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Qubit Manipulations Techniques for Trapped-Ion Quantum Information Processing[1] JOHN GAEBLER, TING REI TAN, YIHENG LIN, RYAN BOWLER, JOHN JOST, ADAM MEIER, EMANUEL KNILL, DIETRICH LEIBFRIED, DAVID WINELAND, National Institute of Standards and Technology, ION STORAGE TEAM — We report recent results on qubit manipulation techniques for trapped-ions towards scalable quantum information processing (QIP). We demonstrate a platform-independent benchmarking protocol for evaluating the performance of Clifford gates, which form a basis for fault-tolerant QIP. We report a demonstration of an entangling gate scheme proposed by Bermudez *et al.* [Phys. Rev. A. **85**, 040302 (2012)] and achieve a fidelity of 0.974(4). This scheme takes advantage of dynamic decoupling which protects the qubit against dephasing errors. It can be applied directly on magnetic-field-insensitive states, and provides a number of simplifications in experimental implementation compared to some other entangling gates with trapped ions. We also report preliminary results on dissipative creation of entanglement with trapped-ions. Creation of an entangled pair does not require discrete logic gates and thus could reduce the level of quantum-coherent control needed for large-scale QIP.

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