Workshop on Programming Languages for High Performance Computing

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
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Problem Formulation: Little's Law

$$\text{Throughput} = \frac{\text{Concurrency}}{\text{Latency}}$$

- **Concurrency:**
  - **ILP: harder for the hardware to find**
  - **TLP: not extensively adopted at SNL/difficult to program**
  - **MPI: a significant existing investment**
- **Latency:**
  - **Dominated by memory (von Neumann bottleneck)**
  - **Increasing relative to processor cycle times**
  - ***RELATED TO ILP-LEVEL CONCURRENCY!!!***
    - ***Increasing Memory Latency DECREASES ILP***
- **Throughput:**
  - **The reason why we're here**

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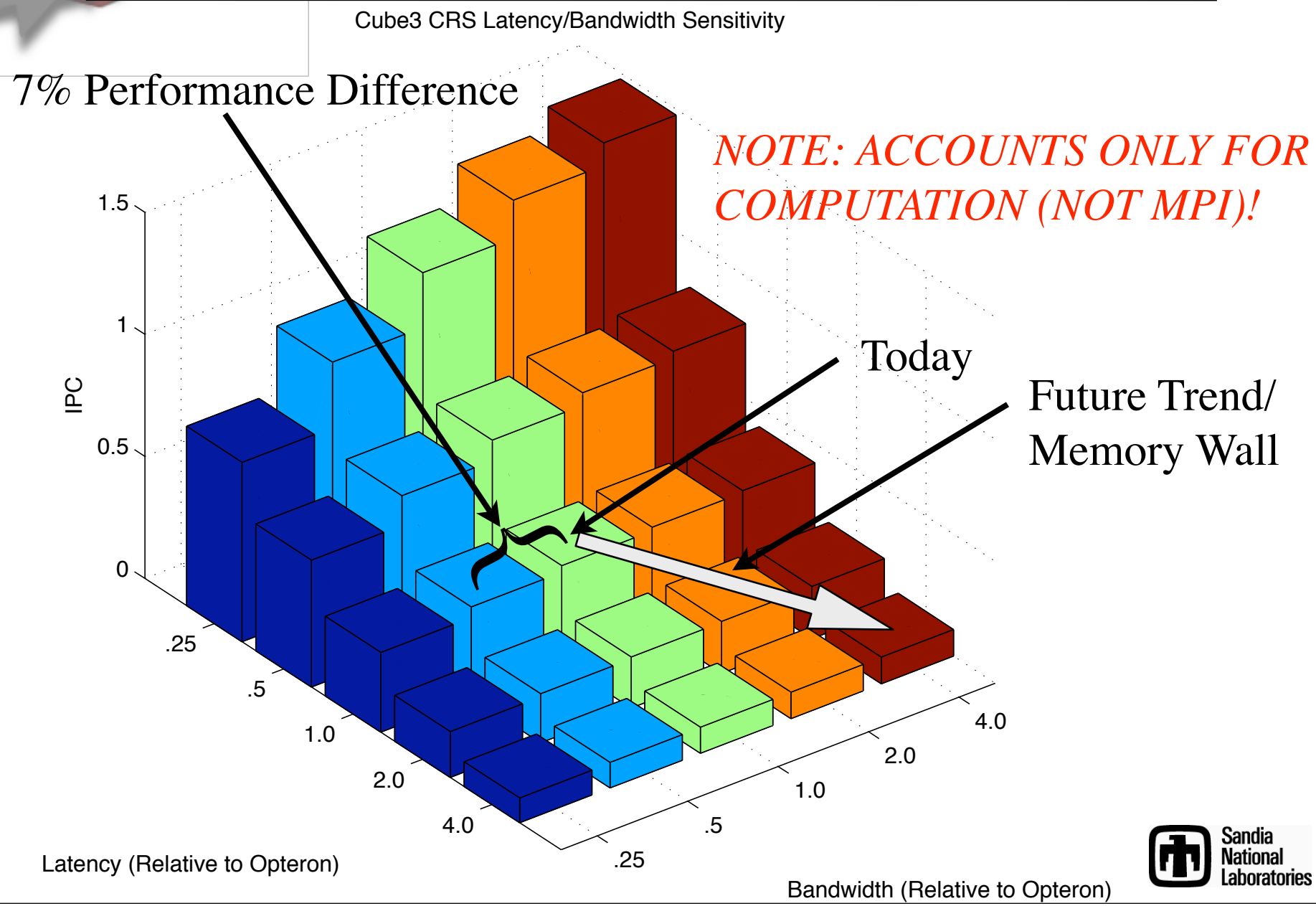
Effects of Memory on Traditional Codes



