ON THE QUANTUM-KINETIC EQUATION FOR A SYSTEM OF CHARGED PARTICLES OF MANY KINDS

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By the method of Bogoliubov[1,2] one can obtain a natural generalization of the quantum-kinetic equation for the description of stochastic processes in a system of charged particles in which the particles belong to an arbitrary number $M \geq 2$ of different kinds. If in the spatially homogeneous case (cf. Ref. 3) one substitutes into the quantum equation for the distribution function $F_a(p; t)$ of any single chosen particle of type a the solution of the system of quantum equations for the quantum correlation-deviation functions g_{ab}, then one can obtain the quantum-kinetic equation for the plasma of many kinds of particles. Since, however, the determination of the exact solution for the functions g_{ab} is a difficult task, it is expedient to introduce the simplifying assumption that the Coulomb and exchange interactions are weak and that the chosen particle exerts only a small reaction influence on the behavior of the large number of charged particles surrounding it. With these assumptions, since an exchange interaction is possible only between particles of the same kind, we find

$$\frac{\partial w_a(p;\ t)}{\partial t} = \sum_{(1\leqslant b\leqslant M)} \frac{2\pi n_b}{(2\pi\hbar)^6\hbar} \int \left\{ \frac{\nu_{ab}(|p-p'|/\hbar)\,\nu_{ab}(|p'-p|/\hbar)}{1+B_{ab}((p'-p)/\hbar;\ (p+p')/2)} \right.$$
$$\left. \pm \frac{\nu_{ab}(|p-p_1'|/\hbar)\,\nu_{ab}(|p'-p_1|/\hbar)}{1+B_{ab}((p-p_1')/\hbar;\ (p_1'+p)/2)} \right\} \delta(p+p_1-p'-p_1')$$
$$\times\,\delta(E_a+E_{1,b}-E_a'-E_{1,b}') \qquad (1)$$
$$\times[(1\pm n_a w_a(p;t))(1\pm n_b w_b(p_1;\ t))\,w_a(p';\ t)\,w_b(p_1';\ t)$$
$$-(1\pm n_a w_a(p';\ t))(1\pm n_b w_b(p_1';\ t))$$
$$\times\,w_a(p;\ t)\,w_b(p_1;\ t)]\,dp_1\,dp'\,dp_1' + \delta R_a.$$

Here

$$w_a(p;t) = \frac{(2\pi)^3}{v} F_a(p;t);\quad E_a = \frac{p^2}{2\mu_a};$$
$$\nu_{ab}(|k|) = \int e^{ikq}\,\Phi_{ab}(|q|)\,dq; \qquad (2)$$
$$B_{ab}(k,\ p) = \left|\,\mathrm{Re}\, i \sum_c n_c \frac{\nu_{cc}(|k|)}{(2\pi)^9\,\hbar^4} \iint_0^\infty [e^{i\hbar k\tau/2} - e^{-i\hbar k\tau/2}]\right.$$
$$\left.\times \exp\{i\theta k(p'/\mu_b - p/\mu_a) + i\tau(\eta-p')\}\,w_b(\eta)\,d\theta\,d\tau\,d\eta\,dp'\,\right|;$$

n_c, μ_c are the concentration and particle mass of the particles of type c in the plasma, c = 1, 2, . . . , M; v is the average volume per particle; and δR_a, a term taking into account the actions on each other of the set of neighboring particles, can be approximately evaluated by a method analogous to that used in Ref. 4.

For heterogeneous systems of large numbers of charged particles obeying the Fermi statistics, under conditions of complete degeneracy the approximate expression for the screening coefficient B_{ab} takes the form

$$B_{ab}(k,\ p) = \frac{1}{r_D^2 k^2} + \frac{1}{2r_D^2 k^2}\left(\frac{\mu_b \mathbf{kp}}{\mu_a k p_0}\right) \ln\left|\frac{1-\mu_b\mathbf{kp}/\mu_a k p_0}{1+\mu_b\mathbf{kp}/\mu_a k p_0}\right|. \qquad (3)$$

Here $r_D = (p_0^2 v/12\pi\mu_b \sum_c n_c e_c^2)^{1/2}$ is the Debye radius for the distribution of the Fermi particles of type b, p_0 is the average upper limit momentum for the system of many kinds of particles, and e_c is the charge of a particle of type c in the plasma.

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99

THE MAGNETIC SUSCEPTIBILITY OF A UNIAXIAL ANTIFERROMAGNETIC

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In a large number of papers,[1] the high frequency magnetic susceptibility of an antiferromagnetic is found by using the concept of the precession of the