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Progress towards a fault tolerant microwave-driven two qubit quantum processor utilizing Bayesian statistics for state determination

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We realize a universal gate-set for quantum computing with microwave nearfields with trapped ions [1]. $^9Be^+$ ions are trapped in a surface electrode trap with an integrated microwave electrode. Single ion addressing is done through micromotion sidebands [2]. We approach entangling infidelity of 10^{-3} with Mølmer-Sørensen gates. Based on the work done by [3] we investigate further use of Bayesian statistics for flourescence readout and state discrimination. The state determination can be improved by techniques to dynamically reduce readout time based on a probability threshold. Further, we will report on utilizing belief information for each state determination together with a time series database for post-analysis. We plan to implement a Bayes filter on top of the time series data from our experiments to track the experiment setup condition.
[1] C. Ospelkaus et al., Phys. Rev. Lett. 101 090502 (2008)
[2] G. Zarantonello et al., Phys. Rev. Lett. 123 260503 (2019)
[3] A. H. Myerson et al., Phys. Rev. Lett. 100 200502 (2008)

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