In-plane Spin Pumping of Chirally Coupled InAs Quantum dots in A Glide Plane Waveguide Device

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Chiral light-matter interaction [1] in optoelectronic devices such as Glide Plane Photonic Crystal Waveguides (GPW) provide an ultimate environment to facilitate on-chip, strong interaction between photons and the spin of charge carriers confined in quantum dot (QD) excitons, opening a new era of scalable, photon-mediated quantum spin network [2]. Here we present a specially designed spin-photon interface [3,4] where the propagation direction of emitted photons is associated with the exciton spin via spin-orbit coupling. The device consists of a p-i-n diode structure that enables the spectral tunability of single photon emitters embedded in a suspended GPW membrane. We focus on emitters located spatially at the chiral points and spectrally inside the slow-light region, where both strong Purcell enhancement and high chirality criteria are satisfied for a single QD (as is shown in Fig.1). A remote excitation method is employed which dramatically enhances the directional contrast under a linearly polarised pump. We show that the combination of GPWs with in-plane p-shell excitation enables an efficient initialisation mechanism of the circularly polarised states. Additionally, this approach facilitates the coherent control on-chip and readout of quantum information encoded in these spins [5].

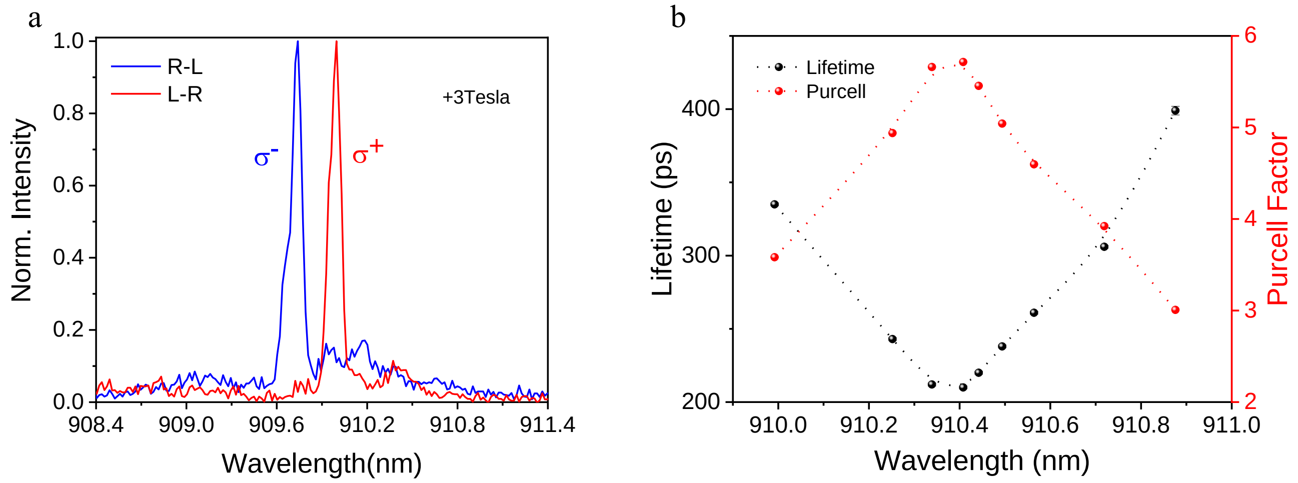

Fig.1 a) PL spectra that show high directional contrast using in-plane, remote excitation at the p-shell resonance. The two Zeeman components are circularly polarised under an external magnetic field in Faraday geometry. b) Demonstration of the reduction in lifetime when the QD's emission wavelength is electrically tuned to the centre of the slow-light region.

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