Ion-neutral collisions and dust grain charging in the presence of electromagnetic radiation in the Earth's Ionosphere

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Ion–neutral collisions in dust particle charging process in the presence of electromagnetic radiation in Earth's "dusty" ionosphere are taken into account. These collisions can result in a charge exchange between a fast ion and a slow neutral. The slow neutrals become slow positively charged ions which interact effectively with positively charged dust grains. As a result a microscopic ion current on the dust grains decreases in comparison with the case when ion–neutral collisions are not taken into account in the dust grain charging process. The microscopic ion current on the positively charged dust grains is derived. A condition on neutral density is obtained for which the influence of ion–neutral collisions on dust particle charging process is important. It is shown that the effect of ion–neutral collisions should be taken into account when considering the charging of nano- and microsize dust grains in Noctilucent Clouds, Polar Mesosphere Summer Echoes, meteoritic dust, active geophysical rocket experiments such as Fluxus 1 and 2. We discuss also the effect of electrons with energies of the order of 1 eV which are produced as a result of photoelectric effect during the charging process, which can result in an increase of the electron temperature in plasmas. The most important effect resulting in cooling of such electrons is that of electron–ion collisions. We found a condition on the neutral density when the electron temperature in Earth's "dusty" ionosphere can become of the order of 1 eV. The importance of this effect for ionospheric plasmas is discussed.