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Regular and Chaotic Motion of a Piecewise Smooth Bouncer[1]
CAMERON LANGER, BRUCE MILLER, Texas Christian University — The dynamical properties of a particle in a gravitational field colliding with a rigid wall moving with piecewise constant velocity are studied. The linear nature of the wall's motion permits further analytical investigation than is possible for the system's sinusoidal counterpart. We consider three distinct collision models: elastic, and inelastic with either a constant or velocity dependent restitution coefficient. We confirm the existence of unbounded orbits (Fermi acceleration) in the elastic model, and find regular and chaotic behavior in the inelastic cases. We also examine trajectories wherein the particle experiences an infinite number of collisions in a finite time i.e., the phenomenon of inelastic collapse. We address these "sticking solutions" and their relation to both the overall dynamics and the phenomenon of self-reanimating chaos. Additionally, we investigate the long-term behavior of the system as a function of both initial conditions and parameter values. We find novel bifurcation phenomena not seen in the sinusoidal model. Our investigations reveal that, although the piecewise linear bouncer is a simplified version of the sinusoidal model, it captures essential features of the latter and also exhibits behavior unique to the discontinuous dynamics.

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