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POS-9 - Polaron master equation theory of an on-demand quantum dot single-photon source through cavity-assisted stimulated adiabatic Raman passage (STIRAP)

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A scheme for an on-demand optical pulse-triggered quantum dot single-photon source which utilizes stimulated Raman adiabatic passage and photonic cavity-coupling is presented. This single photon source is coherently pumped in the presence of a continuous wave drive, allowing for highly efficient indistinguishable single photons to be produced which are of a different polarization than the input pulse, ensuring spectral separability of the outgoing photons. We model this system using an open-system approach at the level of a polaron master equation including both exciton and biexciton states [1]. In addition to zero-phonon Lindblad decoherence processes (including pure dephasing and spontaneous emission), exciton-acoustic-phonon coupling, which degrades the indistinguishability and efficiency of semiconductor photon sources, is rigorously taken into account. Through careful design and analysis, the on-demand source can be minimally affected by phonon coupling, and robust to laser and cavity detuning. We describe how this biexciton-exciton cascade scheme allows for true single photons to be generated with over 90% quantum indistinguishability and efficiency using experimentally realizable parameters.

[1] e.g., see F. Hargart, M. Müller, K. Roy-Choudhury, S. L. Portalupi, C. Schneider, S. Höfling, M. Kamp, S. Hughes, and P. Michler, Cavity-enhanced simultaneous dressing of quantum dot exciton and biexciton states, Phys. Rev. B 93, 115308 (2016).

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