# Thermoelecric energy conversion at the spectrum edges of disordered nanowires

**Riccardo Bosisio**
*CEA-Saclay (IRAMIS/SPEC), Gif-sur-Yvette, France*
e-mail: riccardo.bosisio@cea.fr

The hard challenge to design thermoelectric devices with sufficiently high efficiencies could be overcome thanks to nanostructuration. Indeed nanostructural engineering provides opportunities to reduce the phonon thermal conductivity through appropriate boundary design and allows tailoring of the electronic band structure, a necessary condition to achieve large thermopowers. In comparison to their bulk counterparts, semiconductor nanowires have already led to improved thermoelectric conversion. In that context, it becomes important to determine the doping level of nanowires that optimizes the thermoelectric efficiency. Recent experimental measurements carried out by P. Kim et al [1] illustrates the growing interest of the community to that issue.

In this work [2], we study thermoelectric conversion in a non-interacting disordered nanowire, in presence of a gate voltage which allows to modify the carrier density in it. We discuss the relevant temperature scales which identify the different transport mechanisms. We focus on two situations: first, a low-T (coherent) regime in which transport through the system is elastic; secondly, a higher-T regime known as Mott's Variable Range Hopping (VRH) in which transport is accomplished via inelastic phonon-assisted hopping. In both cases, we investigate how the typical thermopower and its mesoscopic fluctuations depend on the external gate voltage, and show that thermoelectric conversion is enhanced when the edges of the energy spectrum of the system are probed. Using a previous work of Derrida and Gardner giving the localization length of the Anderson model near the spectrum edges [3], we derive for the low-T case an analytical formula describing perfectly the behaviour of the typical thermopower as a function of the gate-voltage.

[1] P. Kim et al., arXiv:1307.0249 (2013).
[2] R. Bosisio, G. Fleury and J-L. Pichard, "paper in preparation".
[3] B. Derrida and E. Gardner, J. Physique **45**, 1283 (1984).