Zeitschrift: Helvetica Physica Acta
Band: 65 (1992)
Heft: 2-3

Artikel: Mathematical survey of some two dimensional dynamical systems
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DOI: https://doi.org/10.5169/seals-116409

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Mathematical Survey of Some Two Dimensional Dynamical Systems

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This talk will focus on recent results concerning chaotic behavior of two dimensional dynamical systems. In particular, I shall discuss the work of Benedicks and Carleson proving the existence of a strange attractor for the area contracting Hénon map. Statistical properties and regularity of the invariant measure for the attractor are also described. This work has been extended to a wider class of maps with homoclinic tangency. An interesting feature of one parameter families of Hénon maps is the Newhouse phenomenon- the appearance of an infinite number of sinks for special parameter values.

In the case of area preserving maps, I shall discuss billiards and the standard map. The main issues addressed here are ergodicity, metric entropy and transport. For the standard map there are a number of conjectures about how KAM circles break up and how Aubry-Mather sets may influence transport giving rise to slow t^{-1} decay of correlations and thus to anomalous diffusion. Rigorous results on Liapunov exponents for the standard map are established in the presence of very small noise and high nonlinearity. If there is no noise, Mané has shown that arbitrarily small perturbations of the standard map can destroy metric entropy. Small perturbations of integrable two dimensional maps are expected to give rise to exponentially small contributions to metric entropy.

Time permitting, I shall also mention some new results on two dimensional coupled map lattices and on two dimensional fluid dynamics.