

State of the Art in Large-Scale Beam Dynamics Modeling for Particle Accelerator Physics

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Abstract. Particle accelerators are among the most important and versatile tools of scientific discovery. They have enabled a wealth of advances in high energy physics, nuclear physics, materials science, chemistry, and the biosciences. They also have important applications in medicine, energy sciences, and national security. Large-scale, parallel beam dynamics simulations are essential to developing the next generation of particle accelerators, to understanding beam instabilities, and to exploring advanced concepts. These simulations are extremely challenging due to the highly nonlinear, many-body, multi-physics nature of beam dynamics in accelerators. Since the late 1990s the US Department of Energy has supported the development of parallel codes for accelerator simulation, first through a DOE Grand Challenge and then through the SciDAC program. The current SciDAC project is the Community Petascale Project for Accelerator Science and Simulation (ComPASS).

This talk describes the latest advances in large-scale, parallel beam dynamics simulation in ComPASS and other projects.