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Regular and Chaotic Motion of a Gravitational Billiard in a Cone
CAMERON LANGER, BRUCE MILLER, Texas Christian University — We study the nonlinear dynamics of a three dimensional billiard in a constant gravitational field colliding elastically with a linear cone of half angle ?. We derive a two-dimensional Poincare map with two parameters, the half angle of the cone and l, the z-component of the billiards angular momentum. We demonstrate several integrable cases of the parameter values, and analytically compute the systems fixed point, analyzing the stability of this orbit as a function of the parameters as well as its relation to the physical trajectory of the billiard. Next, we explore the phase space of the system numerically. We find that for small values of l the conic billiard exhibits behavior characteristic of two-degree-of-freedom Hamiltonian systems with a discontinuity, and the dynamics is qualitatively similar to that of the wedge billiard, although the correspondence is not exact. As we increase l the dynamics becomes, on the whole, less chaotic and the correspondence with the wedge billiard is lost. In common with the wedge billiard, we anticipate that modifications of the cone system will prove valuable for experimental investigation, both with atoms at low temperature and driven billiards.

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