Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

WARPM Framework for advanced plasma model simulations on many-core architectures NOAH REDDELL, URI SHUMLAK, University of Washington — A new framework WARPM designed for many-core computing architectures such as GPU is presented. The framework supports both multi-fluid and continuum kinetic plasma models. We provide exemplary physics results including whistler wave propagation, and show performance gains. For good performance on many-core architectures, 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 parallel numerical method implementation across hundreds of cores per node. The framework manages data movement, sub-domain sequencing, and I/O intelligently such that memory bandwidth bottlenecks can be significantly hidden. Use of OpenCL and our method for sequencing computation naturally allows for heterogeneous computation utilizing both CPU and GPU on a node. A new dynamic OpenCL code assembly scheme allows support for many different models, numerical methods, and geometries; a specific combination of these is chosen at runtime then used to generate a single compiled kernel.

Noah Reddell
University of Washington

Date submitted: 23 Jul 2012 Electronic form version 1.4