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Realizing quantum advantage without entanglement in single-photon states ALEJANDRA MALDONADO-TRAPP, PABLO SOLANO, Joint Quantum Institute, ANZI HU, American University, CHARLES W. CLARK, Joint Quantum Institute — Correlations allow us to measure, and quantitatively study, the properties of physical systems, their evolution and their interactions. Quantum discord expresses quantum correlations beyond those associated with entanglement.[1]. However, discord has not yet been adopted as a standard subject of study by the experimental community. Here we propose a feasible optical setup to generate symmetric two-qubit X-states with controllable coherences, where the two qubits correspond to the spin and path of a photon. With these states we show how a classical random variable K can be encoded by Alice and decoded by Bob. Using our previous results [2] we study the correlations between the spin and path qubits and its relation with the information about K that can be decoded by Bob using local measurements with or without two-qubit gate operations.[3] Discord is the mutual information contained in the coherences of the system, and it is possible to exploit it for quantum advantage even in the absence of entanglement.

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[2]A. Maldonado-Trapp, *et al., Quantum Inf. Process* **14** 1947 (2015)
[3]M. Gu, *et al., Nature Phys.* **8**, 671 (2012)

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