MING MEI, Champlain College and McGill University

Stationary Solutions to Hybrid Quantum Hydrodynamical Model of Semiconductors in Bounded Domain

In this talk we consider a hybrid quantum hydrodynamic model (H-QHD) of semiconductors. First of all, taking into account the quantum effects in the semiconductor device, we derive a new model called the hybrid quantum hydrodynamic model coupled with the Poisson equation for electric potential. In particular, we write the Bohm potential in a revised form. This new potential is derived heuristically assuming that the energy of the electrons depends on the charge density n and on ∇n just in a restricted part of the device domain, whereas the remaining parts are modeled classically. Namely, the device is designed as some part with the quantum effects and some part without the quantum effects. The main target is to investigate the existence of the stationary solutions for the hybrid quantum hydrodynamic model. In order to do so, by the Leray-Schauder fixed point theorem, we first show the existence and uniqueness of weak solutions for the case that the quantum effect can be small but never zero. Further we prove that solution to the fully hybrid problem (obtained assuming that the quantum effect may disappeared in a given part of the domain), can be obtained as limit solution of a class of H-QHD equations, for variable, but non zero, quantum effects. Finally, we carry out some numerical simulations for different devices, which also confirm our theoretical results.

This is a joint work with F. Di Michele, B. Rubino and R.Sampalmieri