Maximizing quantum discord from interference in multi-port fiber beamsplitters

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Resumen

Multi-core optical fibers, composed of several cores within the same cladding, offer an increase in the transmission capacity in comparison to single-mode fibers (SMF) [1]. Furthermore, the relative phase fluctuations between quantum states propagating in different cores of the multi-core fiber is much less than for multiple SMF [2]. This type of fiber promises to have a big impact on quantum information protocols [3], and for their implementation, fiber-embedded muti-core beamsplitters are needed. An important application in this context that has not been studied before is the realization of two-photon interference. It can be used to build photonic controlled-logic gates, entangling measurements, and to produce quantum correlations.

Here we studied two-photon inference using two classical weak coherent states as input to a 4x4 multi-core beamsplitter. We produce quantum correlations, in the form of geometric quantum discord, and show that it can be controlled and maximized by adjusting the intensity ratio between the two inputs. Despite the state is separable, it can outperform some entangled states in the remote state preparation protocol [4] and can achieve higher fidelities than previously recorded. Our results should contribute to the exploitation of quantum correlations in future telecommunication networks, in particular, those that exploit spatially structured fibers.

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