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Large-Scale High-Lundquist Number Reduced MHD Simulations of the Solar Corona using GPU Accelerated Machines

We have recently carried out a computational campaign to investigate a model of coronal heating and current-sheet formation in three-dimensions using reduced magnetohydrodynamics (RMHD). Our code is built on a conventional scheme (pseudo-spectral, semi-implicit) and is parallelized using MPI. The current investigation requires very long time integrations using high Lundquist numbers, where the formation of very fine current layers challenge the resolutions achievable even on massively parallel machines. We present here results of a port to Nvidia CUDA (Compute Unified Device Architecture) for hardware acceleration using graphics processing units (GPUs). In addition to a brief discussion of our general strategy, we will report code performance on several machines that span a variety of hardware configurations and capabilities. These include a desktop workstation with commodity hardware, a dedicated research workstation equipped with four Nvidia C2050 GPUs, as well as several large-scale GPU accelerated distributed memory machines: Lincoln/NCSA, Dirac/NERSC, and Keeneland/NICS.

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