A linearised model of quantum transport in the asymptotic regime of quantum wells

Andrea Mantile

Laboratoire de Mathématiques, Université de Reims - FR3399 CNRS,
Moulin de la Housse BP 1039, 51687 Reims, France

e-mail: andrea.mantile@univ-reims.fr

The effects of the local accumulation of charges in resonant tunnelling heterostructures have been described using 1D Schrödinger-Poisson Hamiltonians in the asymptotic regime of quantum wells (see e.g. in [4], [6]-[7]). Taking into account the features of the underling physical system, the corresponding linearised model is naturally related to the adiabatic evolution of shape resonances on a time scale which is exponentially large w.r.t. an asymptotic parameter 'h'. In our framework, h fixes the quantum scale of the model and is assumed to be small. According to the complex deformation method (see [3] for details), a possible strategy to investigate our adiabatic problem consists in using an exterior complex dilation to identify the resonances with the eigenvalues of the corresponding complex deformed operator. Then, the adiabatic evolution problem for a sheet-density of charges can be reformulated using the deformed dynamical system which, under suitable initial conditions, is expected to evolve following the instantaneous resonant states.

After recalling the main technical difficulties related to this approach, we introduce a modified model where h-dependent artificial interface conditions, occurring at the boundary of the interaction region, allow to obtain adiabatic approximations for the relevant resonant states, while produce a small perturbation on the dynamics (see [2] and [5]). According to these results, we finally suggest an alternative formulation of the adiabatic problem and give an aposteriori justification of our method by considering the explicitly-solvable case presented in [1].

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