Breakthrough experiment on high-temperature superconductors

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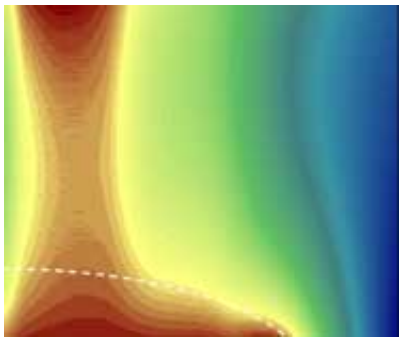

The highly unusual situation shown in this plot had not been predicted by any known theoretical model.

(PhysOrg.com) -- New information about the metallic state from which high temperature superconductivity emerges, has been revealed in an innovative experiment performed at the University of Bristol.

The international team of physicists, led by Professor Nigel Hussey from the University's Physics Department, publish their results today in *Science Express*, a rapid online access service for important new publications in the journal *Science.*

Superconductivity is a process by which a pair of electrons travelling in opposite directions and with opposite spin direction suddenly become attracted to one another. By pairing up, the two electrons manage to lose all their electrical resistance. This superconducting state means that current can flow without the aid of a battery.

Historically, this remarkable state had always been considered a very low temperature phenomenon, thus the origin of the superconductivity peculiar to very unusual metallic materials termed 'high temperature superconductors', still remains a mystery.

Hussey and his team used ultra-high (pulsed) magnetic fields – some of the most powerful in the world – to destroy the superconductivity and follow the form of the electrical resistance down to temperatures close to absolute zero.

They found that it was as the superconductivity becomes stronger, so does the scattering that causes the resistance in the metallic host from which superconductivity emerges. At some point however, the interaction that promotes high temperature superconductivity gets so strong, that ultimately it destroys the very electronic states from which the superconducting pairs form. The next step will be to identify just what that interaction is and how might it be possible to get around its self-destructive tendencies.

In doing this experiment, the team was able to reveal information that will help theorists to develop a more complete theory to explain the properties of high temperature superconductors.

"Indeed", said Hussey, "if researchers are able to identify what make these superconductors tick, and the electrons to pair up, then material scientists might be able to create a room temperature superconductor. This holy grail of superconductivity research holds the promise of loss-free energy transmission, cheap, fast, levitated transport and a whole host of other revolutionary technological innovations."

Journal:
www.sciencemag.org/sciencexpress/recent.dtl

Provided by University of Bristol