where the ξ_1 and ξ_2 represent the overall efficiencies and non-linear interaction strengths for the forward and backward emissions, respectively, they are also linearly proportional to the electric field amplitude of each pulse; $\hat{a}_j^\dagger$, $\hat{b}_j^\dagger$, with $j = \{1,2\}$ are the creation operators of the forward and backward down-conversion modes. From the above equation we obtain the following state,

$$|\Psi_{SPDC}\rangle = \sqrt{(1-|\lambda_1|^2)(1-|\lambda_2|^2)}\sum_{n_1=0}^{\infty}\lambda^{n_1}\,|n_1,n_1\rangle_{a_1,b_1}\sum_{n_2=0}^{\infty}\lambda^{n_2}\,|n_2,n_2\rangle_{a_2,b_2} \tag{11}$$

with $\lambda_1 = \xi_1\tau$ and $\lambda_1 = \xi_2\tau$. Therefore, the probability of creating n_1 and n_2 photons from crystal passes 1 and 2 per pulse is given by

$$P(n_1,n_2) = (1-|\lambda_1|^2)(1-|\lambda_2|^2)\left|\lambda_1^{2n}\right|\left|\lambda_2^{2n}\right|. \tag{12}$$

For independent sources the presence of photons in modes a_1 and a_2 are heralded upon a detection event in modes b_1 and b_2 respectively. Again, using non-number resolving detectors with detection efficiency η, the rate per second of jointly heralding photons in modes a_1 and a_2 is given by

$$C_{coinc} = R\sum_{n_1=1}^{\infty}\sum_{n_2=1}^{\infty}(1-(1-\eta)^{n_1})^2(1-(1-\eta)^{n_2})^2 P(n_1,n_2) \tag{13}$$

Similarly to the previous argument for dependent photons, halving the power per pulse while simultaneously doubling the repetition rate gives

$$C_{coinc} = 2R\sum_{n_1=1}^{\infty}\sum_{n_2=1}^{\infty}\frac{(1-(1-\eta)^{n_1})^2(1-(1-\eta)^{n_2})^2}{2^{n_1+n_2}}P(n_1,n_2). \tag{14}$$

Acknowledgements

We thank T. Jennewein for input on the numerical simulations. This work was financially supported by the Australian Research Council Centre of Excellence, Discovery, and Federation Fellow programs, an IARPA-funded US Army Research Office contract and EC project QUANTIP 244026.