Novel theories for the thermoelectric effect

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Understanding of the thermoelectric effect poses critical challenges for the theorists, since it entails a comprehensive description of both electron and thermal transport, phenomena usually associated with diverse mechanisms, and more importantly with different energy scales. In the last few years, tremendous progress has been made in building models to describe these transport effects, starting from either the Boltzmann equation or the Landauer formalism [1]. In this talk, I will present some of the theoretical advancements made by the Spanish consortium nanoTherm [2], comparing them with the actual international outlook, and in some case bridging the gap with experiments. An overlook of the experimental progress is presented in the talk of Dr. O. Caballero and Dr. M. Martinez.

I will focus my attention to two of the most recent developments, namely an effective description of phonon thermal transport [3] that is able to describe the confinement effect in nanowires of decreasing diameter, and a theory for the Seebeck coefficient where we take into account the effect of the electron exchange and correlation energy [4].

Finally, I will take the opportunity to introduce a novel "Red Tematica" on the thermoelectric theory.

References

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[3] De Tomas, C., Cantarero, A., Lopeandia, A. F. & Alvarez, F. X. J. Appl. Phys. 115, 164314 (2014).
[4] Yang, K., Perfetto, E., Kurth, S., Stefanucci, G. & D'Agosta, R. Phys. Rev. B 94, 81410(R) (2016).

Figures

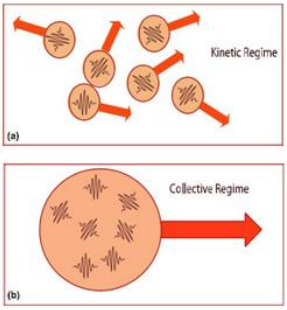

Figure 1: Different energy and time scales define the regime for thermal transport. From [4].

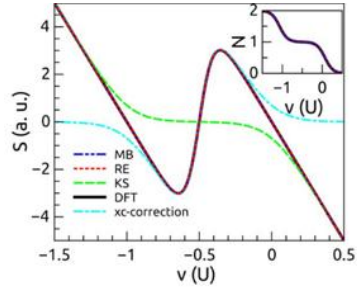

Figure 2: The exact Seebeck coefficient (black and red lines) for a strongly correlated electron system might differ significantly from the prediction of standard ab-initio methods (green lines). From [4].