radius of the electron orbits. It turns out that the equilibrium electron distribution is the same as the distribution, f_0, in the absence of the sound waves. The electron distribution $f = f_0 - \chi(\partial f_0/\partial\epsilon)$ and the electric field $\mathbf{E}$ are determined by the kinetic equations

$$(1/\tau + i\omega - ikv\sin\theta\sin\varphi)\chi - (v/R)\,\partial\chi/\partial\varphi - \overline{\chi}/\tau$$
$$- ev(E_x\sin\theta\cos\varphi + E_y\sin\theta\sin\varphi + E_z\cos\theta) = 0 \quad (1)$$

and the electromagnetic field equations

$$E_x = (4\pi is^2/\omega c^2)\,j_x,$$
$$E_z = (4\pi is^2/\omega c^2)\,j_z, \quad E_y = (4\pi is/\omega)\,\rho. \quad (2)$$

where

$$\rho = (3Ne/mv^2)\,\overline{\chi}, \quad \overline{\chi} = \int \chi d\Omega/4\pi, \quad (3)$$

$$j_x = (3Ne/4\pi mv)\int \chi\sin\theta\cos\varphi d\Omega - Neu_x, \quad (4)$$

$$j_z = (3Ne/4\pi mv)\int \chi\sin\theta\sin\varphi d\Omega - Neu_z, \quad (5)$$

s is the velocity of sound, $\mathbf{u}$ the velocity of the atoms in the lattice, N the number of atoms (and electrons) per cm^3. The field $\mathbf{H}$ is directed along the z axis and the wave vector $\mathbf{k}$ is along the y axis. A solution of Eq. (1) is

$$\chi = \frac{eR\exp(2\pi R/l')}{\exp(2\pi R/l') - 1}\exp(ikR\sin\theta\cos\varphi)$$
$$\times\int_0^{2\pi} d\psi\,[E_x\sin\theta\cos(\varphi+\psi)$$
$$+ E_y\sin\theta\sin(\varphi+\psi) + E_z\cos\theta + \overline{\chi}/el]$$
$$\times\exp[-R\psi/l' - ikR\sin\theta\cos(\varphi+\psi)], \quad (6)$$

where $l' = v\tau/(1+i\omega\tau)$. Making use of (2) and (3) we find $\overline{\chi}/el \ll E_y$. The discussion below will be confined to the case when $l \gg R$.

We consider waves polarized parallel to the field H ($u_x = 0$). From (5) and (6) we obtain

$$j_z = A\sigma E_z - Neu, \quad (7)$$

where

$$\sigma = Ne^2\tau/m,$$
$$A(z) = 6z^{-1}\left[(1+z^{-2})\int_0^z J_0(t)\,dt - J_1(z) - z^{-1}J_0(z)\right],$$
$$z = 2kR. \quad (8)$$

Substituting in (2) we obtain

$$E_z = mu/e\tau(A + iB), \quad (9)$$

where $B = \omega c^2/4\pi s^2\sigma$. Calculation shows that $B \ll A$ for $\omega < 10^8\ \mathrm{sec}^{-1}$.

In one second the lattice loses an amount of energy

$$\dot{Q} = {}^1/_2\,\mathrm{Re}(NeuE_z), \quad (10)$$

and the absorption coefficient is

$$\gamma = 2\dot{Q}/NMu^2s = m/Ms\tau A, \quad (11)$$

where M is the atomic mass.

If the sound waves are polarized perpendicular to the field ($u_z = 0$), then in this expression A_1 must be substituted for A, where

$$A_1(z) = {}^3/_2\,z^{-1}\Big[(1+3z^{-2})\int_0^z J_0(t)\,dt$$
$$- 3J_1(z) - 3z^{-1}J_0(z)\Big]. \quad (12)$$

From Eqs. (8), (11), and (12) it follows that $\gamma(H)$ has a succession of maxima. Their position is not, however, determined by the simple conditions indicated by Pippard[4] and Steinberg.[5]

In conclusion I would like to thank V. P. Silin, under whose direction this work was carried out.

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FREE ENERGY OF STRONG ELECTROLYTES

A. A. VEDENOV

Moscow State University

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THE diagram technique, developed by the author[1] to calculate the paired correlation function in classical statistical physics, was used to determine the free energy of a strong electrolyte, i.e., of a system of charged particles which is neutral as a whole, in which the interaction potential of the particles $V(x)$ behaves arbitrarily at small distances (and corresponds to a repulsion of particles) and goes at large distances into the pure Coulomb potential $Z_1Z_2e'^2/r$ (where $e' = e/\sqrt{\epsilon}$) for particles with charges Z_1 and Z_2 in a medium with dielectric constant ϵ.

