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A single ion coupled to an optical fiber cavity MATTHIAS STEINER, HENDRIK-M. MEYER, University of Cambridge, CHRISTIAN DEUTSCH, Menlo Systems GmbH, JAKOB REICHEL, Laboratoire Kastler-Brossel, ENS/UPMC-Paris 6/CNRS, MICHAEL KÖHL, University of Cambridge
— The development of an efficient ion-photon interface is a major challenge which needs to be overcome to realize large scale ion-based quantum networks. Such an interface could consist of a single ion coupled to high finesse optical cavity. Existing ion-cavity systems operate in a regime, where the coupling of light and ion is smaller than the excited state decay rate. In order to enhance the coupling, smaller cavity mode volumes must be used. We report on the realization of a combined trapped-ion and optical cavity system, in which a single Yb ion is confined by a micron-scale ion trap inside a 230 μm-long optical fibre cavity. We characterize the spatial ion-cavity coupling and measure the ion-cavity coupling strength using a cavity-stimulated Λ-transition. By using micro-machined optical fibre cavities, we achieve mode volumes more than two orders of magnitude smaller than previously reported. Owing to the small mode volume of the fibre resonator, the coherent coupling strength between the ion and a single photon exceeds the natural decay rate of the dipole moment. Our results indicate implicitly that stable trapping of single ions in close vicinity of dielectric surfaces does not impose fundamental problems, even at room temperature.

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