

Assessing Chirikov's Diffusion Theory on the Arnold Model

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Abstract. This work focuses on an Arnold diffusion-like process along the homoclinic tangle of a single resonance in a multidimensional Hamiltonian system. Following Chirikov's theory [2], we consider the two-parameter Arnold model [1], consisting of a pendulum (as a resonance model) and a free rotator coupled through a perturbation. Both the low- and high-frequency regimes of the free rotator are analyzed. We derive a reliable diffusion coefficient (or diffusion timescale) using a relatively novel formulation based on Shannon entropy [3]. We compare the results with Chirikov's estimates and find agreement only in the high-frequency regime. Evidence supporting both the agreement and the discrepancies is presented and discussed using a variety of approaches, ranging from theoretical analysis to numerical experiments. In addition, we compare two characteristic timescales of chaotic dynamics—the Lyapunov time and the diffusion time—showing that the latter provides the relevant timescale for predictable dynamics, yielding another example of stable chaos.

References

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