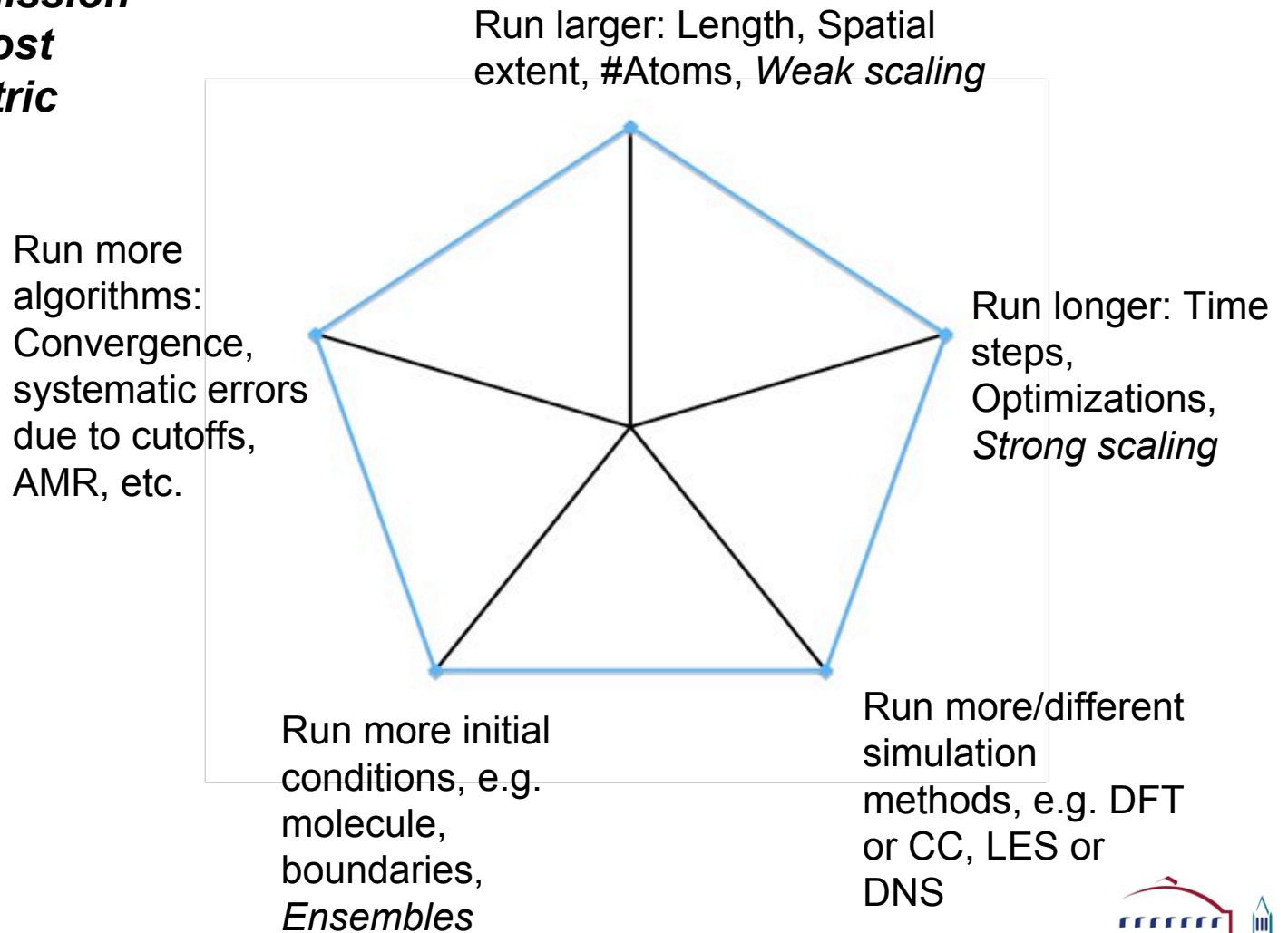


Performance Metrics

Delivering on Mission Needs is the most importance metric



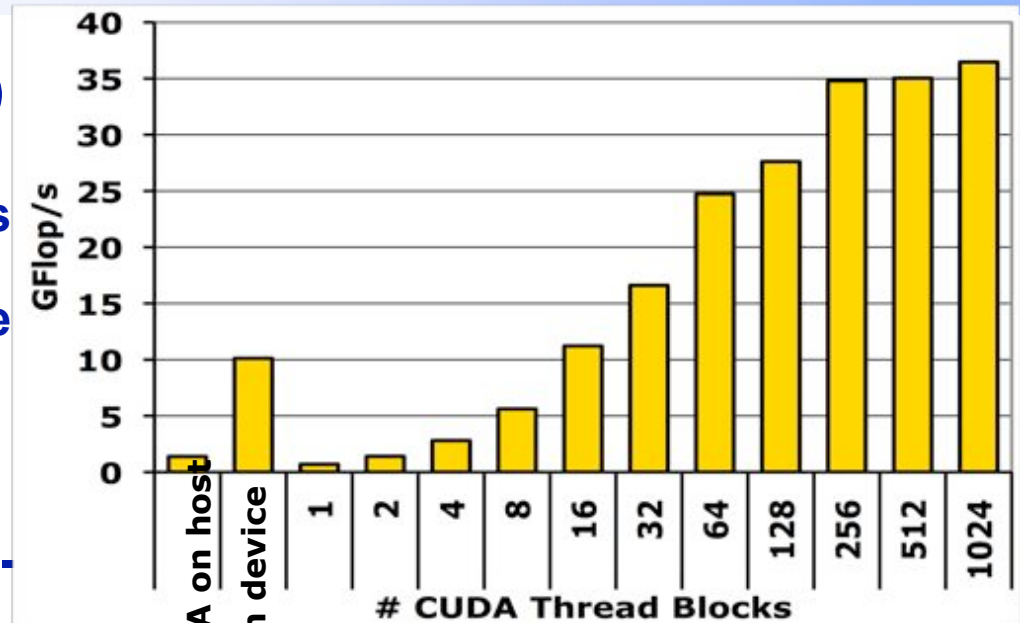


Computational Challenges

- **Abstractions to reveal concurrency, tolerate latency, and tolerate failures**
 - Domain specific, e.g. Global Arrays, or Super Instruction Architecture for chemistry
 - Libraries or frameworks, e.g. ACTS Collection
- **Rethink algorithms based on a flop rich, bandwidth poor, and higher latency environment**
 - If there is extra physics that can be incorporated (at high computational intensity)
 - Balance of control logic versus flops will change

Role of Accelerators

- **Accelerators (at least GPUs) becoming pervasive**
 - Many computational groups investigating: chemistry, accelerator physics, climate
 - Desktop GPUs through to Roadrunner
- **Conventional multicores may adopt features (pseudo-vector, etc.) that provide accelerator advantages without make harder programming abstractions**
- **Data parallelism prevalent in simulation codes**
 - **CUDA provides abstraction to exploit it**

