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PIConGPU: Scaling high-fidelity plasma simulations up to exascale compute systems and a view on recent applications

PIConGPU's latest release 0.6.0 in December 2021 brought a number of new features. Among these are an arbitrary-order Maxwell solver, the Higuera-Cary pusher, collisions, and incident field generation via the total field/scattered field technique enhancing its numerical stability and predictive capabilities.

Furthermore, there are various technical advances, most notably support of the HIP computational backend allowing to run on AMD GPUs. These advances are mainly driven by our participation in OLCF's Frontier Center for Accelerated Application Readiness providing access to the hardware platform of the Frontier exascale supercomputer scheduled for deployment later this year. We show performance data and present recent applications of PIconGPU profiting from these developments. To these applications belongs the advanced laser-plasma accelerator scheme Traveling-wave electron acceleration (TWEAC), providing scalability to energies beyond 10 GeV while avoiding staging. We further present simulation campaigns modeling and delivering valuable insight into the micrometer and femtosecond plasma dynamics of existing experimental campaigns.

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