

Abstract: The Toda lattice prescribes the evolution of N particles interacting under certain Hamiltonian dynamics; it is an archetypal example of a completely integrable system. A question of interest is to understand how the model behaves, under random (or typical) initial data, when the number N of particles becomes large. In this course we describe several results explaining such asymptotics under certain invariant initial data. The proofs proceed by finding a way to interpret the Toda lattice as a dense collection of "quasi-particles" that behave similarly to solitons, and providing a framework to study how these quasi-particles asymptotically evolve in time. In this analysis, arguments from random matrix theory, particularly the analysis of Lyapunov exponents governing the decay rates of eigenvectors of random tridiagonal matrices, play an important role.