# Spin-photon entanglement for the generation of multiphotonic graph states

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One of the most promising approaches to scalable and universal photonic quantum computation is measurement-based quantum computing, which uses as key resource multi-photon entangled states. A particularly promising protocol to deterministically generate those is called Lindner-Rudolph scheme [1]. In this scheme, a single spin confined in a semiconductor quantum dot is precessing due to a small transverse magnetic field. If excited with a laser with the right time a state of entanglement between the spin and the polarization of the photon is generated. By repeating this process this entangle state can be extended to more photon.
This protocol has been demonstrated by several groups [2,3,4] and was recently extended to enable the generation of more complex entangled states, known as "caterpillar states", through the use of optical pulses for spin phase control. [5].
In this poster, I will present the work carried out in our group on the implementation of this scheme, including recent results on newly designed structures aimed at extending the spin coherence time for this protocol. This work is a fundamental milestone toward small scale demonstrations of fault-tolerant quantum computing.

## References

[1] N. H. Lindner, T. Rudolph, Phys. Rev. Lett., 103 (2009) 113602.
[2] Zu-En Su, Boaz Taitler, Ido Schwartz, Dan Cogan, Ismail Nassar, Oded Kenneth, Netanel H. Lindner, David Gershoni, arXiv preprint, 2403.03820v1 (2024).
[3] P. Thomas, L. Ruscio, O. Morin, G. Rempe, Nature, 608 (2022) 677-681
[4] N. Coste, D. Fioretto, N. Belabas, S. C. Wein, P. Hilaire, R. Frantzeskakis, M. Gundin, B. Goes, N. Somaschi, M. Morassi, A. Lemaître, I. Sagnes, A. Harouri, S. E. Economou, A. Auffeves, O. Krebs, L. Lanco, P. Senellart, arXiv preprint, arXiv:2207.09881v1 (2022).
[5] H. Huet, P. R. Ramesh, S. C. Wein, N. Coste, P. Hilaire, N. Somaschi, M. Morassi, A. Lemaître, I. Sagnes, M. F. Doty, O. Krebs, L. Lanco, D. A. Fioretto, P. Senellart, arXiv preprint, 2410.23518 (2024).

## Figures

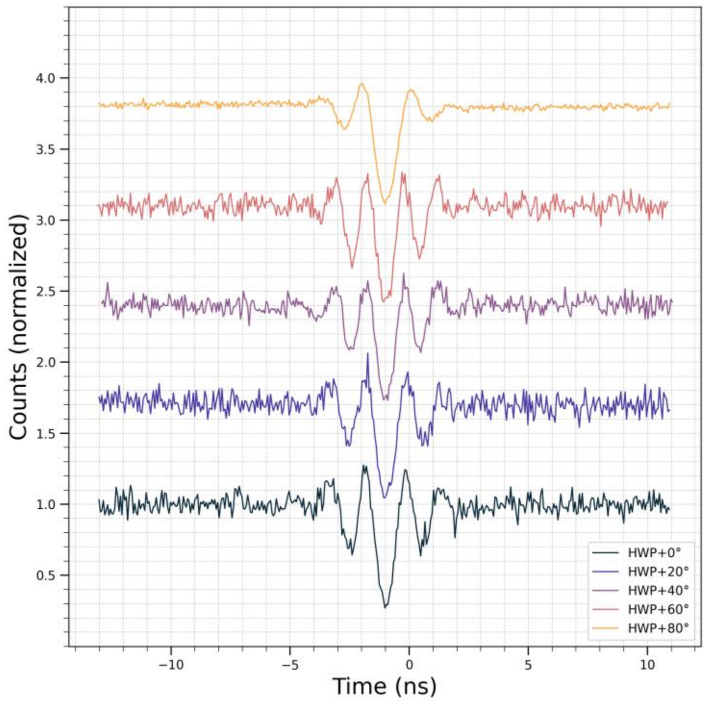


**Figure 1:** Cross-correlation measurements between orthogonal polarizations in the circular basis of the quantum dot (eigenbasis of the spin) with different angles of linear polarization of excitation. The decoherence time of the spin can be extracted from the decay time of the oscillations.