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A numerical investigation of the evolution OAM entanglement in turbulence

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Abstract content
   (Max 300 words)
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The orbital angular momentum (OAM) states of light can potentially be used to implement higher dimensional entangled systems for free-space quantum communication. Unfortunately, the refractive index fluctuation of the atmosphere gives rise to random phase aberrations on a propagating optical beam. To transmit quantum information successfully through a free-space optical channel, one needs to understand how atmospheric turbulence influences quantum entanglement. Some studies has in the past been done on the effect of atmospheric turbulence on entangled OAM states. However the majority of these studies assumed that the overall effect of the turbulence over the propagation path can be modelled by a single phase distortion on the beam. This is the single phase screen approximation. Under this approximation, one finds that the evolution of the OAM entanglement in turbulence can be describe by a single dimensionless parameter, w0/r0, where w0 is the radius of the beam and r0 is the Fried parameter.
Here we use numerical simulations to study how the evolution of entanglement depends on the various dimension parameters (which include the propagation distance, the wavelength, the beam radius and the strength of the turbulence) of the system in the regime where the single phase screen approximation is not valid. It is found that the evolution of entanglement cannot always be described by a single dimensionless parameter. The turbulence atmosphere is modelled by a series of consecutive phase screens based on the Kolmogorov theory of turbulence and the quantum entanglement is quantified in terms of Wooter's concurrence.

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Main supervisor (name and email)
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