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Light controlled dynamics of charge carriers

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Laser pulse driven currents in solids provide a wide variety of promising possible applications. For moderate intensities, if the photon energy of the laser pulse is not close to the band gap, the interband transitions can be neglected, although it can modify the current carried by conduction band electrons. We focus on this intensity range. These currents can easily be generated in metals, and by measuring their time integral (i.e., the charge transferred by the laser pulse), the phenomenon can be useful for detection purposes. For the sake of simplicity, we consider a one-dimensional (1D) model. We consider an electron interacting with a periodic potential that represents a crystalline solid. The energy eigenstates of the system can be written in Bloch-form, i.e., as a product of a plane wave and a lattice periodic function. In order to concentrate on the physical phenomena described above, we restrict our investigation to the conduction band. In this case, the Bloch states are bare plane waves, as it is often assumed in transport theory. While the quantum mechanical state generated by the external pulse from the initial plane wave can be computed by numerical methods, the determination of the extra charge transferred by the laser pulse for long time scales lead to numerical optimalization difficulties. We show that this problem can be handled using an analytical approach which reduces the computational costs and gives an exact formula for the transferred charge.

Biography

István Magashegyi is a PhD Student at the Department of Theoretical Physics, University of Szeged. He is the First Author of a paper and has already presented several posters on international conferences.

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