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Quantum optics in the solid state with diamond nanophotonics RUFFIN EVANS, NATHALIE DE LEON, KRISTIAAN DE GREVE, YIWEN CHU, BRENDAN SHIELDS, Harvard University Department of Physics, BIRGIT HAUSMANN, MICHAEL BUREK, Harvard University School of Engineering and Applied Sciences, PATRICK MALETINSKY, University of Basel Department of Physics, ALEXANDER ZIBROV, HONGKUN PARK, Harvard University Department of Physics, MARKO LONCAR, Harvard University School of Engineering and Applied Sciences, MIKHAIL LUKIN, Harvard University Department of Physics — Quantum networks require interfaces between photons and quantum bits. Nitrogen vacancy (NV) centers in diamond are a promising candidate for this interface: they are optically addressable, have spin degrees of freedom with long coherence times, and can be easily integrated into solid-state nanophotonic devices. The crucial optical feature of the NV is its zero-phonon line (ZPL), a cycling transition allowing coherent optical manipulation and read-out of the spin. However, the ZPL only accounts for 3-5% of the NV emission, and previous methods of producing NV centers yield unstable ZPLs. I will present methods for controlling NV emission by coupling NV centers to nanophotonic devices. In particular, we create a high-density layer of NVs with stable ZPLs in high purity diamond; carve waveguides out of the diamond substrate; and fabricate high quality factor, small mode volume photonic crystal cavities around NVs in these waveguides. We observe an enhancement of the NV emission at the cavity resonance by a factor of 100. These devices will become building blocks for quantum information processing such as single photon transistors, enabling distribution of entanglement over quantum networks.

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