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High dimensional quantum key distribution with vector modes

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Secure key generation and distribution schemes are essential for establishing secure communication networks against any potential eavesdropping. Quantum key distribution (QKD) offers the advantage of having a provably security scheme that is guaranteed by quantum mechanics. Previous implementations relied on polarisation qubit (d=2 dimensional) photonic state manipulation which impose limits on the information capacity to one bit per photon where in general the capacity is log2(d) for a d-dimensional encoding alphabet. Increasing the dimensionality of the encoding alphabet by exploring alternative degrees of freedom has become topical. Recent demonstrations have shown the advantage of using the transverse spatial modes of photons owing to their description on an infinite dimensional state space. Here we exploit a class of spatial modes, called vector modes, with non-separable orbital angular momentum and polarisation coupled states in the BB84 prepare and measure QKD protocol. We generate these modes by manipulating the dynamic and geometric phase control of light. Furthermore, we present a lossless scheme that deterministically sorts the spatial modes and shows an increase in the information capacity in comparison to the current state-of-the-art probabilistic sifting methods that are mainly employed in high dimensional QKD schemes.

Apply to be
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Yes

Level for award
 (Hons, MSc,
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MSc

Main supervisor (name and email)
and his / her institution

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Would you like to
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No

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