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Strong coupling between a quantum dot and a photonic crystal nanocavity¹

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We report the observation of vacuum Rabi splitting (true strong coupling) between a single InAs quantum dot and a photonic crystal nanocavity.¹ An anti-crossing of the dot and nanocavity resonances occurs as the temperature is increased from 15K to 29K. The zero-detuning splitting is 0.164 meV, slightly larger than the 0.13 meV coupled linewidth, so there is a dip between the peaks of 30-40%. The 2D photonic crystal slab is surrounded by air; three holes in a line are omitted and the end holes are shifted out to form the cavity spacer.² The Q of the cavity mode was 13,300 at high power and about 6000 at the low power used for the anti-crossing. The volume of the cavity mode is computed to be about $(\lambda_{cav}/n)^3 = 0.04 \mu\text{m}^3$, where λ_{cav} is the cavity mode wavelength and n is the refractive index. This solid-state system that entangles the quantum-dot-transition qubit with the cavity-mode-photon qubit may find applications in quantum information science as a deterministic single-photon source or quantum phase gate, or for quantum state transfer. 1. T. Yoshie, A. Scherer, J. Hendrickson, G. Khitrova, H. M. Gibbs, G. Rupper, C. Ell, O. B. Shchekin, and D. G. Deppe, *Nature* **432**, 200 (2004). 2. Y. Akahane, T. Asano, B.-S. Song, and S. Noda, *Nature* **425**, 944 (2003).

¹Research performed with the authors of reference 1.