# Discovery could pave the way for quantum computing

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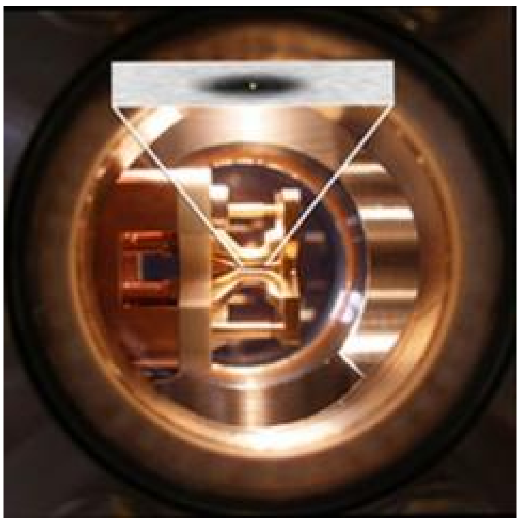

The picture shows the team's experimental apparatus comprising of the ion trap inside the vacuum chamber. The inset shows schematically the single ion (red) in the Bose-Einstein condensate (dark grey).

(PhysOrg.com) -- Two experimental systems at the forefront of modern physics research -- a single trapped ion and a quantum atomic gas -- have been combined for the first time by researchers at Cambridge.

The successful creation of this hybrid system opens the way to new types of experiment, in which the precise controllability of trapped ions can be used to study and manipulate quantum gases with nanometre precision.

In recent years, the ultracold quantum gases known as Bose-Einstein condensates and single ions confined in electromagnetic traps have both been used to explore a wide range of problems in fundamental physics.

Writing in this week's *Nature*, the team from the Department of Physics at the University of Cambridge describe the immersion of a single trapped ytterbium ion in a Bose-Einstein condensate of neutral rubidium atoms.

They showed that they can control the two systems independently, and study their interactions. They also observe 'sympathetic cooling' of the ion by the condensate - an effect that might ultimately prove useful in quantum computing.

According to Dr Michael Köhl: "We placed a single charged Ytterbium atom into a Bose-Einstein condensate, which at only a few billionths of a degree above absolute zero is the coldest thing in the universe."

The results could be used to cool quantum computers - devices that, by employing the laws of quantum mechanics, can solve certain computational tasks much faster than any existing computer. Basic quantum processors already exist but they are not yet surpassing the fastest normal computers.

"Today's most powerful quantum computers are made from single atoms, like our Ytterbium, trapped in vacuum, but they need to be refrigerated in order to compute correctly. Usually this is done with laser light, which is quite complicated, expensive, and it interrupts the computing process. With our new technique, quantum computers could be cooled continuously in the future which could pave the way to a more widespread application," says Dr Köhl.

Provided by University of Cambridge