SUPPRESSING FERMI ACCELERATION IN TWO-DIMENSIONAL DRIVEN BILLIARDS

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Abstract

We consider a dissipative oval-like shaped billiard with a periodically moving boundary. The dissipation considered is proportional to a power of the velocity \( V \) of the particle. The three specific types of power laws used are: (i) \( F \propto -V \); (ii) \( F \propto -V^2 \) and (iii) \( F \propto -V^\delta \) with \( 1 < \delta < 2 \). In the course of the dynamics of the particle, if a large initial velocity is considered, case (i) shows that the decay of the particle’s velocity is a linear function of the number of collisions with the boundary. For case (ii), an exponential decay is observed, and for \( 1 < \delta < 2 \), an power-like decay is observed. Scaling laws were used to characterize a phase transition from limited to unlimited energy gain for case (ii). The critical exponents obtained for the phase transition are the same as those obtained for the dissipative bouncer model. Therefore near this phase transition, these two rather different models belong to the same class of universality. For all types of dissipation, the results obtained allow us to conclude that suppression of the unlimited energy growth is indeed observed.