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Quantum Many-Body Scars in 2+1D Gauge Theories

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The real-time dynamics of Quantum Chromodynamics and other strongly coupled gauge theories present significant challenges for standard Monte Carlo methods due to severe sign problems. This limitation makes these problems ideal candidates for quantum simulation techniques. Identifying phenomena that can be tackled using near-term quantum simulators is crucial for understanding of real-time dynamics in strongly coupled gauge theories.

Quantum many-body scars have recently garnered attention for challenging
the Eigenstate Thermalization Hypothesis (ETH). I will discuss the
emergence of quantum many-body scarring in $U(1)$ gauge theories in (2+1)-d and arbitrary dimension (spin) of the gauge links. Benchmarking against the exact diagonalization for small spin systems, we uncover the analytical structure that facilitates the construction of scar states in gauge links with arbitrarily large Hilbert space dimensions. This allows us to explore potential imprint of quantum many-body scars as we approach the continuum limit and sheds light on how many-body systems may fail to thermalize.

Primary authors: PINTO BARROS, Joao (ETH Zürich); KRSTIC MARINKOVIC, Marina (ETH Zurich); BUDDE, Thea (ETH Zürich)

Presenter: PINTO BARROS, Joao (ETH Zürich)

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