

### Day 3 (Poster D)

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Title: Diagnosing First and Second Order Phase Transitions with Probes of Quantum Chaos

Abstract:

We explore quantum phase transitions using two probes of quantum chaos: out-of-time-order correlators (OTOCs) and the  $r$ -parameter obtained from the level spacing statistics.

In particular, we address  $p$ -spin models associated with quantum annealing or reverse annealing. Quantum annealing triggers first-order or second-order phase transitions, which is crucial for the performance of quantum devices.

We find that the time-averaging OTOCs for the ground state and the average  $r$ -parameter change behavior around the corresponding transition points, diagnosing the phase transition. Furthermore, they can identify the order (first or second) of the phase transition by their behavior at the quantum transition point, which changes abruptly (smoothly) in the case of first-order (second-order) phase transitions.