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.\(^1\) 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. \textbf{84}, 1655 (2012)