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Quantum optical switch controlled by a color center in a diamond nanocavity ALP SIPAHIGIL, RUFFIN E. EVANS, DENIS D. SUKACHEV, Department of Physics, Harvard University, MICHAEL J. BUREK, School of Engineering and Applied Sciences, Harvard University, CHRISTIAN N. NGUYEN, JOHANNES BORREGAARD, MIHIR K. BHASKAR, Department of Physics, Harvard University, HAIG ATIKIAN, School of Engineering and Applied Sciences, Harvard University, JOSE L. PACHECO, RYAN M. CAMACHO, Sandia National Laboratories, FEDOR JELEZKO, Institute for Quantum Optics, University Ulm, EDWARD BIELEJEC, Sandia National Laboratories, HONGKUN PARK, Department of Physics, Harvard University, MARKO LONCAR, School of Engineering and Applied Sciences, Harvard University, MIKHAIL D. LUKIN, Department of Physics, Harvard University — Efficient interfaces between photons and quantum emitters form the basis for quantum networks and enable nonlinear optical devices operating at the single-photon level. By coupling silicon-vacancy (SiV) color centers to a diamond nanophotonic device, we realize a quantum optical switch controlled by a single atom-like crystal defect. In our approach, SiV centers are deterministically positioned in diamond photonic-crystal cavities using targeted silicon implantation. We observe that the cavity transmission is substantially attenuated by a single SiV center, is nonlinear at less than one photon per system's bandwidth and can be switched by optically controlling SiV metastable orbital states. Photon correlation measurements are used to verify optical switching at the single-photon level. Our approach enables the realization of fully integrated, scalable nanophotonic quantum devices.

Alp Sipahigil
Department of Physics, Harvard University

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