

# Geometric algorithms for relativistic dynamics

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Dynamics of relativistic charged particles in external or self-consistent electromagnetic fields serves as the first principle model underlying plasma physics, fusion energy research, accelerator physics, astrophysics, space science, and many other subfields of physics. The long-term relativistic dynamics is critical to describe various multi-timescale problems. The multi-scale problems are hard to deal with both analytically and numerically, since different timescales cannot be effectively decoupled. The coherent accumulation of numerical errors disables their numerical solutions. In this talk, after demonstrating the relativistic system is source-free in phase-space, the corresponding volume-preserving algorithm is developed via splitting technique. Its construction procedure and formulation are introduced.