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A transmon based five-qutrit processor for simulations in high energy physics

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Encoding quantum information in the higher energy levels of the transmon circuit provides a hardware efficient way to harness a larger Hilbert space in existing quantum processors while also increasing their connectivity. Furthermore, a network of qutrits (three-level systems) is naturally suited to experimentally demonstrate recently identified connections between high energy physics and quantum information, such as holographic quantum error correction codes and the physics of scrambling. Here we report on the control of a five-qutrit processor and our progress toward characterizing the scrambling of quantum information. We implement a circuit to measure the decay of out-of-time ordered correlators, a hallmark of scrambling, in a method that distinguishes between decoherence and scrambling. The same circuit can be viewed as a teleportation protocol where quantum information is scrambled by a black hole and then decoded through measurement of emitted Hawking photons.

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