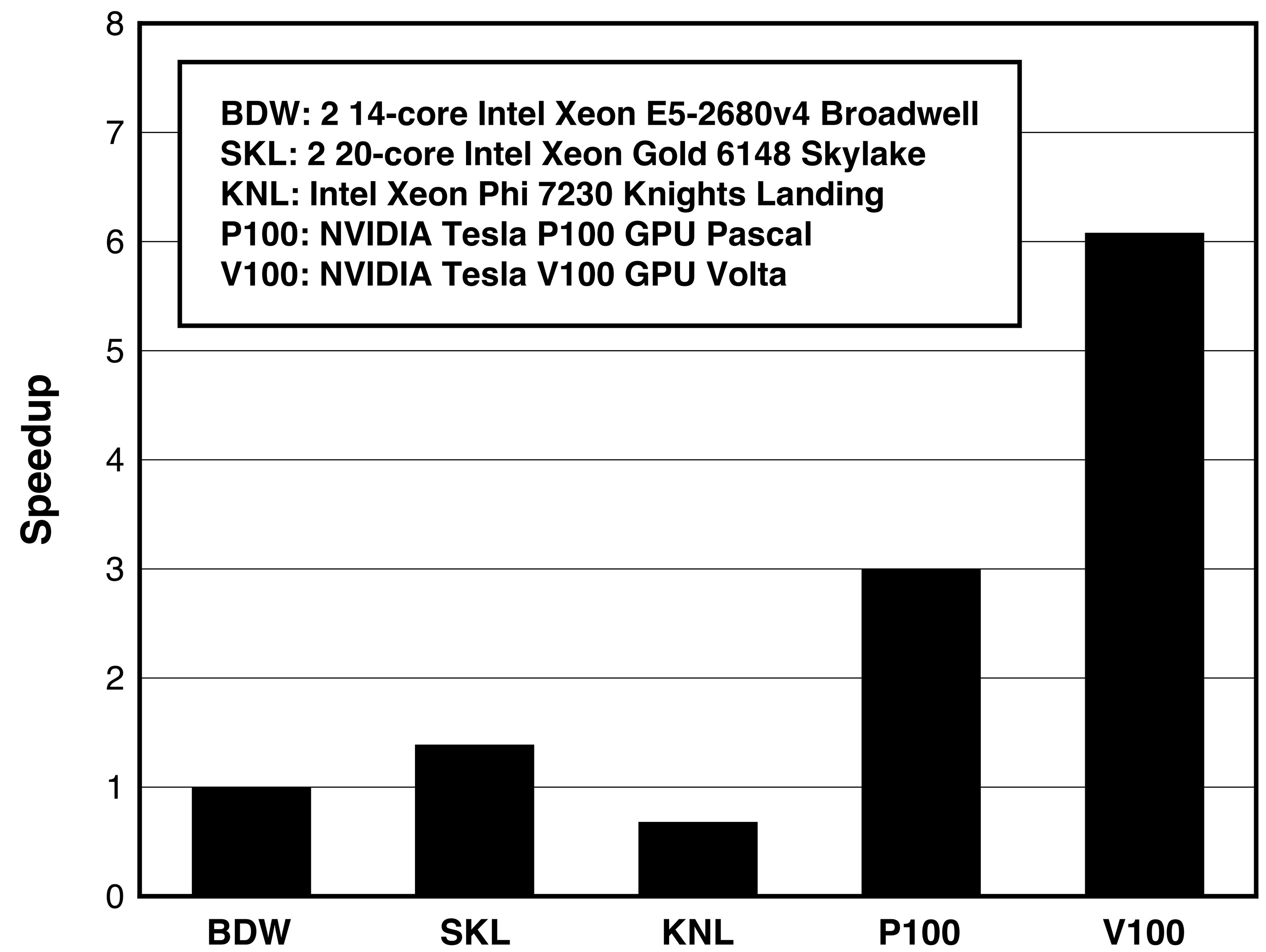
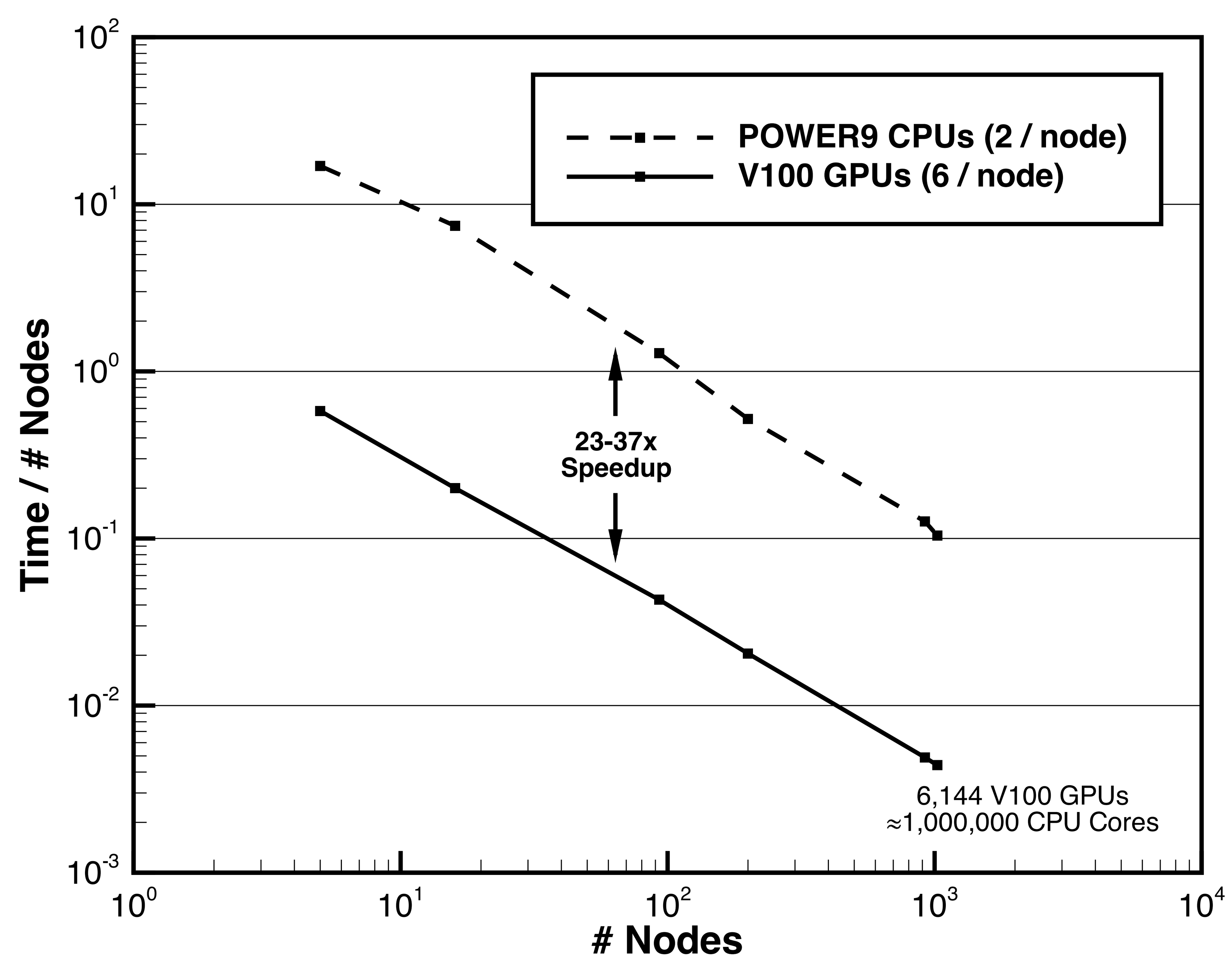


