Universität Basel

Publication

Anisotropic g factor in InAs self-assembled quantum dots

We investigate the wave functions, spectrum, and g-factor anisotropy of low-energy electrons confined to self-assembled, pyramidal InAs quantum dots (QDs) subject to external magnetic and electric fields. We present the construction of trial wave functions for a pyramidal geometry with hard-wall confinement. We explicitly find the ground and first excited states and show the associated probability distributions and energies. Subsequently, we use these wave functions and 8-band kappa center dot p theory to derive a Hamiltonian describing the QD states close to the valence band edge. Using a perturbative approach, we find an effective conduction band Hamiltonian describing low-energy electronic states in the QD. From this, we further extract the magnetic field dependent eigenenergies and associated g factors. We examine the g factors regarding anisotropy and behavior under small electric fields. In particular, we find strong anisotropies, with the specific shape depending strongly on the considered QD level. Our results are in good agreement with recent measurements and support the possibility to control a spin qubit by means of g-tensor modulation.