Experimental quantum photonic memristor

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Memristive devices are a class of physical systems with history-dependent dynamics characterised by signature hysteresis loops in their input-output relations. In the past few decades, memristive systems have attracted enormous interest in electronics. This is because memristive dynamics is very pervasive in nanoscale devices, and has potentially groundbreaking applications, ranging from energy-efficient memories to physical neural networks and neuromorphic computing platforms. Recently, the concept of a *quantum* memristor was introduced by a few proposals, all of which face limited technological practicality. Here we propose and experimentally demonstrate a novel quantum-optical memristor that is based on integrated photonics and acts on single photon states. We fully characterise the memristive dynamics of our device and tomographically reconstruct its quantum output state. Finally, we propose a possible application of our device in the framework of quantum machine learning through a scheme of quantum reservoir computing, which we apply to classical and quantum learning tasks. Our simulations show promising results, and may break new ground towards the use of quantum memristors in quantum neuromorphic architectures.

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