Near-field radiation: tunneling and guiding heat

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When the gap distance between two emitting bodies decreases below Wien's photon wavelength, direct electrostatic interactions between charges yield an exalted heat transfer described by a dipole-dipole (phonon-polariton) interaction larger than the one predicted by Stefan's Law [1].
Using atomic Green Functions, we show that previous dipole based Maxwell descriptions remain limited to gaps larger than about 10nm and highlight that surface charge interactions predominate below this distance down to a few Angstroëms. From a few Angströems to contact, a chemical bond is formed between the two systems, which generates an intense "pseud-conductive" heat transfer [2].
We also show that phonon-polaritons are able to transfer energy along nanostructures and prove the existence of a guided radiated heat flux larger than the one transported through lattice vibrations. This flux might be estimated with the quantum of thermal conductance at ambient temperature in nanowires[3].

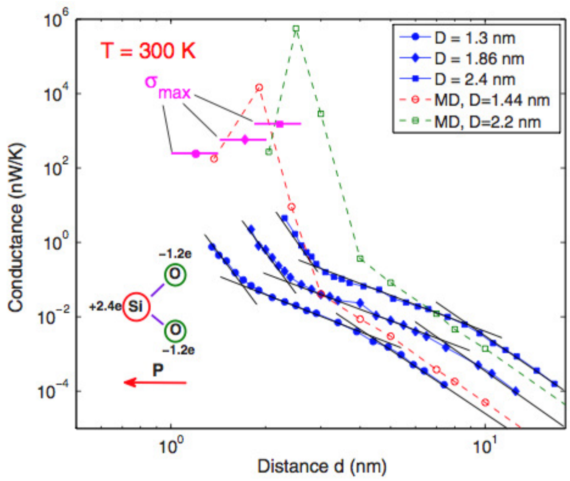

Fig. 1: Thermal conductance as a function of gap distance via near-field radiation.

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