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Robust entanglement of trapped ion qubits YOTAM SHAPIRA, RAVID SHANIV, TOM MANOVITZ, NITZAN AKERMAN, ROEE OZERI, Weizmann Institute of Science — Two-qubit entangling gates are central to quantum information processing. High fidelity two-qubit entangling gates have been demonstrated in several trapped ions systems. A common choice for such entangling gates is the well-known bi-chromatic Mlmer-Srensen (MS) gate, which ideally allows for deterministic two-qubit entanglement. However, calibration errors such as gate-timing errors or drifts of the normal-mode harmonic frequency result in a, temperature-sensitive, reduced gate fidelity. Furthermore, the gate is constrained to act slower than the trapping frequency due to off-resonance direct carrier coupling. Here, we generalize the MS gate by driving the ions with a multi-chromatic drive, the different components of the drive are then treated as additional degrees of freedom that allow for reducing or eliminating different error mechanisms leading to robust entanglement. Specifically we implement our robust entanglement scheme on two trapped $^{88}Sr^{+}$ ions. We explicitly measure the increased robustness to gate-timing errors, normal-mode frequency errors and off-resonance carrier coupling.

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