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Quantum many-body scars in dual-unitary circuits

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Dual-unitary circuits are a class of quantum systems for which exact calculations of various quantities are possible, even when the system is chaotic. The array of known exact results paints a picture of dual-unitary circuits as rapidly thermalising systems. However, we present a method to construct dual-unitary circuits for which some simple initial states fail to thermalise, despite the circuits being “maximally chaotic”, ergodic and mixing. This is achieved by embedding quantum many-body scars in the circuit. We support our analytic results with numerical simulations showing the stark contrast in the rate of entanglement growth from an initial scar state compared to non-scar initial states. Our results are well suited to an experimental test, due to the compatibility of the circuit layout with the native structure of current digital quantum simulators.

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