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Chaos in a Spatially Periodic 3-Body (1+1)-Dimensional Self-Gravitating System PANKAJ KUMAR, BRUCE MILLER, Texas Christian University — We investigate regular and chaotic motion of a classical 3-body, one-dimensional, self-gravitating system with periodic boundary conditions. We demonstrate that the dynamics of the 3-body system may be modeled by that of a spatially periodic system of a single particle on a rhombic plane. The analytic form of the Hamiltonian has been derived in rhombic coordinates. Phase-space evolution is followed in simulation through an event-driven algorithm which utilizes exact solutions for the time-evolution of positions and velocities. We calculate the largest Lyapunov exponent and the Kolmogorov-Sinai entropy of the system for different initial conditions of the system. Poincare surfaces have also been presented for several energies. The simulation results show that the motion exhibits chaotic, quasiperiodic, and periodic behaviors in segmented regions of the phase space. Finally, the results are compared with those already known for classical and relativistic versions of the 3-body gravitating system with free boundary conditions. Our treatment of the system is the first one of its kind and opens avenues for analysis of the dynamical properties exhibited by spatially periodic versions of various classes of systems studied in plasma and gravitational physics as well as in cosmology.

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