Using spatio-temporal correlations for tuning the biphoton wavefunction

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Photons are a natural choice for quantum information protocols. Among others, one technical advance that has allowed this wide range of applications of photons is the production of photonics states in nonlinear processes, such as spontaneous parametric downconversion (SPDC). The versatility of this technique resides in the fact that the generated pairs of photons can be manipulated in several degrees of freedom (DOFs). In particular, the correlations between spatial and temporal DOFs are specially important in SPDC processes. Moreover, the ability of tuning the spectro-temporal distribution is also fundamental in several applications. In this sense, several methods for shaping the spectro-temporal distribution of entangled photons have been reported in literature. In particular, when pumping with a focused beam on a nonlinear crystal and collecting them with monomode optical fibers, the spatio-temporal correlations of the generated photons can be exploited on order to tuning their spectro-temporal distribution [1,2].

Here, we will show how a typical experimental configuration of a SPDC photons source is and how we can shape its spectro-temporal distribution. In particular, we will show a versatile proposal that encompasses a straightforward experimental implementation. This method is to modify the area of the portion of the crystal from which we collect the photons, that is, the detection beam waist. In addition, we will see that the spectro-temporal distribution depends very weakly on the waist of the Gaussian pump beam. Finally, we will see that under standard experimental conditions the spectral bandwidth of the biphoton wavefunction can be tuned by approximately a factor of five [3].

References

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Figures

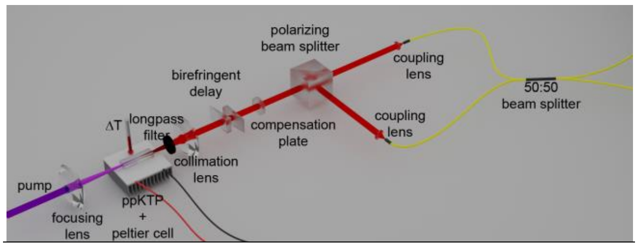

Figure 1: SPDC twin photons source.