Multi-photon emission from a resonantly pumped quantum dot

Francesco Giorgino
P. Zahálka, L. Carosini, L.M. Hansen, J.C. Loredo, and P. Walther

University of Vienna, Faculty of Physics, Vienna Center for Quantum Science and Technology (VCQ),1090 Vienna, Austria

francesco.giorgino@univie.ac.at
juan.loredo@univie.ac.at

Resonance fluorescence of natural or artificial atoms constitutes a prime method for the generation of non-classical light. To date, it has largely focused on producing single-photons, however, ubiquitous multi-photon emission is inevitably observed.
We experimentally quantify the multi-photon emission statistics in a two-level artificial atom - a semiconductor quantum dot in a micropillar cavity - pumping with a short optical pulse and measuring autocorrelation functions $g^{(n)}[0,...,0]$ up to the fourth order, for different pumping powers. We measure up to four-photon emitted after a single pumping pulse and, with fine temporally-resolved measurement, we investigate the emission dynamics. Additionally, we back our data with a theoretical model based on a simple quantum trajectories approach, explaining how a two-level system can produce multi-photon states.
Our results aim to deepen the understanding of the full photon-emission in coherently driven atomic systems.

References

[1] Kevin A Fischer *et al*, *Quantum Sci. Technol.* **3** 014006 (2018)

Figures

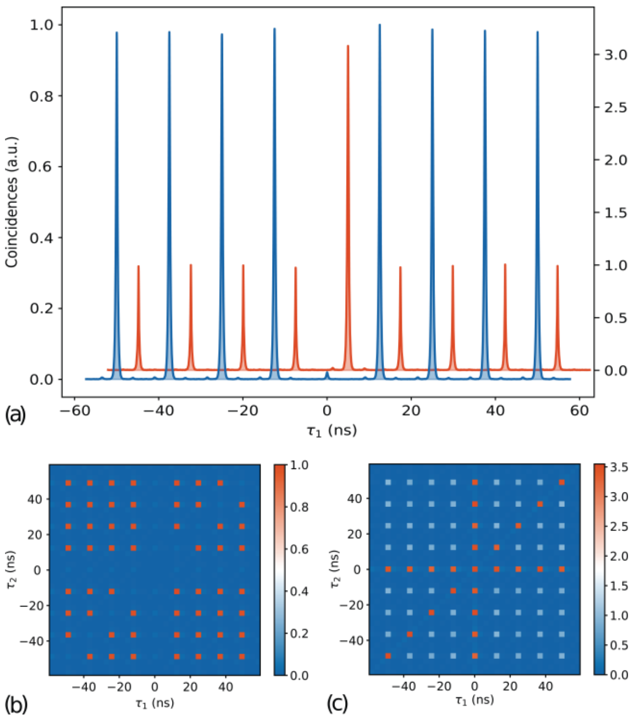

Fig.1 Correlation histograms. *(a)* The blue (red) line shows the second-order cross correlation histograms with a π(2π) pumping pulse area. The extracted values at zero time-delay are: $g^{(2)}_{\pi}[0] = 0.025(1)$, $g^{(2)}_{2\pi}[0] = 4.08(1)$.
(b - c) Third-order cross correlation histograms for a π-pulse (left) and 2π-pulse (right), resulting in $g^{(3)}_{\pi}[0,0] = (5.08\pm 8)\cdot 10^{-4}$, $g^{(3)}_{2\pi}[0,0]=4.31(18)$.