Introducing the GPU-based Particle-in-Cell Code Aperture YU-RAN CHEN, Princeton University — Aperture is a Particle-in-Cell code designed and developed from scratch. It was designed from the beginning to be run on GPUs and scalable to large GPU clusters. It was originally developed for simulations of magnetospheres of neutron stars, but was designed to be flexible and can be applied to many different plasma physics problems, especially when the interaction of radiation and plasma is important. It has different radiation modules that handle synchrotron loss, resonant and non-resonant inverse Compton scattering, triplet pair production, and photon-photon pair production. It has been used to simulate the pair creation process near pulsars, the hard X-ray emission from magnetars, and pair-producing gaps in the vicinity of supermassive black holes. The GPU architecture allows a speed up factor of several hundred over conventional CPU cores, and alleviates load balancing issues with larger subdomains. I will also present my accompanying work on interactive visualization of the simulation results using WebGL. It is possible to render volumetric data, iso-surfaces, and particles using this pipeline in real time in a modern browser, and it is one click away from viewing the result in virtual reality.

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