Experimental Observation of 'Digital' Heat Flow

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The first observation of "digital" or quantized heat flow in a nanostructure at ambient conditions has been made by Caltech researchers using carbon nanotubes suspended between two electrodes.

A new experiment carried out at Caltech furthers the effort to employ nanotubes as a conduit for removing unwanted heat from microcircuits. Carbon nanotubes, nanometer-wide cylinders made from rolled-up sheets of graphite, have a versatile array of mechanical, electrical, and magnetic properties.

Their thermal properties should be just as valuable. Because phonons (the particle manifestations of heat flow) can move so freely in nanotubes, even ballistically (meaning that they refrain from scattering and travel in straight lines), the flow of heat in nanotubes should have quantum properties.

Indeed, Caltech scientist Marc Bockrath and his colleagues have observed that heat conductivity in nanotubes can reach an ultimate limit to heat flow where heat conduction occurs in multiples of a quantum unit of heat flow. Phonons seem to move nearly as far as hundreds of nanometers (a long distance for nanoscopically sized objects) even at temperatures of 600 C.

The phonons' mean-free path (the average distance they travel between collisions) should be even larger at room temperature. This, says Bockrath, underscores the fantastic potential of nanotubes as thermal

conduits.

This and other questions will be addressed on Monday, October 31, 2005, from 1-2 PM, at a press luncheon for the 52nd AVS International Symposium & Exhibition in Boston. (Speaker: Marc Bockrath, Caltech)

The luncheon will take place in the Exhibitor Workshop area of Exhibit Hall D of the Hynes Convention Center (900 Boylston Street). The entire symposium takes place between October 30-November 4, 2005. The meeting will feature over 1300 papers and posters, with at least 3,000 expected attendees.

Source: American Institute of Physics