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Progress on the Vorpal exascale transition

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Vorpal was designed nearly 20 years ago, with its first applications roughly four years later, as a highly performant, flexible plasma simulation code. Using object oriented methods, Vorpal was designed to allow runtime selection from multiple field solvers, particle dynamics, and reactions. It has been successful in modeling for many areas of accelerator physics, including RF structures, laser-plasma and beam-plasma acceleration, and dielectric-based accelerators. Now it is critical to move to exascale systems, with their compute accelerator architectures, massive threading, and advanced instruction sets. Previous revolutionary changes, such as the move to distributed memory computing (MPI), led to entirely new applications, as the extensive required restructuring made new application development from scratch the more efficient process. Here we discuss how we have moved this complex, multiphysics computational application to the new computing paradigm, and how it was done in a way that kept the application producing physics during the move. We present performance results showing significant speedups in all parts of the PIC loop, including field updates, particle pushes, and reactions.

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