Researchers break record for atoms positioned individually in a trap to create defect-free arrays

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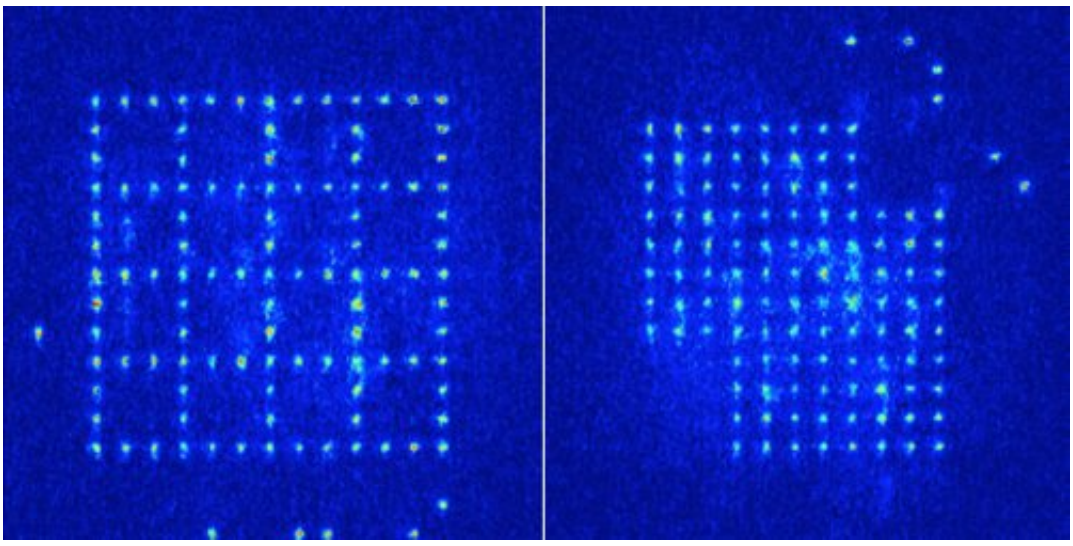

Credit: D. Ohl de Mello et al., *Phys. Rev. Lett.* (2019)

A team of researchers at Technische Universität Darmstadt has broken the record for the number of atoms positioned individually in a trap to create a defect-free array. In their paper published in the journal *Physical Review Letters*, the group explains how they built their trap and their plans for making even larger ones.

Scientists working to build a truly useful quantum computer believe that it will be necessary to trap neutral atoms in arrays of dipoles to serve as

qubits. The prior record number of trapped atoms in such a trap was 72. In this new effort, the researchers have pushed the new record to 111. They claim their method is also scalable and that it should be possible to use it to create arrays holding up to a million or more atoms.

To create their array, the researchers started with a cloud of rubidium atoms in a vacuum held in place by a magneto-optical trap. Next, they allowed the atoms in the cloud to cool. When they reached 100 μKelvin, they were moved to a microtrap array they had built using hundreds of laser traps that had been arranged in a square.

The team reports that in its initial stage, each of the traps contained a few atoms—they whittled them down to each holding just one or zero atoms by using a collisional blockade. They followed that by creating an image of the system to allow them to identify which traps held an atom and which were empty. They then placed a single atom in each of the empty traps using optical tweezers. Once all the empty traps had been filled, the team imaged the array once again to make sure that each trap had just a single atom in it. They note that the process of adding a single atom to an empty slot could be used again if any were found empty.

They further report that their process was used to create a 10x10 2D square array of atoms, a 105-atom checkerboard array and one made from two squares connected together that had 111 atoms. They add that they are currently at work building an array that can hold 1000 atoms and claim that the only roadblock to building much larger arrays is cost.

More information: Daniel Ohl de Mello et al. Defect-Free Assembly of 2D Clusters of More Than 100 Single-Atom Quantum Systems, *Physical Review Letters* (2019). DOI: 10.1103/PhysRevLett.122.203601

On *arXiv*: arXiv:1902.00284v4 [quant-ph], arxiv.org/abs/1902.00284.