Rutgers University
Hill Center - Room 705

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Eigenstate statistical mechanics: thermalization and localization - PART I & II

Abstract

Progress in physics and quantum information science motivates much recent study of the behavior of strongly-interacting many-body quantum systems fully isolated from their environment, and thus undergoing unitary time evolution. What does it mean for such a system to go to thermal equilibrium? I will explain the Eigenstate Thermalization Hypothesis (ETH), which says that each individual exact eigenstate of the system's Hamiltonian is at thermal equilibrium, and which appears to be true for most (but not all) quantum many-body systems. Prominent among the systems that do not obey this hypothesis are quantum systems that are many-body Anderson localized and thus do not constitute a reservoir that can thermalize itself. When the ETH is true, one can do standard statistical mechanics using the 'single-eigenstate ensembles', which are the limit of the microcanonical ensemble where the 'energy window' contains only a single many-body quantum state. These eigenstate ensembles are more powerful than the traditional ensembles, in that they can also 'see' the quantum phase transition in to the localized phase, as well as a rich new world of phases and phase transitions within the localized phase. Ref.: Huse, et al., Phys. Rev. B 88, 014206 (2013).