

## Quantum Dots in Photonic Crystal Cavities: Tuning, 'Self-Tuning' and Strong Coupling

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The exceptional properties of MBE-grown quantum dots (QDs) coupled to photonic crystal (PC) cavities make these ideal testbeds for the exploration of cavity-QED in the solid state. Extremely strong light-matter interactions can be engineered in these structures, and there has been recent progress in the tuning of QDs and PC cavities to obtain both spatial coupling and spectral resonance. These 'deterministic' approaches have led to the observation of strong coupling of a single quantum dot to the PC cavity, and accord well with the model of an 'atom-like' quantum dot coupling to a high Q cavity. However, detailed studies of these QD-PC cavity systems also highlight the complexity of the QD environment, and the sensitivity of the coupling to possible defects in the semiconductor matrix. Furthermore, there appears to be substantial interactions between QD optical emission (excitons) and cavity modes even *without* spectral resonance. Such deterministically engineered QD-PC cavity systems therefore not only hold promise for applications in solid state quantum information and low-threshold photon sources, but can also enhance our understanding of the complexities of the light-matter interaction in the solid state.

[1] Badolato, A., et al., *Deterministic coupling of single quantum dots to single nanocavity modes*. *Science*, **308**(5725): p. 1158-61 (2005)

[2] Hennessy, K., et al., *Quantum nature of a strongly coupled single quantum dot-cavity system*. *Nature*, **445**(7130): p. 896-9 (2007)