Heat transport in quantum conductors

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Quantum physics rules electrical and thermal transport across low dimensional conductors. Despite thirty years of research in mesoscopic physics, the field of quantum heat transport remains mostly unexplored experimentally, essentially because heat currents are much harder to probe than electrical currents.

In this talk, I will present how heat transport measurements allow us to investigate fundamental properties, such as the quantum of thermal conductance[1,2], and the violation of the Wiedeman Franz law[3] (which usually relates heat and charge conductances). We have developed a straightforward approach to infer the heat current in quantum conductors realized in two dimensional electron gases at the interface between GaAs and AlGaAs layers. It relies on the measurement of current fluctuations using an extremely sensitive voltage amplifier operating at cryogenic temperatures, based on homegrown high-electron-mobility transistors.

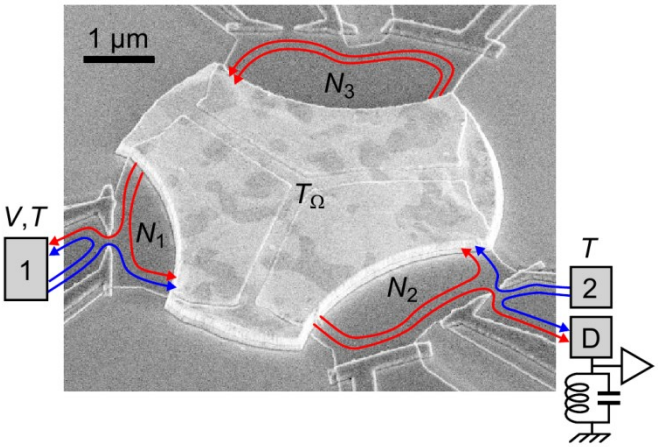

Figure : SEM image of a sample where quantum conductors are realized in a two dimensional electron gas (schematized by continuous lines). The quantum of thermal conductance was inferred from the measurements of current fluctuations using the voltage amplifier (bottom right) when Joule power was injected by a bias voltage (bottom left).

These experiments pave the way to many studies in the emergent field of quantum heat transport, such as the quantum phase manipulation of heat currents, and to the future engineering of heat nanomachine.

[1] Jezouin *et al.,* Science **342**, 601 (2013)

[2] Anthore *et al.,* Reflets de la physique **42**, 16 (2014)

[3] Sivre *et al.*, Nature Physics, doi:10.1038/nphys4280