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Comparison between ion traps with integrated optical cavities for scalable quantum information networks

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Individual trapped ions are among the leading candidates for the realisation of quantum information processing networks. Scaling the networks to many quantum bits can be achieved via photonic links between ion trap nodes through deterministic coupling of ions to optical cavities. However, integrating optical cavities into ion traps remains a challenge as the dielectric cavity mirrors affect the ion trapping potential. We compare five different ion trap geometries with the aim to identify the trap and cavity configurations that would allow both strong ion confinement and small cavity volume. We compare the traps by analysing the trapping potential distortions caused by dielectric mirrors in the case of different mirror orientations with respect to the trap axes, as well as the trap stability to any mirror misalignment. We also analyse the effect of the mirror material properties, and study the effect of surface charges on the mirrors.