

Quantum nature of a photonic crystal nanocavity coupled to a single quantum dot

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Coupling semiconductor quantum dots to photonic cavities is a promising route for realizing quantum information tasks in the solid state. However, validating the efficacy of quantum dots for these applications requires confirmation of the quantum nature of the quantum-dot-cavity system. In this work we find a confirmation by observing quantum correlations in photoluminescence from a photonic crystal nanocavity interacting with one, and only one, quantum dot precisely aligned at the cavity center.¹ The high quality factor and ultra small volume of the nanocavity allows us to realize the regime of strong coupling between the quantum dot and cavity mode. In this regime, we find that the photon stream from the cavity is anti-bunched, indicative of coupling between two discrete quantum states. These results show that quantum dots, although comprised of thousands of atoms, can be considered single quantum emitters for applications in solid state quantum information.

[1] K. Hennessy, A. Badolato, M. Winger et. al. *arXiv*, quant-ph/0610034, (2006).