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Individual ion addressing using a magnetic field gradient in a surface-electrode ion trap SHANNON WANG, JAROSLAW LABAZIEWICZ, YUFEI GE, ISAAC CHUANG, MIT — The ability to address individual ions is an important issue in using multiple trapped ions to perform quantum operations. Previous efforts have included using precisely focused laser beams aimed at only one ion at a time, which poses a significant technical challenge. An alternative is to use field-dependent transitions and a magnetic field gradient to shift the transition frequencies of ions as a function of position. This requires good stability of the local field in order to achieve desired fidelity of quantum operations. In a cryogenic Sr^+ ion trap we use the $5S_{1/2} \rightarrow 4D_{5/2}$ transition as an optical qubit, which can be Zeeman shifted using a bias field generated by external coils. We present a scheme to create a local field gradient by integrating current sources onto a microfabricated surface-electrode trap. Taking advantage of the cryogenic environment, we stabilize the field at the trap site using superconducting rings as flux shields. The rings can be integrated with the trap, simplifying implementation and improving alignment to the ions.

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