HARVARD UNIVERSITY

DEPARTMENT OF MATHEMATICS

JOINT DEPARTMENT OF MATHEMATICS AND CMSA

RANDOM MATRIX AND PROBABILITY THEORY SEMINAR

Ramis Movassagh

IBM Research

will speak on:

Generic Gaplessness, and Hamiltonian density of states from free probability theory

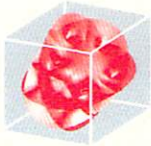
Thursday, February 7, 2019

4:30 – 5:30 pm

Science Center 530 ***note different location***

Quantum many-body systems usually reside in their lowest energy states. This among other things, motives understanding the gap, which is generally an undecidable problem. Nevertheless, we prove that generically local quantum Hamiltonians are gapless in any dimension and on any graph with bounded maximum degree.

We then provide an applied and approximate answer to an old problem in pure mathematics. Suppose the eigenvalue distributions of two matrices M_1 and M_2 are known. What is the eigenvalue distribution of the sum M_1+M_2? This problem has a rich pure mathematics history dating back to H. Weyl (1912) with many applications in various fields. Free probability theory (FPT) answers this question under certain conditions. We will describe FPT and show examples of its powers for approximating physical quantities such as the density of states of the Anderson model, quantum spin chains, and gapped vs. gapless phases of some Floquet systems. These physical quantities are often hard to compute exactly (provably NP-hard). Nevertheless, using FPT and other ideas from random matrix theory excellent approximations can be obtained. Besides the applications presented, we believe the techniques will find new applications in fresh new contexts.



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