

Vertical chaos and horizontal diffusion in the bouncing-ball billiard

A. S. de Wijn*, H. Kantz

Max-Planck-Institute for the Physics of Complex Systems, Nöthnitzer Straße 38,
01187 Dresden, Germany

* Electronic Address: wijn@mpipks-dresden.mpg.de

The bouncing-ball billiard is an interesting, low-dimensional system in which transport properties of real physical systems can be studied theoretically. We study the bouncing-ball billiard with non-convex scatterers with small slopes. We show that there is a time-scale separation between the horizontal and vertical motion, which is controlled by the slope of the billiard. We apply the theory of time-scale separation developed in ref. [1]. If the vertical motion is chaotic, the horizontal motion is diffusive, but if the vertical motion is (quasi-)periodic, there is no diffusion. We confirm the results with numerical simulations. Hence, the order-chaos transition in the vertical degrees of freedom translates into a localisation-delocalisation transition for the horizontal motion.

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- [1] Anja Riegert, Nilüfer Baba, Katrin Gelfert, Wolfram Just, Holger Kantz, Hamiltonian chaos acts like a finite energy reservoir: Accuracy of the Fokker-Planck approximation, *Phys. Rev. Lett.* 94 054103 (2005).