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Cold-atom quantum simulators of gauge theories

Tuesday 5 March 2024 12:00 (1 hour)

Gauge theories are a fundamental framework of modern physics and the staple of the Standard Model. Their principal property, gauge symmetry, implements the laws of nature through intrinsic local relations between matter and gauge fields, with Gauss's law from electrodynamics as a paradigmatic example. In recent years, there has been a considerable drive in realizing gauge theories on quantum simulators, which are accessible tunable tabletop devices that can naturally handle entanglement buildup owing to quantum advantage. In this talk, I will first motivate this technology and then discuss recent theoretical and experimental progress in quantum simulators of 1+1D Abelian gauge theories in cold-atom platforms. I will then discuss exotic far-from-equilibrium phenomena that one can probe on such quantum simulators, including particle collisions. I will end by discussing experimental proposals towards advancing quantum simulators of gauge theories to higher spatial dimensions, non-Abelian gauge groups, and towards the lattice quantum field theory limit.

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