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Self-healing of quantum entanglement after an obstruction

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Abstract

Quantum entanglement between photon pairs is fragile and can easily be masked by losses in transmission path and noise in the detection system. When observing the quantum entanglement between the spatial states of photon pairs produced by parametric downconversion, the presence of an obstruction introduces losses that can mask the correlations associated with the entanglement. Here we show that we can overcome these losses by measuring in the Bessel basis, thus once again revealing the entanglement after propagation beyond the obstruction.We confirm that, for the entanglement of orbital angular momentum, measurement in the Bessel basis is more robust to these losses than measuring in the usually employed Laguerre–Gaussian basis. Our results show that appropriate choice of measurement basis can overcome some limitations of the transmission path, perhaps offering advantages in free-space quantum communication or quantum processing systems.