A Purely non-Markovian Charge Transfer from Adatoms to
1D Semiconductor Superlattice

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Abstract

Instability of an excited electron in adatoms attached to one-dimensional semiconductor suplerlattice is theoretically analyzed. We found several "bound states in continuum," i.e., stable states of the electron for multi-adatom systems, such as a two-adatom case discussed in this seminar, even in the case where the value of the energy of the electron overlaps with a continuous spectrum in the energy mini-band of the superlattice.

Furthermore we found that anti-symmetric states of the electron may decay obeying purely power-law (i.e., purely non-Markov decay, since there is no exponential decaying component) when the energy of the electron is located near the edge of the mini-band. In this non-Markov process, there appear two qualitatively different schemes; one is the far-long time zone, decaying with $t^{-3/2}$ law, and the other is the near-long time zone, decaying with $t^{-1/2}$ law. One scheme switches to the other around the time scale of $t \sim g^{-6}$, where g is a coupling constant of the electron state in the adatom to the mini-band state in the supperlattice. There is an interesting mathematical analogy of these two different time-dependent schemes to the well-known two different space-dependent schemes, i.e., van der Waals' near zone and Casimir-Polder's far zone in the photon dressing of atoms.