How to identify chiral superconductivity in new materials

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(PhysOrg.com) -- "Chiral superconductivity is the dream of mankind," Carlo Beenakker tells *PhysOrg.com*. "All sorts of scientists are working on it, and there are many labs trying to create materials that are predicted to provide chiral p-wave superconductivity."

Beenakker is a scientist at the Instituut-Lorentz of Leiden University in The Netherlands. Along with Serban, Béri and Akhmerov, Beenakker is in a group that says it has produced a test for determining whether or not a material meets the criteria for chiral p-wave superconductivity. The work of the group is described in Physical Review Letters: “Domain Wall in a Chiral p-Wave Superconductor: A Pathway for Electrical Current.”

“Efforts are going into creating a chiral superconductor, in which there is transport in one direction, instead of two. This superconductor would have electrons moving in only one direction,” Beenakker explains. “This has been seen in the quantum Hall effects, and scientists are interested in other systems that would show similar characteristics of electrons moving in one direction without resistance.”

Right now, chiral transport in a superconductor is difficult to detect. While many labs and scientific groups are laboring with different materials to create chiral transport in a superconductor, there are challenges to actually knowing when this is accomplished. This is where Beenakker and his colleagues, along with their test, come in. “We propose what should work as a test to verify that a chiral p-wave

superconductor has, in fact, been created," he says.

The test would be administered by first hooking up a wire to the opposite ends of a domain wall of the material. "Next, we would apply a voltage to see if you can send current from one side to the other," Beenakker says. "Then, you could invert the voltage, to see if the current can flow in the opposite direction. In this way you could find out whether it is going in only one direction."

Such a test is a step in efforts to develop superconductors that could be used for a variety of applications in the future. "We are theorists, coming up with ideas that could be useful in experiments," Beenakker explains. "This test could be used in the development of future superconductor technology. A group would say that they think they have developed a chiral superconductor, and then they could use this test to determine whether or not it truly is such a superconductor. This test provides a way to observe chirality in a way that has not been available up to this point."

Beenakker says that the work of the group in The Netherlands is especially exciting since it could lead to different ways of building quantum computers. "Chiral p-wave superconductors are among the candidates for supercomputer platforms," he points out. "Being able to find these materials, would be very helpful in moving forward with quantum computing. If p-wave superconductors really exist, and we can make them accessible and robust in labs, it could be a significant step forward in terms of making the building blocks of quantum computing."

More information: I. Serban, B. Béri, A.R. Akhmerov, C.W. J. Beenakker, "Domain Wall in a Chiral p-Wave Superconductor: A Pathway for Electrical Current," *Physical Review Letters* (2010). Available online: link.aps.org/doi/10.1103/PhysRevLett.104.147001