Quantifying chaos in many-particle Hamiltonian systems

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In a chaotic system, nearby trajectories diverge exponentially fast, with an asymptotic rate given by the largest Lyapunov exponent (LLE). Formally, the LLE is extracted from the dynamics in tangent space. So, for a Hamiltonian system, isolated and in equilibrium, the LLE must be a function of the (microcanonical) statistical properties of the Hessian of the Hamiltonian. The basic idea is to treat the tangent dynamics with the standard techniques of stochastic differential equations. We show that, in weakly correlated regimes, the LLE can be expressed in terms of few suitable thermal averages. A satisfactory quantitative agreement is found when comparing the predictions of the theory with the results of numerical simulations of long-range Hamiltonian systems.

References

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