techman / May 10, 2012 09:58AM

[Physics] Atomic-scale Visualization of Cooper Pairing in Iron Superconductors Supports Magnetic Pairing Theory: Academia Sinica

[Physics] Atomic-scale Visualization of Cooper Pairing in Iron Superconductors Supports Magnetic Pairing Theory: Academia Sinica (Chinese Version)

Academia Sinica Newsletter (2012/05/10) Scientists from an international team including Dr. Tien-Ming CHUANG, Assistant Research Fellow at Academia Sinica's Institute of Physics have recently provided direct evidence supporting theories that magnetism holds the key to the ability of superconductors to carry current with no resistance, strengthening confidence that this type of theory may one day be used to design superconductors that operate at room temperatures. The findings were published in Science on May 4, 2012.

High-temperature superconductors fascinate both scientists and engineers as they carry current with no loss at temperatures as high as -110° Celsius, close to the lowest temperature recorded on earth (-90° Celsius in Antarctica) hinting at possible applications in energy-saving technologies. Conventional superconductors must be chilled to near absolute zero (0 kelvin, or -273° Celsius). In superconductors, electrons form cooper pairs and move through the crystal lattice without resistance. By measuring how strongly cooper pairs are bound together in an iron-based superconductor, the scientists have provided direct evidence supporting theories that state magnetism holds the key to this material's ability to carry current with no resistance. The measurements take into account the directions in which the electrons are traveling, which was central to testing the theoretical predictions, thereby strengthening confidence that this type of theory may one day be used to identify or design new materials with improved properties - namely, superconductors operating at room temperature.

The physics of high temperature superconductivity has confounded scientists over the last 30 years. It is generally believed that the magnetically mediated electron-electron interaction of these materials is the key. When iron-based superconductors were discovered in 2008, this idea received a big boost because their parent compounds exhibit similar magnetic properties as their copper-based counterparts. However, determining that role is a very complex problem. In each iron atom there are five magnetic electrons. In order to find out if the magnetic interactions between electrons are generating the superconductivity, it is necessary to measure what is called the anisotropic superconducting energy gap, which can tell scientists the binding strength of cooper pairs along different directions in momentum space.

Many theorists have developed different versions of a theory predicting what the measurements should be if magnetism were the pairing mechanism for superconductivity. The researchers' method, multi-band Bogoliubov quasiparticle scattering interference, found the "signature" predicted by the theorists. "Although theorists predicted the existence of superconducting gap anisotropy, it's difficult to calculate how large this effect is. Our measurements not only agree with the theoretical prediction but also provide theorists with crucial information towards a more quantified description." said Dr. CHUANG. The next step is to use the same technique to determine whether the theory holds true for other iron superconductors. If those experiments show that the theory is indeed correct, the model could then be used to predict the properties of other elements and combinations - and ideally point the way toward engineering new materials and higher-temperature superconductors.

The complete article is available at: http://dx.doi.org/10.1126/science.1218726

Related Website:
http://www.sciencedaily.com/releases/2012/05/120503142542.htm

Media Contacts:
Tien-Ming CHUANG, Assistant Research Fellow, Institute of Physics, Academia Sinicachuangtm@phys.sinica.edu.tw (Tel) +886-27896731
Ms. Pearl HUANG, Office of Public Affairs, Central Office of Administration,
Academia Sinica pearlhuang@gate.sinica.edu.tw
(Tel) +886-2-2789-8820 (Fax) +886-2-2782-1551

Ms. Mei-Hui LIN, Office of Public Affairs, Central Office of Administration,
Academia Sinica mhlin313@gate.sinica.edu.tw
(Tel) +886-2-2789-8821 (Fax) +886-2-2782-1551

Further Information:
[Academia Sinica Newsletter 2012/05/10]

Edited 1 time(s). Last edit at 05/10/2012 09:59AM by techman.