Cavity-enhanced transport of charge

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We discuss the effects on charge conductivity in a molecular semiconductor of coupling intra-molecular electronic transitions to the bosonic field of a cavity or of a plasmonic structure prepared in its vacuum state [1]. We present a proof-of-principle model where this coupling leads to a light-matter hybridization - the dressed fermionic bands interact via absorption and emission of dressed cavity-photons - that ultimately provides an enhancement of charge conductivity in the steady-state. We discuss the role of the finite electronic band-width in the dressing, and explain how this affects the current enhancement. We demonstrate that under certain experimentally relevant conditions the enhancement can reach orders of magnitudes and discuss the relevance of these results to recent experiments with organic semi-conductors, where a dramatic enhancement of charge conductivity was demonstrated [2]. We conclude with a discussion of open questions.

[1] *Cavity-enhanced transport of charge*, D. Hagenmüller, J. Schachenmayer, S. Schütz, C. Genes, and G. Pupillo, arXiv:1703.00803 (2017).
[2] *Conductivity in organic semiconductors hybridized with the vacuum field*, E. Orgiu et al., Nature Materials 14, 1123-1129 (2015).