Contributed Session | March

Emerging Topics in Quantum Scars

8:00 am – 11:00 am, Friday March 21 // Session MAR-W29 // Anaheim Convention Center, 252B (Level 2)

Chair: Alexey Khudorozhkov, Boston University

Topics:
Condensed Matter; Constrained Quantum Systems; Integrable Systems; Nonequilibrium Quantum Physics; Nonequilibrium Systems
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Bridging quantum criticality via many-body scarring

8:00 am – 8:12 am

Presenter: Aiden L Daniel (University of Leeds)

Authors: Ana Hudomal (Institute of Physics Belgrade), Zlatko Papic (University of Leeds), Jean-Yves Desaules (Institute of Science and Technology Austria), Guo-Xian Su (Heidelberg University), Andrew Hallam (University of Leeds), Jad Halimeh (INO-CNR BEC Center and Department of Physics, Uni Trento)

Collaboration: UNIVERSITY OF LEEDS; UNIVERSITY OF BELGRADE; QUERA; HEFEI NATIONAL LABORATORY

Quantum dynamics in certain kinetically-constrained systems can display a strong sensitivity to the initial condition, wherein some initial states give rise to persistent quantum revivals—a type of weak ergodicity breaking known as “quantum many-body scarring” (QMBS) due to mid spectrum "scarred" eigenstates. Another well-known phenomena is quantum criticality which, in contrast, concerns the properties of ground states. While initially appearing as independent properties, we show that this picture can be much richer in systems that display QMBS dynamics from a continuous family of initial conditions: As the system is tuned across the critical point while at the same time deforming the initial state, the dynamical signatures of QMBS at intermediate times can undergo an apparently smooth evolution across the equilibrium phase transition point. Remarkably the dynamics exactly at the critical point also displays profound ergodicity breaking. We demonstrate this using the PXP model—a paradigmatic model of QMBS. Using exact diagonalization and matrix product state methods, we map out the dynamical phase diagram of the PXP model with the quenched chemical potential. We demonstrate the existence of a continuous family of initial states that give rise to QMBS and formulate a ramping protocol that we use to prepare such states on QuEra's quantum simulator where we find great agreement. Our results show the ubiquity of scarring in the PXP model and highlight its intriguing interplay with quantum criticality.

Funding acknowledgement

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PRESENTATIONS (15)

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8:00 am – 8:12 am
Bridging quantum criticality via many-body scarring
Aiden L Daniel (presenter), Ana Hudomal, Zlatko Papic, Jean-Yves Desaules, Guo-Xian Su, Andrew Hallam, Jad C Halimeh

8:12 am – 8:24 am
Quantum Many Body Scars from Emergent Chiral Symmetry in a Density-Difference-Dependent Gauge Field
William N Faugno (presenter), Hosho Katsura, Tomoki Ozawa