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Confinement and Dynamical Quantum Phase Transitions in $\mathbb{Z}_2$ Lattice Gauge Theories

Lattice gauge theories (LGTs) have gained increasing attention in both condensed matter and high-energy physics in recent years and have become the centre of many quantum simulation experiments. Theoretical and experimental works have shown that LGTs exhibit rich far-from-equilibrium phenomena relevant to central questions in quantum many-body physics. In this work, we discuss the connection between confinement and dynamical quantum phase transitions (DQPTs) in LGTs. The existence of confinement can be indicated by the nature of DQPTs occurring during the unitary time evolution of the system. We demonstrate the idea in a 1+1D $\mathbb{Z}_2$ LGT. Finally, we reveal more intriguing dynamics behind the interplay of a staggered mass term and an external electric field. We provide an outlook on the possibility of extracting universal behaviour from explicit out-of-equilibrium critical exponents in LGTs from DQPTs.

Author: Dr WONG, Cheuk Yiu

Co-authors: HALIMEH, Jad C.; Dr OSBORNE, Jesse J.

Presenter: Dr WONG, Cheuk Yiu

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