New method to understand superconductors

December 13 2012

Researchers at The Open University have devised a new method to understand the processes that happen when atoms cool which could lead to new materials for superconducting power grids and widespread use of magnetic resonance imaging (MRI).

In a paper, "Bilayers of Rydberg atoms as a quantum simulator for unconventional superconductors" just published in *Physical Review Letters*, Dr Jim Hague and Dr Calum McCormick at The Open University's Department of Physical Sciences describe a new method to understand the cooling of atoms, which is to simulate a superconductor using a "quantum simulator" (a kind of bespoke quantum computer for examining specific problems) rather than a supercomputer.

The researchers found that just such a simulator can be built to examine atoms cooled to just a millionth of a degree above absolute zero. The atoms are controlled using laser beams which enhance the electrical forces between the atoms, which are usually weak and unimportant. These forces mimic the physics of the superconductor, and the proposed simulator includes far more physical detail than ever before.

"The problem is that up to now nobody knew how to build such a material because physics of the best superconductors are extremely difficult to understand", said Dr Hague. "By studying the atoms in the quantum simulator, we expect that it will be possible to make major progress in unravelling the underlying theory of these fascinating materials. A superconductor (a material with no electrical resistance) operating close to room temperature would offer potentially

revolutionary technology."

More information: Hague, J. and MacCormick, C. Bilayers of Rydberg Atoms as a Quantum Simulator for Unconventional Superconductors. *APS Journals*. prl.aps.org/abstract/PRL/v109/i22/e223001

Provided by The Open University