Dynamical glass

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Classical many body interacting systems are typically chaotic (nonzero Lyapunov exponents) and their microcanonical dynamics ensures that time averages and phase space averages are identical (ergodic hypothesis). In proximity to an integrable limit the long- or short-range properties of the network of non-integrable action space perturbations define the finite time relaxation properties of the system towards Gibbs equilibrium. I will focus on short range networks which lead to a dynamical glass (DG), using a classical Josephson junction chain in the limit of large energy densities or small Josephson energies. Close to these limits the Josephson coupling between the superconducting grains induces a short-range nonintegrable network in the corresponding action space. I will introduce a set of quantitative measures which lead to the Lyapunov time T_Λ, the ergodization time T_E, and to a diffusion constant D. In the DG the system fragments into large patches of nonresonant 'integrable' grains of size l separated by triplets of resonant chaotic patches, all surviving over large times. T_E sets the time scale for chaotic dynamics in the triplets. Contrary, $T_E \approx l^2/D$ is the much larger time scale of slow diffusion of chaotic triplets. The DG is a generic feature of weakly nonintegrable systems with a short range coupling network in action space, and expected to be related to nonergodic quantum metallic states of quantum-many-body systems in proximity to a many-body localization phase.