Plasma Physics Simulations on Next Generation Platforms
APS Division of Plasma Physics Annual Meeting, Denver, CO, November 2013

NERSC’s Dirac GPU Cluster (sub-cluster of Carver)

Dirac has 50 GPU nodes containing 2 Intel Xeon 2.2 GHz, 8 GB RAM, and 1 NVIDIA Tesla C2050 GPU core per node. These nodes are configured in 10 5-node racks. Each rack contains 2 interconnects and 20 GB of memory per core. Each node has 2 NVIDIA Tesla C2050 GPUs, each with 4 GB of memory and 464 parallel CUDA processor cores.

NERSC’s Dirac GPU Cluster (sub-cluster of Carver)

OpenCL – Open Computing Language
Open, royalty-free standard for portable, parallel programming of heterogeneous CPU, GPU, and other processors

SC13 Tutorial next week in Denver
OpenCL: A Hands-on Introduction
Tim Mattison, Simon McIntosh-Smith, Alice Koniges

Extending MPI + OpenMP and new approaches

A new "decoy" algorithm is using a combination of MPI, OpenMP, and CAF giving significant performance improvement on 13k cores

Particle-Grid algorithms combined with developing programming languages are appropriate for next generation platforms

- A broad family of computations using discrete-particle methods already perform at extremely high scalability
- Exascale will be constrained by lock-step nature
- Consider new and rethought algorithms that break away from traditional lock-step programming
- Compute send compute send=faulted overlap
- Use a message-driven work-based approach based to fiber grid parallelism based on lightweight constraint-based synchronization

Execllence operating systems, e.g., Parallel Execution Model, may support totally new programming models

A combination of new algorithms with purpose event driven models can surpass performance of traditional time-step models

OpenCL is also good for systems using Xeon Phi Coprocessors

Batchbility is NERSC internal cluster containing the Intel/Intel Phi coprocessor, which is sometimes called a Many Integrated Core (MIC) architecture. Batchbility is not available to general NERSC users. Batchbility has one login node and 46 compute nodes with two MIC cards and two Intel Xeon "host" processor within each compute node.

NERSC is exploring new ways to share and analyze terabytes of science data

Science Gateways http://portal.nersc.gov

Web-accessible Data Depots
- High-performance web and software tools for science data discovery
- GridFTP, HDF5, HDF, available on portal.nersc.gov

Web-based Team Analytics
- Collaboratively build data-driven models, from data science
- TrapPi, SUMO, SciDB, Bolitas, machine learning

ITC & HPC Execution Engines
- Marshal high-throughput workflows and ensembles
- Exascale app support between ITC and HPC needs

Data as a tool for Web Apps
- Modern APIs (API, REST, etc.) to deliver data downstream
- Science-aware data protocols and APIs w/ production-reliability

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