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Exascale and ML Models for Accelerator Simulations

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Computational modeling is essential to the exploration and design of advanced particle accelerators. The modeling of laser-plasma acceleration and interaction can achieve predictive quality for experiments if adequate resolution, full geometry and physical effects are included. Here, we report on the significant evolution in fully relativistic full-3D modeling of conventional and advanced accelerators in the WarpX and ImpactX codes with the introduction of Exascale supercomputing and AI/ML models. We will cover the first PIC simulations on an Exascale machine, the need for and evolution of open standards, and based on our fully open community codes, the connection of time and space scales from plasma to conventional beamlines with data-driven machine-learning models.

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