Physicists demonstrate quantum mechanical nature of heat flow

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One of the hallmarks of quantum mechanics -- the laws of physics that apply on very small scales -- is the wave nature exhibited by sub-atomic particles such as electrons. An electron presented with two paths to a destination will use its wave nature to traverse both paths and, depending on the parameters of the two paths, will constructively or destructively interfere with itself at its destination, leading to a high or low probability of it appearing there.

A classic demonstration of this is the Aharonov-Bohm effect where electrons are sent along two paths that may be altered by the application of an external magnetic field. By tuning the magnetic field, the constructive or destructive interference of the electrons is manifested as an increase or decrease in the conduction of electric current. Now physicists at Northwestern University show that, using the fact that electrons carry heat as well as charge, the conduction of heat may be similarly tuned. Their findings will be published April 22 by Physical Review Letters, the journal of the American Physical Society.

Venkat Chandrasekhar, professor of physics in Northwestern's Weinberg College of Arts and Sciences, and his graduate student Zhigang Jiang showed that a magnetic field can be used to increase or decrease the flow of heat through an "Andreev interferometer," a nanoscale device with one normal metal path and one superconducting path. Though the quantum interference of electrons in this device is responsible for these changes in heat flow, the flow of charge through the interferometer is zero. The researchers recently observed this effect experimentally.

Source: Northwestern University