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Adjustable 'ion trap' boosts quantum computing

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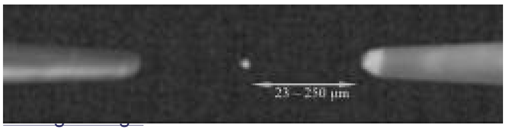

The electrodes used to trap atomic particles can be adjusted (Image: University of Sussex/Hensinger)

The first adjustable "ion trap" could help scientists better understand the challenges of building practical quantum computers, researchers say.

Conventional ion traps confine atomic particles within a vacuum and an electric field generated by two fixed-position electrodes. The electronic states of these particles can be used to represent quantum bits of information. Unlike normal "bits" of information, which are represented by distinguishable states, such as a binary "1" or a "0", quantum information can exist in different states simultaneously.

This means computers that can process quantum information could perform mind-boggling computations instantaneously. However, maintaining quantum information is extremely difficult, and so building a sufficiently complex, practical quantum computer represents an enormous challenge.

Louis Deslauriers at the University of Michigan, US, and Winfried Hensinger at the University of Sussex, UK, and colleagues, created the novel trap. It allows the distance between each electrode to be adjusted without losing the ion trapped in-between.

Scaling down

For the first time, this allowed them to measure precisely how down-scaling the trap affected the quantum state of the trapped ion. They found that reducing the size of the trap increased its temperature, thus boosting "decoherence", which could ultimately destroy quantum information.

It was still possible to shrink the trap down to 23 microns in diameter – the smallest ion trap ever made – without impairing its function. And, by cooling it to -120°C, they were able to reduce the heating that threatened to destroy to the ion's quantum properties.

Hensinger estimates that it should be possible to scale down an ion trap even further, to around 1 micron, providing it is cooled sufficiently. This could prove crucial as a practical quantum computer would require hundreds of thousands of such devices in order to perform useful calculations.

"Very clever"

"The significance is quite big," Hensinger told **New Scientist**. "This adds an advantage to the field that other people can use." He adds that the cooling required should not make the construction of a working computer overly complicated.

"It's very clever," says Daniel Segal, an ion trap researcher at Imperial College London in the UK, who agrees that the work could be very significant. "This does a very systematic job of measuring something that is rather tedious, but is very important indeed," Segal says. "Up until this, the only evidence about how the heating rate scales with trap size came from different people's heating rate measurements."

Hensinger believes ion traps hold the most promise for building quantum computers, but adds that much work remains to be done. "There is still a very large challenge in bringing everything together," he warns.

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