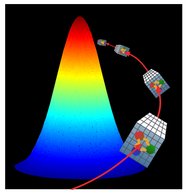
Accelerating QCD Gauge Generation on GPUs

Objectives

- Discovery of the properties of hadronic and nuclear matter through world leading Lattice Quantum Chromodynamics (LQCD) calculations
- Extension of the state of the art in LQCD computational capability by the development and integration of advanced algorithms
- Maximally exploiting advanced leadership hardware capabilities such as GPUs in OLCF Titan and OLCF Summit

Impact

- Nearly 2 orders of magnitude efficiency increase for gauge generation using OLCF Summit
- Titan improvements bring nearly an order of magnitude increase in value from existing INCITE allocation for USQCD gauge generation program
- Improvements fundamentally shift the balance of costs between gauge generation and gauge field analysis, allowing previously unaffordable calculations



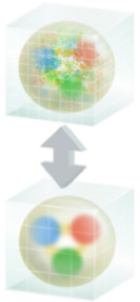
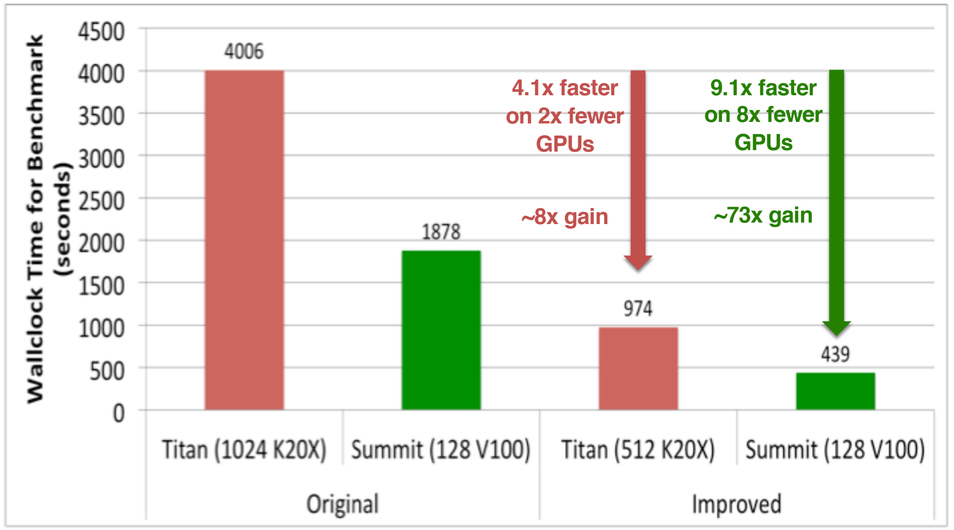


Image Credit: Joanna Griffin, Jefferson Lab Public Affairs



Accomplishments

- **~9x** wallclock speed-up on Summit using **8x** fewer GPUs than Titan**: ~73x improvement in computational efficiency**
- Moved Multi-grid set-up phase in QUDA library entirely to GPUs allowing its use in gauge generation, and added extra optimizations (K. Clark, NVIDIA)
- Multi-grid solver integrated into Gauge Generation code (B. Joo, JLab)
- Developed Force-Gradient Time-stepper for Chroma (B. Yoon, LANL)
- Re-tuned Hamiltonian splitting and multi-level integration scheme enabled by these advances (B. Joo, JLab)

Computing Properties of Matter with Leadership Computing Resources

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