Physicists drop supercold exotic matter

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A Birmingham physicist, along with a team of European scientists, has demonstrated a new technique to recreate Galileo's drop experiment with an exotic state of matter called a Bose Einstein condensate.

The scientists have created the Bose Einstein condensation by lowering the temperature of a gas to almost absolute zero (less than a millionth of a degree above absolute zero, minus 273 degrees Centigrade). In doing this they have seen the gas behave in a different way – it shows an exotic behaviour that is explained by quantum mechanics, usually only seen on very small scale.

As the atoms get colder and are in the Bose Einstein condensed state, they become fuzzy and start to look identical – like one big super-atom.

Since its discovery in 1995 by Nobel Laureates Eric Cornell, Wolfgang Ketterle and Carl Wieman, this exotic state of matter has spurred speculations about quantum applications.

Now the drop team has achieved a new milestone in the direction of quantum technologies. The scientists created the Bose Einstein condensed matter using a new generation of robust technologies and dropped the whole experiment down a 110m high tower at the Centre of Applied Space Technology and Microgravity in Bremen, Germany. The physicists were able to observe the new matter for one second in free fall, 20 times longer than ever before.

> Professor Kai Bongs, School of Physics and Astronomy and Midlands Cold Atom Centre "Just as Galileo discovered that weights of different materials dropped from the top of the Leaning Tower of Pisa both fall at the same speed, we are trying to extend this to exotic quantum matter. Similar to the ultra high energy experiments in particle physics our experiments at ultra low energy promise to find the basic building blocks of physics. In addition the technology we have developed might be integrated into precision atomic sensors which may be taken into space, where they promise new geophysical, hydrology and climate data."

This demonstration opens up a whole new area of research at ultra low energy scales. The University of Birmingham coordinates a 3.5M€ European Project which aims at taking the drop tower technology to the next level into a backpack sized quantum sensor. This precision gravity sensor could find applications in detecting new oil, mineral and diamond deposits or by monitoring carbon sequestration sites.