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High-Lundquist Number Simulations of Solar Coronal Heating 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). In the high-Lundquist number (S) limit, the coronal heating rate obtained so far is consistent with a trend that is independent of S , as predicted by previous analysis as well as 2D simulations. In the same limit the average magnetic energy built up by the random footpoint motion tends to have a much weaker dependence on S than that in the 2D simulations, as well as the scaling obtained by [Longcope and Sudan, *Astrophys. J.*, 437, 491 (1994)]. The current investigation requires very long time integrations to obtain good statistics, as well as high-resolution to resolve very fine current layers. We will present scaling analysis showing that when the dissipation time is comparable or larger than the correlation time of the random footpoint motion, the heating rate tends to become independent of S , and that the magnetic energy production is also reduced significantly. We will also present 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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