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Microwave-double dressed entangling gate with trapped 171Yb+ ions

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Entangling gates are an essential buliding block of any quantum processor, ideally working at high speeds in a in a robust and scaleable manner. Microwave-driven trapped-ion gates present promising features in terms of scalability and stability of the driving field. Experimentally, limited fidelity values are mostly attributed to the use of magnetic field sensitive states, which make qubits vulnerable to magnetic noise sources. Here we present a promising Mølmer- Sørensen type entangling gate based on a continuous dynamical decoupling technique [1]. We implement a double dressing field scheme, using a single microwave field per ion.

The gate is implemented on trapped 171Yb+-ions in a static magnetic gradient of 19 T/m and an inherent all-to-all coupling based on the Magnetic Gradient Induced Coupling (MAGIC) scheme [2]. Here, we show first experimental results of these fast entangling gates that take a few hundred microseconds. This is an order-of-magnitude improvement in gate time compared to our previous entangling gate results. These are achieved without siginficant modifications of the trapping parameters and the magnetic field gradient as compared to previous gate realizations [2, 3].

[1] D. Farfurnik et al, Phys. Rev. A, 96, 013850 (2017)
[2] Ch. Piltz et al, Sci. Adv.2, e1600093 (2016)
[3] P. Barthel et al, New J. Phys., 25, 063023 (2023)

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