Tuning the Fine-Structure Splitting of InAs/InP Nanowire Quantum Dots via Voigt-Configuration Magnetic Field

Chiao-Tzu Huang[1,2], Sofiane Haffouz[3], Philip J. Poole[3], Dan Dalacu[3], Ali W. Elshaari[4], Valéry Zwiller[5], Wen-Hao Chang[1,2]

[1]*Research Center for Critical Issues, Academia Sinica, Tainan City 711010, Taiwan*

[2]*Department of Electrophysics, National Yang Ming Chiao Tung university, Hsinchu City 300093, Taiwan*

[3]*National Research Council, Ontario K1A 0R6, Canada*

[4]*Division of Quantum and Nano Physics, Kungliga Tekniska högskolan, Stockholm 11419, Sweden*

[5]*Department of Molecular Medicine and Surgery, Karolinska Institutet, Stockholm 17177, Sweden*

Generating entangled photon-pairs at telecom wavelengths is a cornerstone of long-distance quantum communication [1]. While the biexciton-exciton (XX-X) cascaded emission in semiconductor quantum dots provides a deterministic method for polarization-entangled photon-pairs [2], the time-evolving phase of the entangled state, driven by the fine-structure splitting (FSS) of excitonic energy levels, degrades time-averaged fidelity [3]. In this work, we demonstrate the tuning of FSS in position-controlled InAs/InP nanowire quantum dots (NWQDs) emitting in the telecom O-band. By applying an external magnetic field in the Voigt configuration, we manipulate the exchange interaction to minimize FSS. The magnitude of the FSS is precisely characterized by the oscillation in cross-correlation measurement. We further analyse the polarization eigenaxes relative to the FSS tuning. Leveraging the high extraction efficiency inherent to the nanowire waveguide, these results pave the way toward high-brightness, precession-free entangled photon sources for fibre-based quantum networks.

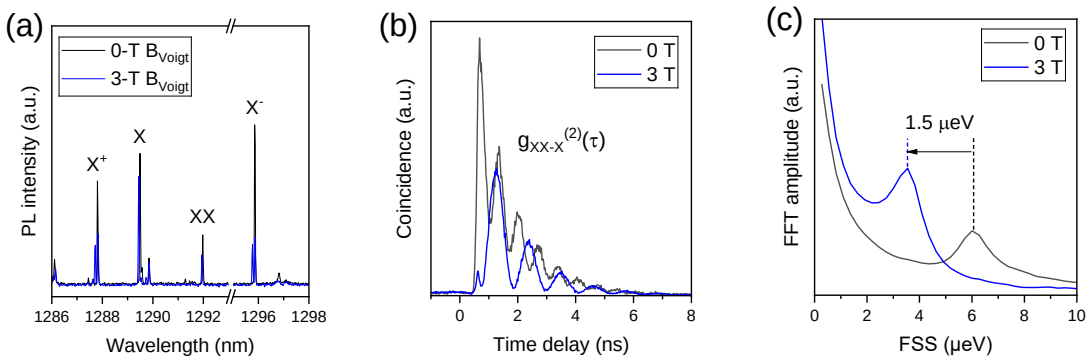

Fig. 1: *Low-temperature photoluminescence results of a single nanowire quantum dot under Voigt-configuration magnetic field. (a) PL spectrum of NWQD emission. (b) Cross-correlation measurement of XX-X cascaded emission. (c) Fast-Fourier transform of data in (b) with converted units.*

Funding acknowledgement

This research was supported by Academia Sinica (AS-GC-110-02) and Nation Science and Technology council (113-2923-M-A49-005-) in Taiwan.

References

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