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Towards correcting atmospheric turbulence effects via pump beam control in a down conversion process

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Quantum Communication can be done using single photons generated via spontaneous parametric down conversion (SPDC). Since these protocols only use the signals that are collected by the receiver, the system is not as negatively affected by occasional drop outs as compared to classical communication protocols. In order to collect as many photons as possible, it is necessary to have a mechanism to guide them to the receiver.

The photon pairs that are created through the process of SPDC conserve their momentum and are therefore spatially correlated. The temporal and spatial modes of the photons can be adjusted according to the specific requirements of a transmission link. The correction for tip/tilt errors in pointing is usually performed on the transmitted beam itself. However, due to the correlations between the pump beam and the down converted photons, it is possible to manipulate the pump beam instead of the transmitted arm to achieve a similar effect. This technique can be very useful for Quantum Communication protocols since interfering with the transmitted arm can cause alterations to the polarisation and other properties and thus destroy the encoding in the photon. By manipulating the pump, the transmitted arm remains untouched but is guided towards the receiver for a higher collection efficiency.

We have developed a theoretical model to calculate the effect of varying the pump beam angle into the non-linear crystal on the signal photon while holding the idler photon in a fixed position. The technique we use to observe these correlations is based on an array of single photon avalanche diodes (SPAD), offering temporal and spatial resolution on a single photon level. Here we investigate the possibility to control the spatial characteristics of one of the down converted photons by altering the direction of the pump beam.

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