Project: Holes in semiconductor nanostructures

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Description of the group

This project will be carried out in the condensed matter theory group. The CMT group performs theoretical and computational research in the area of mesoscopic physics and nanophysics. For more info, see www.cmt.ua.ac.be.

To understand the optical properties of semiconductors, we have to know the electronic band structure. Knowing the initial and final states of the electrons, we may calculate the optical absorption using Fermi’s golden rule. Many phenomena in semiconductors involve low energy carriers only. The lowest excitations correspond to promoting electrons from the top of the valence band to the bottom of the conduction band, creating two types of charge carriers, electrons in the conduction band and holes in the valence band. For such phenomena it is sufficient to know the band structure at the band extrema. The first goal of this project is to introduce the k.p method which is a model to describe the band structure of semiconductors near the band edges. As a next step, we want to investigate how the electronic properties (especially the holes) develop in a nanostructure. Therefore we will apply the effective mass approximation on the k.p model. The final goal of this project is to realize a computer code that calculates the hole energy states in a quantum well and a quantum wire.

Typical atomic force microscopy (AFM) image of an uncapped InAs/InP QWRs grown by MBE on an InP(001) substrate (from L. Gonzalez et al., APL 76, 1104 (2000).