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Non-Canonical Symplectic Integration of Guiding Center Orbits[1]

C. LELAND ELLISON, Princeton Plasma Physics Laboratory, JOHN M. FINN, Los Alamos National Laboratory, HONG QIN, WILLIAM M. TANG, Princeton Plasma Physics Laboratory — The calculation of guiding center trajectories is an important aspect of evaluating particle confinement in a given magnetic configuration. An attractive approach to doing so involves the specification of a non-canonical guiding center Lagrangian which in turn requires novel methods to develop geometric (i.e. symplectic) algorithms. We present results from the progress made in the use of variational integrators applied to the guiding center problem. The stability of various classes of discrete Lagrangians is discussed using backwards error analysis, and new methods for controlling parasitic modes are introduced. Cross-benchmarking comparisons are carried out against standard Runge-Kutta methods applied to the calculation of guiding center orbits in 3-D toroidal geometries. The conserved quantities in the variational algorithms are shown to lead to good numerical fidelity in simulations of long duration.

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C. Leland Ellison
Princeton Plasma Physics Laboratory

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