11. Physica 107A (1981) Pages 587 - 597

Wigner Representation of Bloch Electrons in Uniform Fields

A. Jannussis, **A. Streklas** and K. Vlachos

Department of Theoretical Physics, University of Patras, Patras, Greece

Abstract

In this paper we calculate the Wigner distribution function and the partition function of Bloch electrons in uniform electric and magnetic fields with the help of the effective Hamiltonian,

$$\mathcal{H}(\vec{k},\vec{q}) = \mathcal{E}\left(\vec{k} - \frac{e}{\hbar c}\vec{A}(\vec{q})\right) - e\vec{E}\cdot\vec{q}.$$

We calculate the magnetic and the electric susceptibilities. Using standard techniques of operator ordering, the quantities are calculated in a manner which shows the exact contribution of the electric field to the magnetic susceptibility.

We find also the exact partition function of Bloch electrons in a uniform electric field, in the case of simple cubic lattice with the following despersion law

$\mathcal{E}(\vec{k}) = \epsilon\left[\cos\left(a_1k_1\right) + \cos\left(a_2k_2\right) + \cos\left(a_3k_3\right)\right]$.

$$Z(b) = \prod_{i=1}^{3} I_0\left(\epsilon\frac{\sinh\left(beE_ia_i/2\right)}{eE_ia_i/2}\right)$$

I_0 is the modified zeroth-order Bessel function.