A Direct Comparison of Symplectic Maps with High-Order Multistep Integrators for Long-Term Solar System Dynamical Simulations

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Abstract: In recent years, symplectic mapping techniques have found widespread use in the solar system dynamics community. The appeal of these methods lies in their seeming computational efficiency: the long timesteps, typically 1 year as employed by users of these methods, allow for long-term dynamical simulations at a fraction of the computational expense of other integration methods. What is the cost of this expediency, however? Recent work by Haberkorn and Newman (1996) has shown that symplectic mapping schemes can artificially alter the dynamics of a system, particularly when trajectories lie near separatrices - resulting in integrable systems showing non-physical chaotic behavior if both the integration and time-steps are long. In this study, we repeat our 100,000 particle survey of the dynamical lifetimes of planetesimals situated in the gap between Jupiter and Saturn using the popular Wisdom-Holman second order symplectic mapping technique. We compare and contrast these results to those previous obtained using a 13th order Stormer multistep integrator, using 4-day time steps, having well-known and bounded error growth properties.

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