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Cavity quantum electrodynamics with surface plasmons DARRICK CHANG, Harvard University Physics Department, Cambridge, MA 02138, ANDERS SORENSEN, Niels Bohr Institute, DK-2100 Copenhagen, Denmark, MIKHAIL LUKIN, Harvard University Physics Department, Cambridge, MA 02138
— The possibility of implementing cavity QED on a solid-state microchip has been explored recently [childress04,sorensen04,blais04,wallraff04]. These ideas involve strong coupling between microwave emitters and superconducting transmission lines. It is desirable to extend these ideas into the optical domain because of smaller mode volumes and faster operations, and because optical photons are ideal for long-range quantum communication. Here we propose a novel approach to accomplish this, based on strong coupling between optical emitters and electromagnetic surface modes, or surface plasmons, confined to a sub-wavelength nanowire. The tight transverse confinement of the plasmons on a scale of the wire radius R enables strong coupling between plasmons and nearby emitters. We explore the possibility of efficient single photon generation and long-range coupling of quantum bits in such a system.

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