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Nanoscale control of antenna-coupling strength g for bright single photon sources

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Cavity QED is the art of enhancing light-matter interaction of photon emitters in cavities, with opportunities for sensing, quantum information and energy capture technologies. To boost emitter-cavity interaction, i.e. coupling strength ⊠, ultrahigh quality cavities have been concocted yielding photon trapping times of μs to ms. However, such high-Q cavities give poor photon output, hindering applications. To preserve high photon output it is advantageous to strive for highly localised electric fields in radiatively lossy cavities. Nanophotonic antennas are ideal candidates combining low-Q factors with deeply localised mode volumes, allowing large ⊠, provided the emitter is positioned exactly right inside the nanoscale mode volume. Here, with nanometre resolution, we map and tune the coupling strength between a dipole nanoantenna-cavity and a single molecule, obtaining a coupling rate of 2⊠max = 412 GHz. Together with accelerated single photon output, this provides ideal conditions for fast and pure non-classical single photon emission with brightness exceeding 10E9 photons/sec. Clearly nanoantennas, acting as "bad" cavities, offer an optimal regime for strong coupling ⊠, to deliver bright on-demand and ultrafast single photon nanosources for quantum technologies.

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