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Use of Hilbert Curves in Parallelized CUDA code: Interaction of Interstellar Atoms with the Heliosphere[1] ANTHONY DESTEFANO, JACOB HEERIKHUISEN, Univ of Alabama - Huntsville — Fully 3Dparticle simulations can be a computationally and memory expensive task, especially when high resolution grid cells are required. The problem becomes further complicated when parallelization is needed. In this work we focus on computational methods to solve these difficulties. Hilbert curves are used to map the 3D particle space to the 1D contiguous memory space. This method of organization allows for minimized cache misses on the GPU as well as a sorted structure that is equivalent to an octal tree data structure. This type of sorted structure is attractive for uses in adaptive mesh implementations due to the logarithm search time. Implementations using the Message Passing Interface (MPI) library and NVIDIA's parallel computing platform CUDA will be compared, as MPI is commonly used on server nodes with many CPU's. We will also compare static grid structures with those of adaptive mesh structures. The physical test bed will be simulating heavy interstellar atoms interacting with a background plasma, the heliosphere, simulated from fully consistent coupled MHD/kinetic particle code. It is known that charge exchange is an important factor in space plasmas, specifically it modifies the structure of the heliosphere itself.

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