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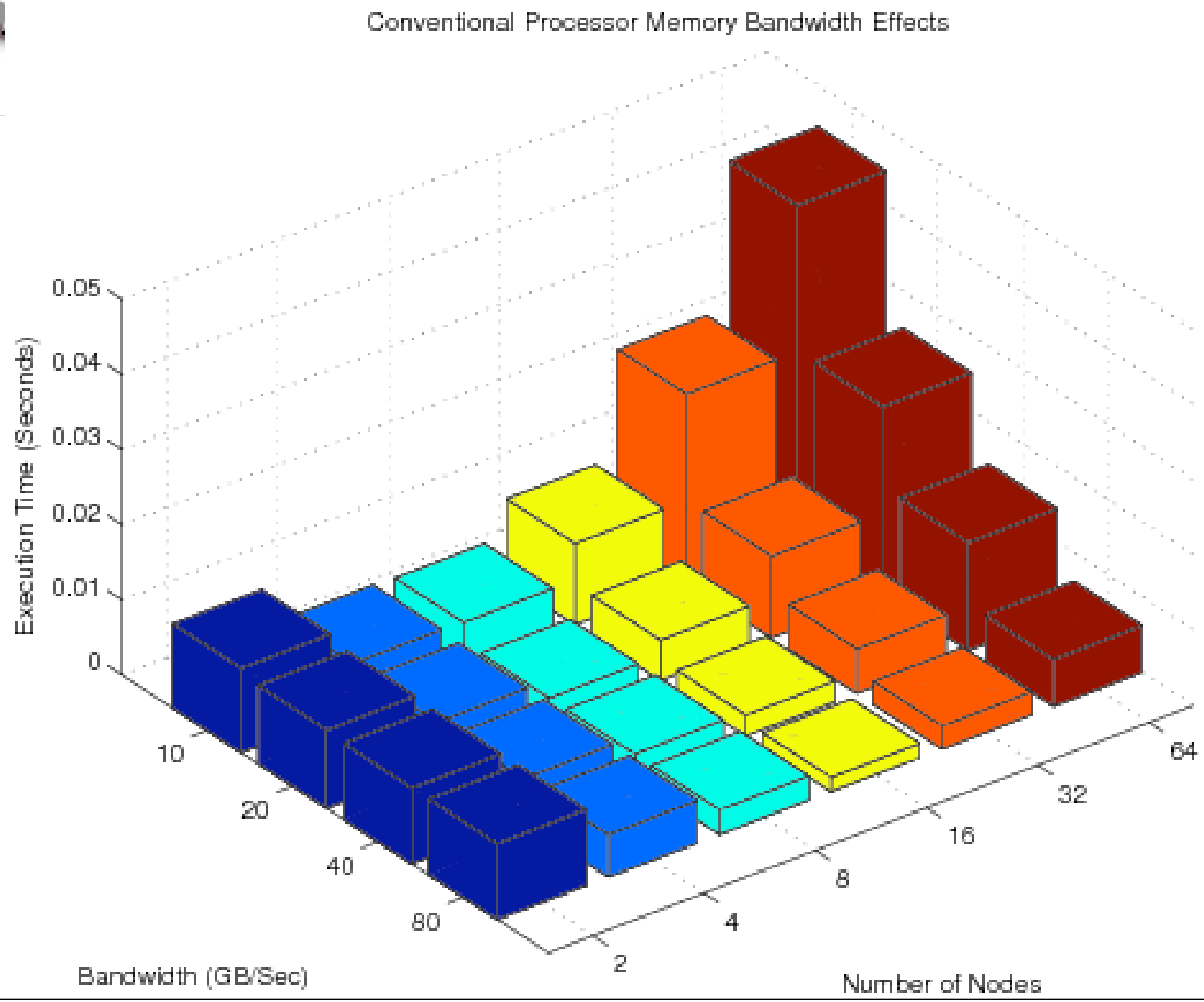
Emerging Codes



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Workshop Agenda and Key Questions Tuesday

- Architecture:
  - What's changing about architecture? What do we agree is coming (multicore) and what's potentially new and interesting?
- Keynote Address: Neurocomputing
  - Bill Carlson's Challenge to find an HPC application that isn't!
- Applications:
  - What can we learn from applications that are difficult to address using MPI?
  - What about "productivity" now that HPCS is in Phase-III?
- Programming Models Keynote: MPI: The Last Large Scale Success?
  - What did we get right the last time?
- WORKSHOP DINNER(S)

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Workshop Agenda and Key Questions Wednesday

- HPCS Languages Round Table
  - What is the time-frame for generating large-scale applications on large machines with performance comparable to MPI?
  - What features of each language are most suited to current and forthcoming scientific computing applications on highly parallel systems? What about emerging combinatorial HPC applications?
  - If a standardization effort was started to create a single HPCS language, what critical features of your language would be "required"? Do you think such an effort makes sense?

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Workshop Agenda and Key Questions Wednesday (continued)

- Programming Models
  - What examples other than MPI have we seen that work (UPC, Co-Array Fortran, HPF, etc.)?
  - What about compilers for novel architectures?
  - What is the future of programming models: what have we done well and what are we missing?
- Panel: What is a realistic vision of the future?

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