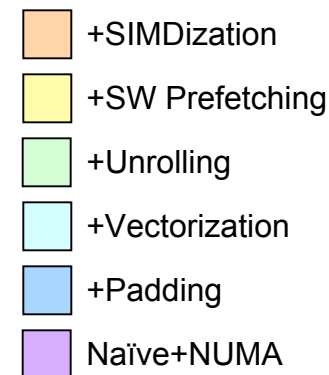
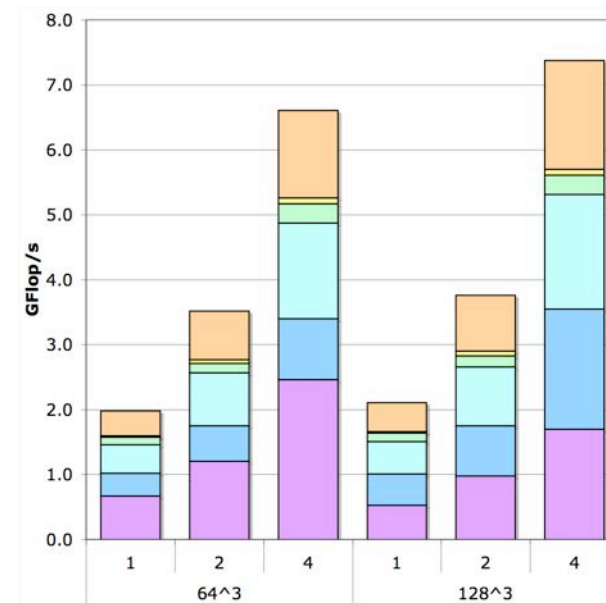


Results from 7-point stencil on NVIDIA GTX 280 (double precision)

Programming Models

- For simulations using a large fraction of a system in the next 2-3 years MPI+X will substantially increase
 - Replicated data structures grow in importance as memory per core decreases
- Auto-tuning to get the best from existing programming models
- Existing models will adapt, e.g. MPI and fault tolerance, OpenMP and data placement, or be incrementally replaced
- New models from left field, e.g. map reduce

Auto-tuning results on Opteron Socket F for LBMHD





System Attributes

- **System architecture trends indicate flop-rich, bandwidth poorer, and latency poorer per socket.**
- **Intermediate storage between memory and disk, e.g. FLASH will become common place**
- **Data deluge will increase**
 - **If we have a exascale systems nationally, petascale desktops will increase data-handling demands of even the least data-rich disciplines**
 - **Higher demand for storage and networking**
- **Power will be a major preoccupation**