Performance of an unsteady Navier-Stokes simulation on common high-performance computing architectures is shown relative to a dual-socket node with two Intel Xeon E5-2680v4 Broadwell processors. The unstructured mesh contains approximately 10 million elements, sized for 16 gigabytes of memory. Though not shown, the energy efficiency of the NVIDIA Tesla V100 is over four times that of the Intel Xeon Gold 6148 Skylake node when comparing thermal design power. *Aaron Walden, Eric Nielsen, NASA/Langley*



Weak scaling performance on the Summit system at the Oak Ridge Leadership Computing Facility. Each dual-socket node contains two IBM POWER9 CPUs and six NVIDIA Tesla V100 GPUs. MPI+OpenMP on CPUs is compared with MPI+CUDA on GPUs. The largest computations are performed on 1,024 nodes (6,144 GPUs) using an unstructured mesh consisting of 58 billion elements. The GPU simulations show a nominal 30x speed advantage, with the largest GPU run equivalent to the computational throughput of over a million CPU cores. *Eric Nielsen, Aaron Walden, NASA/Langley*

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Preparing the FUN3D CFD Solver for the Exascale Era

Exascale-class simulations will be achieved through a combination of high concurrency and energy efficiency. Although accelerator architectures like GPUs are so equipped, the task of adapting a feature-rich legacy application to modern HPC hardware can be daunting. We present the implementation of such GPU capability in the NASA Langley FUN3D computational fluid dynamics (CFD) flow solver. The Summit system at the Oak Ridge Leadership Computing Facility was used to demonstrate the implementation at scale. With this effort, a thousand of today's 6-GPU nodes can do the work of over a million CPU cores for a fraction of the energy cost. Our work will enable timely simulation of large-scale applications relevant to a broad range of NASA missions.

Eric Nielsen, NASA Langley Research Center
Aaron Walden, NASA Langley Research Center

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