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Valence Band Spin-Splitting of GaAs in a Magnetic Field[1]
XINGYUAN PAN, GARY SANDERS, CHRISTOPHER STANTON, University of Florida, SOPHIA HAYES, Washington University in St. Louis — We present calculations of the conduction and valence band Landau levels in bulk GaAs in a magnetic field. Our calculations are based on the 8-band Pidgeon-Brown model. Energy is accurate up to one meV. The wave functions for each Landau level and magnetic field are given in terms of linear combinations of the 8 basis states. We show that the conduction band and the spin-orbit split-off band can be treated as almost pure states without significant band mixing. However, the heavy-hole and light-hole bands are strongly mixed even for a small Landau level quantum number and at small magnetic fields. This mixing between heavy-hole and light-hole states gets stronger at higher magnetic fields. As a result, there are multiple optical transitions between a given valence band state and conduction band state even within a single Pidgeon-Brown manifold. We calculate the magneto absorption spectra, the magnetic circular dichroism and the optically pumped NMR signal as a function of magnetic field within Fermi's golden rule approximation. Comparison with experiment allows an accurate determination of the spin-split valence band structure.

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