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Ming Hsieh Institute - Physics

Joint Seminar Series

USC Viterbi School of Engineering
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Quantum many-body scars: a new paradigm of order amidst quantum chaos

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In-person: MCB 102
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Abstract: The quest to understand out-of-equilibrium behavior of complex quantum systems represents one of the frontiers of contemporary quantum science. For a long time, the prevailing belief has been that complex quantum systems, comprising many interacting degrees of freedom, all suffer the same inevitable fate: that of thermalization, whereby the system relaxes towards a featureless thermal state, completely "forgetting" its initial condition. However, a flurry of recent works has unearthed a new paradigm of behavior in many well-known physical systems, including Rydberg atoms, lattice gauge theories, and certain kinds of frustrated magnets. Such systems have been understood to possess a subtle breakdown of ergodicity, now commonly known as "quantum many-body scars". Quantum many-body scars exhibit fascinating properties, such as extreme sensitivity to initial conditions: while a system initialized randomly undergoes chaotic dynamics and thermalization, specific initial conditions can result in persistent dynamical revivals, surpassing native thermalization timescales. The discovery of quantum many-body scars has not only deepened our understanding of many-body quantum mechanics, but it also has direct practical relevance for improving the control over the delicate physical phenomena underpinning quantum technologies. In this talk, I will present a pedagogical overview of this fascinating new field of physics, highlighting a few of the remaining mysteries for theory and future experiments.

Biography: Zlatko Papic is a Professor of Theoretical Physics at the University of Leeds in the United Kingdom. He obtained his PhD at Universite Paris-Sud in 2010, followed by postdoctoral positions at Princeton University in the US and Perimeter Institute in Canada. Prof. Papic's research straddles condensed matter theory and quantum information science, focusing on emergent phenomena in many-particle systems. He is particularly known for his contributions to topological phases of matter and the fractional quantum Hall effect, as well as pioneering work in the field of ergodicity breaking in out-of-equilibrium systems, including many-body localization and quantum many-body scars.

Hosted by
Quntao Zhuang, Eli Levinson-Falk, Jonathan Habif, Daniel Lidar, Kelly Luo, Todd Brun, Tony Levi, Stephan Haas