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Playing the Aharon-Vaidman quantum game with a Young type photonic qutrit PIOTR KOLENDERSKI, URBASI SINHA, Institute for Quantum Computing, University of Waterloo, 200 University Ave. West, Waterloo, Ontario, Canada, YOUNING LI, Department of Physics, Tsinghua University, Beijing 100084, China, TONG ZHAO, MATTHEW VOLPINI, Institute for Quantum Computing, University of Waterloo, 200 University Ave. West, Waterloo, Ontario, Canada, ADAN CABELLO, Departamento de Fisica Aplicada II, Universidad de Sevilla, E-41012 Sevilla, Spain ; Department of Physics, Stockholm University, S-10691 Stockholm, RAYMOND LAFALMME, Institute for Quantum Computing, University of Waterloo, 200 University Ave. West, Waterloo, Ontario, Canada, THOMAS JENNEWEIN, Institute for Quantum Computing, University of Waterloo, 200 University Ave. West, Waterloo, Ontario, CA — The Aharon-Vaidman (AV) game exemplifies the advantage of using simple quantum systems to outperform classical strategies. We present an experimental test of this quantum advantage by using a three-state quantum system (qutrit) encoded in a spatial mode of a single photon passing through a system of three slits. The preparation of a particular state is controlled as the photon propagates through the slits by varying the number of open slits and their respective phases. The measurements are achieved by placing detectors in the specific positions in the near and far-field after the slits. This set of tools allowed us to perform tomographic reconstructions of generalized qutrit states, and implement the quantum version of the AV game with compelling evidence of the quantum advantage.

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