The calculation is carried out under the assumption that the radius of the short-distance repulsion forces r_0 and the averaged scattering amplitude e'^2/T in the Coulomb field e'^2/r are considerably smaller than the average distance between particles $\bar{r} = \nu^{-1/3}$. These conditions signify that the system is close to ideal, i.e., the correction to the free energy, due to the interaction, are small compared with the free energy of the ideal gas. It was also assumed that the probability of molecule formation is small and the contribution of molecules to the free energy of the system can be neglected. The electrolyte was assumed to consist of two types of particles with charges Z_1 and Z_2.

The expression used for the paired correlation function was that given in reference 1 (correct for distances $|\mathbf{x}| \gg e^2T$), and was "joined," at distances much smaller than the Debye radius, with the expression $\exp\{-\beta V(\mathbf{x})\}$ for the correlation function at small distances.

With all the foregoing conditions satisfied, the free energy of a strong electrolyte is an expansion in the particle density ν, given, with accuracy to terms up to the second power in ν inclusive, by the following formula (for the free energy per unit volume):

$$F = F_0 - \frac{T\varkappa^3}{12\pi} + \lim_{R\to\infty}\Big\{-2\pi T\int_0^R r^2 dr \sum_{\alpha\beta} \nu_\alpha \nu_\beta \left(e^{-\beta V_{\alpha\beta}(r)} - 1\right) + \frac{T\varkappa^4}{16\pi} R - \frac{\pi}{3}\beta^2 e'^6 \left(\sum \nu Z^3\right)^2 \ln \varkappa R\Big\} + \pi\beta^2 e'^6 \left[\left(\sum \nu Z^3\right)^2 \frac{1}{3}\left(C - \ln 3\right) - \sum \nu Z^2 \sum \nu Z^4\right], \quad \varkappa = \sqrt{4\pi\beta e'^2 \sum_\alpha \nu_\alpha Z_\alpha^2}. \tag{1}$$

Here F_0 is the free energy of an ideal gas, κ is the reciprocal of the Debye radius, ν_α and Z_α are the density and charge of particles of type α, $\beta = 1/T$ is the reciprocal of the temperature, and C is Euler's constant. The summation in (1) is by particle type.

We note that the expression obtained in reference 2 for the free energy F for the case of charged ideally-hard spheres is incorrect, since the expression used there for the paired correlation function is inaccurate, and, furthermore, the limit for the case of ideally hard spheres was approached incorrectly, and as a result the contribution of the non-electric (i.e., repulsive short-range) forces to the free energy was lost.

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ON THE POSSIBLE MULTIPLE PRODUCTION OF MUONS

I. L. ROZENTAL'

P. N. Lebedev Physics Institute, Academy of Sciences, U. S.S.R.

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IN a study of the curve of the spreading of shower μ mesons of very high energy ($\sim 10^{12}$ ev) Barrett and others[1] observed a remarkable break in the curve at small distances ($\sim 1-2$ m) between the counter systems used for the measurements. This break was at once interpreted as an indication of two different processes. In the opinion of the authors of the paper in question multiple production of μ mesons from the decay of π mesons is responsible for the coincidences at large distances ($> 1-2$ m), whereas the sharp rise in the number of coincidences at small distances is due to local showers in the earth (the thickness of earth in these experiments was 1600 m water equivalent). The latter conclusion was based on the following chain of argument: the production of μ mesons in the air should occur at distances of about a nuclear range from the boundary of the atmosphere, which means a height of about 10 km. Consequently, the angle of divergence of the particles responsible for the rise of the spreading curve is $\sim 10^{-4}$ rad. If we assume that when a primary particle makes a collision the secondaries are distributed isotropically in the center-of-mass system, such values of the angle correspond to primary particle energies of the order of 10^{17} ev, which considerably exceeds the observed value of the energy of the showers accompanying the μ mesons ($\sim 3 \times 10^{15}$ ev). Therefore the authors of reference 1 reject the "air hypothesis" of the origin of the break. In the light of the latest data such an argument does not seem convincing, since it has now been established (see, e.g., reference 2) that the angular distribution in the center-of-mass system is aniso-