



# 清华大学高等研究院

Institute for Advanced Study, Tsinghua University

## 物理学学术报告 Physics Seminars (biweekly)

- Title:** **Equilibration, Thermalization, and Entanglement in Quantum Many-Body Systems**
- Speaker:** **Alioscia Hamma**  
*Institute for Interdisciplinary Information Sciences, Tsinghua*
- Time:** **4:00pm, Wednesday, Nov 5, 2014**  
**(3:30~4:00pm, Tea, Coffee, and Cookie)**
- Venue:** **Conference Hall 322, Science Building, Tsinghua University**

### Abstract

The most familiar fact of physics in our experience is that physical systems spontaneously tend to reach equilibrium, and to thermalize. This very basic fact has always been at odds with the fundamental laws of physics, that are time-reversal. In particular, Quantum dynamics in an isolated is unitary, reversible and no entropy can increase. For a long time, it has been speculated that observable quantities could thermalize even if the global system is in a pure state away from equilibrium. One of the mechanisms for this to happen is the Eigenstate Thermalization Hypothesis (ETH), that states that thermalization happens at the level of single eigenstates. Recently, people have understood that entanglement is at the root of this phenomenon, and these phenomena have become experimentally relevant in the setting of ultra cold atom gases. Moreover, there is a strong interest in those systems that refuse to thermalize. In fact, interesting things happen away from equilibrium. After all, there is no one way to extract work (without other changes) - to give an example - from an equilibrium state. Such states that refuse to thermalize are either fine-tuned, or are those called Many-Body Localized states. In this talk, I will present a current review of all these notions, and put forward some new problems and tentative directions of solutions. In particular, even though we know that entanglement is involved in thermalization and ETH, its role is not completely understood, namely because entanglement is very strong even in systems that do not thermalize. I will show some new results on the study of entanglement spectrum, suggesting that entanglement level statistics may contain the relevant information as to how ETH is obeyed or not.