Neutral Atoms in Tweezer Arrays for Hybrid Quantum Computing

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Our project has the goal of building a quantum co-processor consisting of neutral atoms in tweezer arrays. This quantum co-processor will form part of an online-accessible hybrid quantum computer tailored for solving quantum chemistry problems.

The quantum co-processor will consist of strontium-88 atoms trapped in 2-dimensional arrays of optical tweezers, with a single atom trapped per tweezer. Qubit states will be encoded on the $^1S_0$ and $^3P_0$ electronic states of the atoms. Laser driven site selective single qubit rotations will be performed on the doubly dipole forbidden $^1S_0 \leftrightarrow {}^3P_0$ optical clock transition. Global excitations to Rydberg states will be used to generate entanglement between the qubits.

We report on our progress in the development of the 2nd generation strontium-based system in Eindhoven (see FIG 1), whilst the existing 1st generation system is situated in Amsterdam. We also report on the status of our rubidium-based system in Eindhoven (see FIG 2), which will be used to test various components before integration into the new strontium-based system.

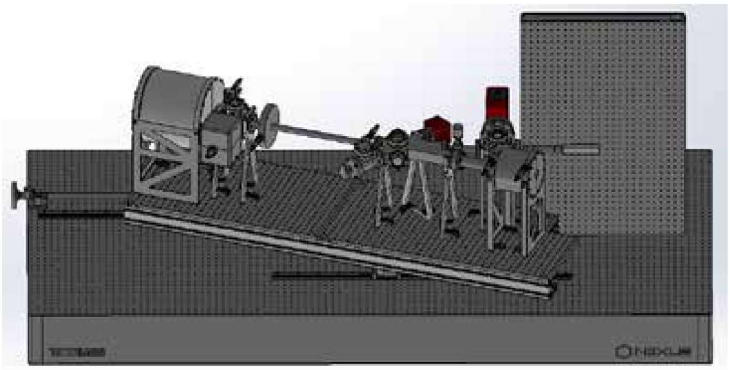

FIG. 1: CAD of vacuum system for the 2nd generation strontium-based system.

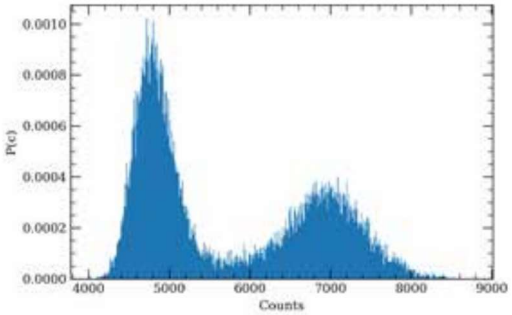

FIG. 2: Probability distribution of camera counts for repeated loading of a 3x3 tweezer array of single ^{85}Rb atoms with $\approx 50\%$ single atom probability per array site.