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Realizing quantum advantage without entanglement in single-photon states ALEJANDRA MALDONADO TRAPP, Joint Quantum Institute , PABLO SOLANO, University of Maryland, Joint Quantum Institute , ANZI HU, American University, CHARLES W. CLARK, Joint Quantum Institute — Quantum discord expresses quantum correlations beyond those associated with entanglement.[1]. Although it has been extensively studied theoretically, quantum discord has yet to become a standard tool in experimental studies of correlation. We propose a class of experiments in which quantum correlations are present in the absence of entanglement, and are best understood in terms of quantum discord.. These utilize X-states of two qubits, which correspond to the polarization and the optical path of a single photon within a Mach-Zehnder interferometer. We show how to produce states with diverse measures of discord and entanglement, including the case of discord without entanglement. 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 analytically 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]

[1]K Modi, *et al., Rev. Mod. Phys.* **84, 1655 (2012)**
[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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