Photoelectron distribution function over the illuminated part of the Moon

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At the daytime the surface of the Moon is charged under the action of the electromagnetic radiation of the Sun, solar-wind plasma, and plasma of the Earth's magnetotail. The surface of the Moon and dusts levitating over the lunar surface interact with solar radiation. They emit electrons owing to the photoelectric effect, which leads to the formation of the photoelectron layer over the surface. Here, using the Vlasov equation we determine the photoelectron distribution function over the lunar dayside.

The photoelectron emission is due to the solar vacuum ultraviolet (VUV) radiation. During the 11–year solar cycle the amount of radiated VUV energy changes significantly, that results in a significant variation in the photoelectron current. Here, we present the results of our calculations for three different solar activity conditions. These are the solar minimum, solar maximum, an X28 class solar flare event. Furthermore, we discuss the dependence of the photoelectron distribution function on the photoelectric yield and the work function of the lunar regolith.

The largest contributions to the distribution function are shown to be due to photon energies in the vicinity of the work function (typically from 5 to 6 eV) and in the photon energy range corresponding to H Lyman-alpha line of the solar radiation spectrum (10.2 eV). The existence of these ranges results in an appearance of two groups of the photoelectrons. The first one (corresponding to the photon energies close to the work function) is characterized by large photoelectron number density and small electron temperature, while the second one (corresponding to the photon energies close to 10.2 eV) – by small photoelectron number density and large electron temperature.

The steady-state photoelectron distribution functions (over the lunar dayside far from the terminator) are isotropic in the momentum-space. Thus they are stable. However, at the daytime the surface of the Moon is subjected to the action of the solar wind. The relative motion of the solar wind with respect to the ambient dusty plasma results in the excitation of waves over the lunar surface.

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