Inelastic Quantum Transport in Nanoscale Junctions :
Role of electron-phonon interactions on the current-current noise characteristics

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Recent theoretical advances have unveiled the role of electron-phonon (e-ph) interactions in the current-current fluctuations (shot noise) versus voltage characteristics of molecular nano-devices [1,2,3]. For voltages crossing the inelastic threshold, the correction to the noise induced by e-ph interactions was shown to exhibit a crossover between a positive and negative correction, depending on the parameters describing the junction (position of the molecular level, asymmetry of the coupling to the leads) [1,2,3]. More generally the high-bias properties of the noise versus voltage characteristics were shown to result from both electronic and vibronic dynamics [4], the fluctuations of the later being responsible of a dynamical feedback inducing strong non-linear effects in the transport properties [5].

In this work, we would like to review the state of the art of the literature concerning transport properties of molecular junctions (current, noise and full counting statistics) in presence of such inelastic effects. We also would like to address the description of the remaining open questions, as well as some possible directions for further theoretical works.

The aim of such investigations could be to generate simulation tools for computing noise characteristics as efficient as the one available for computing I-Vs [6], and to provide a new way of characterizing experimentally transport properties of molecular junctions [7].

References

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