A Neutral Atom Quantum Computing Platform with Mid-Circuit Measurement Capability.

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Within the TU/e Kat-1 collaboration, we aim to construct a full-stack hybrid quantum computer. At its core, our quantum processor consists of individually trapped Rubidium-85 atoms in optical tweezers, with qubit states encoded in the hyperfine splitting of the atomic ground state.

In this poster, we briefly introduce neutral-atom quantum computing and present the redesign and initial characterization of our experimental platform, developed to support mid-circuit measurements as a crucial first step towards quantum error correction (QEC). Key improvements include the design of a four-loop antenna configuration for driving global microwave transitions with arbitrary polarizations and increased homogeneity. In addition, we introduce an alignment-free dual-wavelength local addressing system. This system suppresses relative beam-pointing instabilities between the trapping and addressing beams, enabling us to locally apply stable differential Stark shifts. Together with the global microwaves, this enables local state shelving into the ground-state Zeeman levels, which in turn allows site-selective mid-circuit measurements - an important step towards the realization of QEC on our platform.

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