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Microwave-controlled qubit interactions in a cryogenic surface electrode ion trap MALTE NIEMANN, TIMKO DUBIELZIG, ANNA-GRETA PASCHKE, IQO and QUEST, Leibniz University Hannover, Germany, MARTINA CARSJENS, MATTHIAS KOHNEN, CHRISTIAN OSPELKAUS, IQO and QUEST, Leibniz University Hannover and PTB Braunschweig, Germany — Multi-qubit interactions for quantum information processing with trapped ions require a coupling between individual ion-qubits and a shared motional degree of freedom. Recent experiments have shown how such interactions can be realized using microwave near-fields rather than laser fields. This holds great promise for integration, simplification and fidelities. One successful approach to create the required field configuration uses currents in three near-by microwave electrodes integrated on a chip [1,2]. Relative phase and amplitude stability of the currents may be one of the main limitations with this approach. We have designed an electrode configuration that requires only a single microwave electrode to create the field required to address sideband transitions. This technique requires close proximity of ion-qubits to conductors, where anomalous motional heating can be a source of decoherence [3]. To suppress these effects in our experiments, we have developed a low-vibration closed-cycle cryogenic setup. We will discuss this setup including the vacuum and imaging design as well as the proposed microwave electrode configuration.

[1] Ospelkaus et al., Nature 476, 181-184 (2011)
[2] Allcock et al., arXiv:1210.3272

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