Particle-in-cell Simulations with Charge-Conserving Current Deposition on Graphic Processing Units[1] XIANGLONG KONG, MICHAEL HUANG, CHUANG REN, University of Rochester, VIKTOR DECYK, University of California Los Angeles — We present an implementation of a fully relativistic, electromagnetic PIC code, with charge-conserving current deposition, on graphics processing units (GPUs) with NVIDIA's massively multithreaded computing architecture CUDA. A particle-based computation thread assignment was used in the current deposition scheme and write conflicts among the threads were resolved by a thread racing technique. A parallel particle sorting scheme was also developed and used. The implementation took advantage of fast on-chip shared memory. The 2D implementation achieved a one particle-step process time of 2.28 ns for cold plasma runs and 8.53 ns for extremely relativistic plasma runs on a GTX 280 graphic card, which were respectively 90 and 29 times faster than a single threaded state-of-art CPU code. A comparable speedup was also achieved for the 3D implementation.

Xianglong Kong
University of Rochester

Date submitted: 12 Jul 2010

Electronic form version 1.4