Study finds the law governing how heat transport scales up with temperature

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How heat travels matters. Yet, there is still no consensus on the exact physical mechanism that causes anomalous heat conduction - despite the existence of previous numerical simulation, theoretical predictions and experimental observations. Now, a team based in Asia has demonstrated that electron transport depends on temperature. It follows a scaling governed by a power law - and not the exponential scaling previously envisaged. These findings were recently published in *EPJ B* by Yunyun Li Tongji University, Shanghai, China, and colleagues in Singapore.

Heat conduction depends on the internal energy transferred by microscopic diffusion and collisions of particles, such as electrons, within a given body. Anomalous heat conduction can be best studied in a particular kind of model: one that accounts for the thermal transport in a one-dimensional (1D) lattice. In this study, the chosen 1D model is dubbed the coupled rotator lattice model.

The specificities of the chosen model is that it conserves heat conductions - that is heat transport and heat diffusion - as well as momentum diffusion. Under these conditions, the expectation is that the heat conduction would be anomalous. But in reality, numerical simulations have previously demonstrated that the model exhibits normal heat conduction. For physicists, these results don't intuitively match the fact the heat is diffusing in a way that preserves its momentum. To complement their approach, they also drew a comparison with a single kicked rotator.

The authors systematically investigated how heat conductivity changes with temperature in the selected 1D model. This approach led them to the thesis that heat conductivity correlates with a power law, instead of an exponential scaling as previously predicted. Further, this phenomenon occurs without a transition temperature above which the heat conduction is normal and below which it is anomalous.

More information: "Temperature dependence of thermal conductivities of coupled rotator lattice and the momentum diffusion in standard map," *Eur. Phys. J. B*, DOI: 10.1140/epjb/e2015-60361-5

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