Optimizing the Generation of Multiphotonic Entangled Graph States

L. Couronné[12], H. Huet[1], E. Annoni[1], S. Boissier[1], A. Lemaître[2], M. Morassi[2], A. Pishchagin[1], P. Steindl[2], O. Krebs[2], V. Villafane[1], D. Fioretto[2], S. Wein[1], P. Senellart[2]

[1]*Quandela, 91300, Massy, France*

[2]*C2N, 91120, Palaiseau, France*

One of the most promising approaches to scalable and universal photonic quantum computation is measurement-based quantum computing, using multi-photon entangled states as resource states. To generate such states, we use state-of-the-art single photon source with up to 60% brightness. These emitters are InGaAs quantum dots that emits through recombination of exciton, yielding high indistinguishability single photons.

These device enable to confine an additional carrier, with a spin, with the exciton. Through optical selection rule, the spin state of the carrier is mapped on the polarization of the emitted photon, which allows to implement the Lindner-Rudolph scheme [1]. Using a small magnetic field, this spin precesses. Triggering emission as the spin is in a superposed state yields entanglement between the spin and the photon. Repeating this process allow to generates bigger multiphotonic entangled state. This protocol has been demonstrated in many groups [2, 3] and recently it has been extended, via short optical pulses acting as spin phase control, to generate more complex entangled states including "caterpillar states" [4].

In this talk, we are going to present the work has been carried on in the group regarding the implementation of this scheme, entangling up to 10 photons, and focus on the methods investigated to improve its performance, such as spin-echo or time filtering. This work is a fundamental milestone toward small scale demonstrations of fault-tolerant quantum computing.

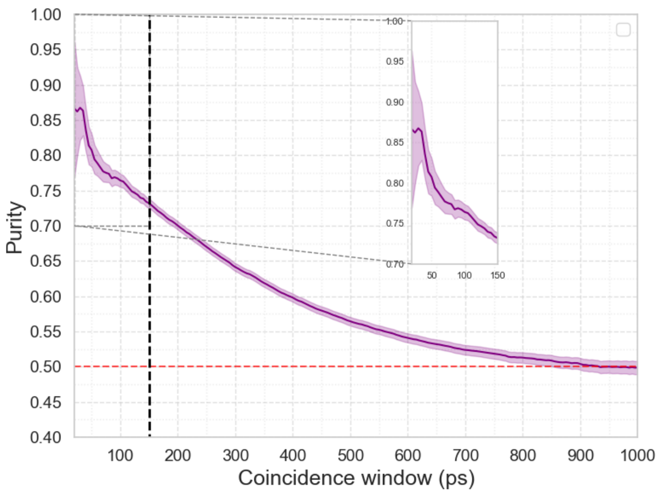

Fig. 1: *Purity of the state of the middle photon in a 3-partite linear cluster state in function of coincidence windows used.*

References

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