RELAXATION OF BACKGROUND ELECTRONS AND IONS IN DUSTY PLASMAS

Yu. I. Chutov.
Faculty of Radio Physics, Taras Shevchenko Kiev University,
Volodymyrs'ka Str. 64, 252017 Kiev, Ukraine

Plasmas with micrometer or submicrometer size dust particles observed in space plasmas, as well as in many laboratory and technological devices, have been intensively investigated in recent years. These dust particles can strongly influence the plasma properties because of the large charge as well as the dynamics of this charge.

This paper consist of a discussion of numerical investigation results of relaxation phenomena in dusty plasmas with taking into account the charge dynamics of dust particles without the assumption on equilibrium electrons and ions. A collection of background electrons and ions by dust particles have been taking into account in the framework of the modified PIC method, the Coulomb collisions have been simulated in the framework of the method of stochastic differential equations or the Monte-Carlo method.

The obtained results show that the electron and ion energy distribution functions as well as plasma parameters change strongly during the plasma relaxation due to a selective collection of electrons and ions by dust particles with a self-consistent negative charge. The peculiarities of these changes are caused by a dependence of this collection on energy of electrons and ions.

Computer modeling of relaxation phenomena in some dusty crystals shows also an essential influence of a collection of electrons and ions by dust particles on these phenomena. Relaxing background electrons and ions can be non-ideal components of these dusty crystals due to a self-consistent electric potential even in the case if an initial number of electrons and ions in the Debye cube is essentially more one. Besides, electron and ion velocity distribution functions can be strongly non-equilibrium in such plasmas due to a selective collection of electrons and ions by dust particles. Spatial distributions of background electrons and ions around dust particles can be strongly non-uniform so that some sandwich structure of a space electric charge can be realized.

Previous results of these investigations were published in [1-11].

References

1. Chutov Yu.I. et al. Ukrainian Journal of Physics. - 1997. - V.42, No 8. - P. 996-1015.
2. Chutov Yu.I. et al. 24th EPS Conference on Contr. Fusion and Plasma Phys., Berchtesgaden, Germany, 1997. Abstracts of Invited and Contributed Papers, p.401.
3. Chutov Yu.I. et al. Ibid, p.402.
4. Chutov Yu. I. et al. Proceedings of XXIII ICPIG, July 1997, Toulouse, France, V.5, p.V.64.
5. Chutov Yu.I. et al. J.Plasma Phys.- 1996.- V.55, part 1.- p.87.
6. Sytenko O.G.et al. Plasma Phys. and Contr. Fusion. - 1996.- V.38, No 12a.- p.A105.
7. Chutov Yu. et al. Physica. - 1996. - V.B128. - pp.11-20.
8. Chutov Yu.I. et al. In: Double Layers - Potential Formation and Related Nonlinear Phenomena in Plasmas. Edited by SENDAI "Plasma Forum" Tohoku University Sendai 980-77, Japan. Published by World Scientific Publishing Co. Pte. Ltd, Singapure 9128, p.419-428.
9. Chutov Yu.I. et al. Abstr. Proc. Intern. Conf. Physics of Dusty Plasmas, 1996, Goa, India., p.93
10. Chutov Yu.I. at al. Proc. Intern. Conf. Plasma Phys., Sept. 1996, Nagoya, Japan. V.2, p.1970.
11. Chutov Yu.I. et al. 23rd EPS Conf. Contr. Fusion Plasma Phys., 1996, Kiev, Ukraine. Pt III, p.1183.