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Measurement-Induced Phase Transitions in Long-range Quantum Circuits MAXWELL BLOCK, YIMU BAO, SOONWON CHOI, EHUD ALTMAN[1], NORMAN YAO[2], University of California, Berkeley — Recent theoretical work has demonstrated a phase transition in the dynamics of quantum entanglement, originating from competition between scrambling unitary evolution and unwanted coupling to a classical bath, represented by measurements. In realistic systems, the presence of long-range interactions often allows for parametrically faster scrambling dynamics, which may qualitatively modify the transition. In this poster, we show this is indeed the case: long-range interactions change the universality of the transition. More specifically, we study 1D long-range quantum circuits, interspersed with projective measurements, where each unitary is a random two-qubit Clifford gate with range sampled from a $1/r^{\alpha}$ power law distribution. We find that the parameter of the interaction has a dramatic effect: for $\alpha > 3$, the critical exponents agree with studies of nearest-neighbor hybrid circuits, while for $\alpha < 3$ the critical exponents change continuously with α. Moreover, for $\alpha < 2$ the area-law scaling crosses over to a sub-volume law scaling in which entanglement entropy grows with system size, even under high measurement rates. We conclude with a resource analysis of realizing the transition in several AMO quantum simulators.

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