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Ion Trap for efficient single Photon-Atom Coupling ROBERT MAIWALD, IOIP, NIST, MARKUS SONDERMANN, GERD LEUCHS[1], IOIP, JAMES C. BERGQUIST, DIETRICH LEIBFRIED, JOE BRITTON, DAVID J. WINELAND[2], NIST — Excitation of a single atom by a single photon is a fundamental process of physics, yet fairly inefficient in today's realizations. We present the design of a compact ion trap with superior optical access compared to conventional designs that allows for the localization of an ion in the focal point of a deep parabolic mirror. The electrode geometry results in a trapping potential that follows the axial symmetry of the mirror and provides optical access to the ion from almost the entire solid angle. The latter property is essential for efficient coupling of single ions to single photons in free space. The trap design can be adapted for other applications by replacing the mirror by a planar electrode. Using this more general design the ion can still be optically accessed from at least half to over 90% of the solid angle. The generation of a suitable mode-matched, dipole-like excitation pattern is discussed as well. Applications of an efficient light-matter coupling scheme include decoherence studies, quantum repeaters and quantum memories.

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