

THE WIGNER FUNCTION FOR THERMAL EQUILIBRIUM OF A TWO-BAND SEMICONDUCTOR DEVICE.

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In his 1932 paper, [1], E. Wigner obtained the quantum correction of order \hbar^2 to the classical thermal equilibrium for a standard one-particle Hamiltonian. In this pioneering work, the celebrated *Wigner function* was introduced for the first time and it was shown that, in thermal equilibrium, it is given by a classical Maxwellian plus a term of order \hbar^2 (explicitly calculated) plus higher order terms.

Our aim is to calculate the (two-band) Wigner function, [2], for thermal equilibrium, in the case of a $k \cdot P$ Hamiltonian, [3]. This kind of Hamiltonian is of importance in two-band semiconductor modeling [4]. Since Wigner’s original method seems to be too difficult to be handled in this framework, we use an alternative approach, based on the so-called *Bloch equation* for the equilibrium function. This method allows us to recover Wigner’s results in a fairly simple way and to extend them to the two-band case. We find that, in such case, the \hbar^0 -order term is given by two Maxwellians, one in each band, without band coupling, and that there is a non-vanishing \hbar^1 -order correction.

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