

High-dimensional decoy-state quantum key distribution over multicore telecommunication fibers

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Multiplexing is a strategy to augment the transmission capacity of a communication system. It consists of combining multiple signals over the same data channel and it has been very successful in classical communications. However, the use of enhanced channels has only reached limited practicality in quantum communications (QC) as it requires the manipulation of quantum systems of higher dimensions. Considerable effort is being made towards QC using high-dimensional quantum systems encoded into the transverse momentum of single photons but, so far, no approach has been proven to be fully compatible with the existing telecommunication fibers. Here, we overcome such a challenge and demonstrate a secure high-dimensional decoy-state quantum key distribution session over a 300 m long multicore optical fiber. The high-dimensional quantum states are defined in terms of the transverse core modes available for the photon transmission over the fiber, and theoretical analyses show that positive secret key rates can be achieved through metropolitan distances.