Molecular wires in strong laser fields

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Recent experimental progress enabled the measurement of weak tunneling currents through molecules which are coupled by sulfur ligands to gold contacts. We present a study of the transport properties of such molecular wires under the influence of a laser field. Our approach is based on the single-particle Floquet states of the driven wire and allows even in the case of large molecules for an efficient numerical treatment beyond linear response.

In the absence of certain symmetries, the wire rectifies the laser-induced current resulting in a non-zero average current even if no voltage is applied [1]. We find that the current saturates as a function of the wire length such that already a relatively short wire can mimic the behavior of an infinite system. Thus, molecular wires enable to study the behavior of (strictly periodic, thus infinite) coherent quantum ratchets. As a second class of application, we discuss the possibility to suppress in the presence of an external voltage the resulting current by the laser field [2]. These phenomena enable a coherent current control by oscillating fields.

[1] J. Lehmann, S. Kohler, P. Hänggi, and A. Nitzan, Phys. Rev. Lett. **88**, 228305 (2002); cond-mat/0208404.
[2] J. Lehmann, S. Camalet, S. Kohler, and P. Hänggi, cond-mat/0208404.