makes possible lattice QCD simulations in the parameter region relevant to Nuclear Physics. We will show that the large memory footprint of these codes requires the use of multiple GPUs in parallel and we will discuss methods used to implement this operator efficiently: mixed-precision for inverters, hybrid CPU/GPU memory use for eigensolvers, and MPI/OpenMP/CUDA parallelization strategies required to take full advantage of both GPU and CPU available resources. We compare the performance of our codes on a GPU cluster and a CPU cluster with similar interconnects. We discuss the strong scaling for problem sizes relevant to current lattice QCD simulations.

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