Nonlinear wave processes during the interaction of Earth’s magnetotail with the dusty plasma near the surface of the Moon

1,2Morozova T.I., 1,2Popel S.I.

1Russian Space Research Institute, Russian Academy of Sciences, Moscow, Russia,
 timoroz@yandex.ru
2Moscow Institute of Physics and Technology, Dolgoprudnyi, Moscow oblast, Russia

Wave processes in the Earth's magnetotail plasma during the interactions with the dust near the surface of the Moon are considered. It is shown that the excitation of waves is possible for photoelectron parameters characterized by a quantum yield of the lunar regolith from the paper [Willis R.F., Anderegg M., Feuerbacher B., Fitton B. // Photon and Particle Interactions With Surfaces in Space, ed. by R.J.L. Grard, D. Reidel, Dordrecht (1973), p. 389]. Ion-sound waves are excited in the magnetosheath and/or boundary layer of the magnetosphere as a result of linear hydrodynamic instability, while dust acoustic waves are generated due to the development of a linear kinetic instability in the entire region of the magnetotail plasma during the interactions with the lunar dust. In both the situations, the development of the instabilities is caused by the relative motion of magnetospheric ions and charged dust particles. The processes of ion-acoustic and dust acoustic turbulence are described. Ion-acoustic turbulence is considered from the viewpoint of strong turbulence, whereas to describe dust acoustic turbulence, we use the weak turbulence theory. The wave energy densities, the effective collision frequencies, and the electric fields appearing in the system are determined for the cases of ion-acoustic and dust acoustic turbulences. It is shown that the development of ion-acoustic turbulence in dusty plasma system near the Moon is accompanied by the excitation of the electric fields several smaller than the electric fields arising due to the process of charging of the surface of the Moon during its interaction with the solar radiation. Nevertheless, the electric fields appearing due to the development of ion-acoustic turbulence are important to establish an adequate picture of the electric fields on the Moon. The resulting effective collision frequencies should be considered in the hydrodynamic equations for dusty plasma ions with taking into account its turbulent heating.

The work is supported by the Program No. 9 of the Presidium of RAS "Experimental and theoretical studies of objects of the Solar System and the planet systems of stars'', by the Program of the International Space Science Institute “Dusty Plasma Effects in the System Earth-Moon”, and by the RFBR (project № 15-02-05627-a).