The Fate of the Metastable State of the Fermi-Pasta-Ulam-Tsingou (FPUT) Problem

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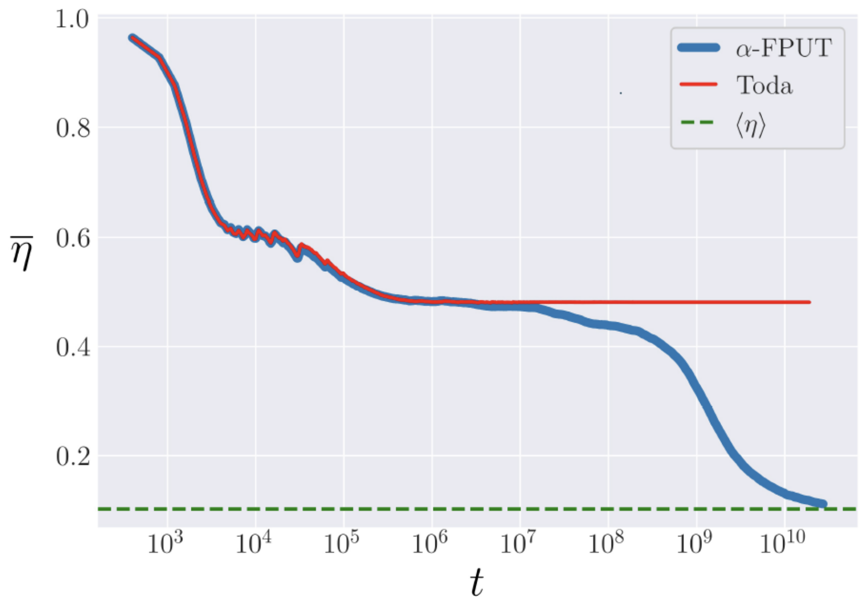

Since the pioneering computational study of Fermi, Pasta Ulam, and Tsingou (FPUT) on the approach to thermalization in a non-integrable, nonlinear classical many-body model system, there have been numerous studies attempting to explain in detail the time evolution of the FPUT system. In particular, the existence of a long-lived "metastable" state, which slows (perhaps prevents?) the approach to a true equilibrium has been observed in this system. In this talk, we discuss the latest developments in this long saga. We treat both the α- and β FPUT models, exploring the quantitative and qualitative behavior of the metastable state in these two systems. In particular, we introduce measures quantifying the distance of this state from true equilibrium and argue that for small values of the nonlinear parameters α and β the metastable state exists for exponentially (super-exponentially?) long times. We explore the mechanism of the final decay of the metastable state as well as the possibility that it is somehow "trapped" in a small region of phase space that prevents its decay. We also analyze the relation of this state to the well-known "q-breathers" which in the limit of small α and β are stable, exactly periodic orbits in the FPUT systems. We speculate on the behavior in the true thermodynamic limit in which the size of the system (N) goes to infinity while the energy density remains finite.