Phonon Mediated Heat transfer in Vacuum

Sebastian Volz [(a)]

[(a)] *LaboraLaboratoire d'Energétique Moléculaire et Macroscopique, Combustion, UPR CNRS 288, Ecole Centrale Paris - 92295 Châtenay Malabry – France*

Abstract: We tackle the mechanism of radiation at small scales. When the gap distance between two emitting bodies decreases below the Wien's photon wavelength, direct electrostatic interactions between charges yield an exalted heat transfer larger than the one predicted Stefan's Law. We show that the proposed Maxwell equation approach remains limited to gaps larger than about 10nm and we highlight that charge-charge interactions predominate below this distance down to a few Angstroëms [1]. We also prove the existence of a guided radiated heat flux along polar nanowires that can be larger than the one transported through lattice vibrations. This flux can be estimated with the quantum of thermal conductance at ambient temperature [2].

[1] S. Xiong, K. Yang, Y.A. Kosevich, Y. Chalopin, R. D'Agosta, P. Cortona, S.Volz, Classical to quantum transition of heat transfer between two nanoparticles, Phys. Rev. Lett. 112, 114301 (2014)C. van Tiger, Phy. Rev. Lett. 14, 741-755 (1997).

[2] J. Ordonez -Miranda, L. Tranchant, B. Kim, Y. Chalopin, T. Antoni and S. Volz, Quantized Thermal Conductance of Nanowires at Room Temperature due to Surface Phonon-Polaritons, Phys. Rev. Lett., 112, 055901, (2014).