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Framework for advanced plasma simulations on many-core architectures and results NOAH REDDELL, URI SHUMLAK, University of Washington, GUOYONG FU, Princeton Plasma Physics Laboratory — A new framework designed for emerging many-core computing architectures is developed. The framework is used for simulation of both multi-fluid plasma models and continuum kinetic models. We provide exemplary physics results, and show performance gains seen using this approach. Many-core architectures will dominate the field of high performance computing in the coming decade. In order to maximize performance and power efficiency on these systems, code design should minimize data movement. The algorithms developed are thus both local and explicit. Fluid and continuum kinetic models on structured grids also benefit from predictable data access patterns as opposed to PIC models. The resulting framework is a hybrid combination of MPI for communication between nodes, threads for task parallelism on each node, and OpenCL for parallel scientific computation on tens or hundreds of cores available on each node - often a GPU machine. The framework fulfills the significant challenges of managing data movement, sub- domain sequencing, and file output such that memory bandwidth bottlenecks can be significantly hidden. Framework users can concentrate on algorithm development specific to their model. Physics results including energetic particle-induced geodesic acoustic mode (EGAM) in tokamaks and two-fluid Whistler wave propagation are demonstrated.

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