Deterministic chaos and diffusion in maps and billiards

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Abstract

A fundamental problem of statistical mechanics and dynamical systems theory is to understand classical transport processes such as diffusion on the basis of deterministic chaos. In my talk I will outline a theory by which physical quantities such as diffusion coefficients can be calculated exactly in terms of dynamical systems properties. Applying this theory to a piecewise linear map lifted periodically onto the real line, the diffusion coefficient is found to be a fractal function of control parameters. This fractality can be understood by analysing Markov partitions, the invariant probability measure of the map and de Rham-type functional equations. Similar results hold for deterministic diffusion in particle billiards leading to the prediction that traces of such properties should be seen in experiments.