1. INTRODUCTION

When considering a system of charged particles, the field generated by them is often called the microfield to distinguish it from external fields. Distribution of such microfields, depending on the analyzed system, can determine a manifold of different system characteristics such as displacements and widening of atomic spectra, cross-sections of particle collisions, etc. Thus, knowledge of the characteristic behavior of the microfield distribution (asymptotic forms, existence of extremums) for concrete systems can turn out to be useful for investigating different physical phenomena occurring in them.

In an elementary case of an infinite system of charged particles, which are uniformly distributed in space, an exact analytical solution for determining the microfield distribution function was found by Holtsmark as early as in 1919 [1]. In this solution it is assumed that the particles are distributed independently (the correlation between them being zero) and their temperature tends to infinity (correspondingly, the plasma coupling parameter $\Gamma = U_{pol}/E_{kin}$ is zero).

The Holtsmark distribution is described by the expression

$$H(u) = \frac{2}{\pi u} \int_0^\infty \sin t \exp \left(-t/u\right)^{3/2} dt,$$

where $u = E/E_H$ is the normalized microfield value, $E$ is the microfield absolute value, $E_H$ is the so-called Holtsmark microfield equal to $2\pi(4/15)^{2/3}qn^{2/3}$ (here, $n$ is the particle density and $q$ is the particle charge).

It should be noted, that distribution (1) reaches its maximum at $u \approx 1.607$ and has the following asymptotics:

$$H(u) = \begin{cases} 4u^2/3\pi + O(u^3), & u \to 0 \\ (15/8)(2/\pi)^{1/2}u^{-5/2} + O(u^{-4}), & u \to \infty. \end{cases}$$

Note that the distribution of the microfield generated by two types of independently and uniformly distributed particles with identical charges is similar to that of the microfields corresponding to each type separately, i.e., according to Holtsmark.

The described distribution is an important but, however, too simplified and unrealizable model; that is why many attempts to improve it have been made. The researchers who have solved this problem used (to this or that extent) the Fourier-image of the distribution function; different approximated analytical expressions have been obtained for it and the sought function was then found using numerical integration [2–6]. At that, two-component electron-ion plasma was of particular interest. The characteristic field of this plasma can be divided into the following two components:

(i) a high-frequency component whose time variations are attributed to electron motion and which is thus determined by the total electron field;

(ii) a low-frequency component which is attributed to ion motion and which consists of the ion fields screened by electron clouds.

The approximate solutions that take into account pair interparticle correlations and are valid within a wide range of the plasma coupling parameter $\Gamma$ were found for each of these components. These distributions are valid for a sufficiently large plasma bulk where the boundary effect can be neglected. If we con-


2. CHARACTERISTIC FEATURES OF THE MICROFIELD DISTRIBUTION FUNCTION IN AN ION CLUSTER

Let us consider two types of spherical clusters. The first type comprises the clusters with the particles randomly distributed over the volume, the field of each particle being \( E = q/r^2 \). In this case, the distribution function is obtained by averaging over particle position samplings. The second type comprises equilibrium configurations of particles which interact according to the Coulomb law and are in the external parabolic potential. Such configurations with a small number of ions (from 4 to 20) were considered in [9] where it was shown that, for the number of particles \( N \leq 11 \), all the ions are positioned near the cluster surface and form one coating. At \( N > 11 \), a structural transition in the clusters is possible. At that, a greater number of coatings with different radii can appear with an increase in the ion number. The existence of such coatings should affect the distribution function, namely additional maxima should appear. The below dependences for the clusters with the particle numbers larger than 11 correspond to one particular equilibrium configuration since the authors of this paper did not intend to study all distribution functions for each equilibrium particle configuration and analyzed only general peculiarities of these functions.

From the physical point of view the considered clusters correspond to fragments of a solid and condensate drops which, as have already been mentioned above, can be formed in the process of laser evapora-