The effect of high energy photoelectrons on the structure of photoelectric sheath and dynamics of dust grains in the sheath

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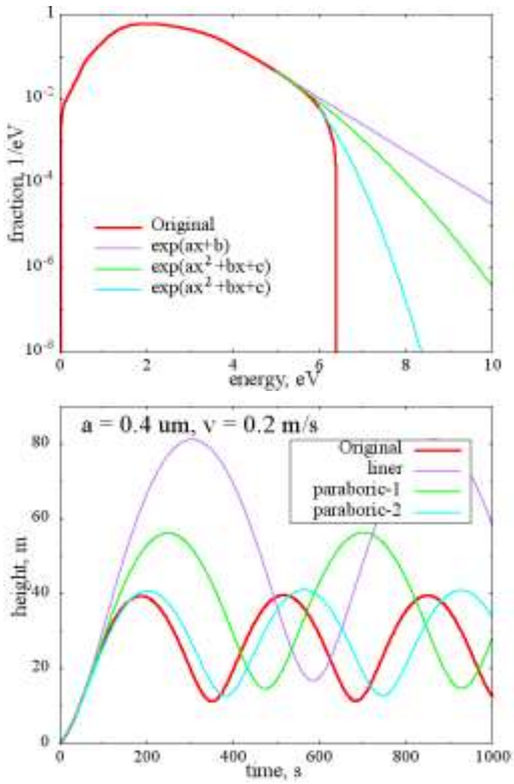
When an air-less body's surface is irradiated from solar UV photoelectrons are emitted. Although each photoelectrons eventually comes back to the surface due to electrostatic force from the positively charged surface, static electric field is formed above the surface. The layer which contains photoelectrons is called a photoelectric sheath. The thickness and vertical structure of the photoelectric sheath is decided by the energy distribution function of photoelectrons. The energy distribution function of photoelectrons depends on the composition of surface layer, however, there are one and only one study on the energy distribution function of photoelectrons emitted from astronomically relevant material [1]. We showed that the energy distribution function of photoelectrons obtained from laboratory experiments had been used inadequately in the previous studies [2]. Although the energy distribution function was experimentally measured for integrated value only in the emission angle from the normal to the surface to about $\pi/4$ [1], some of previous studies used the energy distribution function as a vertical component and others assumed the Maxwellian energy distribution function for photoelectrons using the mean energy obtained from the laboratory experiment. Thus we developed a new analytical method to calculate an angle-resolved velocity distribution function of photoelectrons from the energy distribution function of photoelectrons obtained from laboratory experimental [2].

We omitted the high energy (> 6 eV) component of photoelectrons in the previous work [2] because the fraction of high energy component was too low to be evaluated from the original figure. However, irradiation of high-energy photons to an air-less body's surface should emit photoelectrons beyond 6 eV. Indeed, the Apollo 14 charged-particle lunar environment experiment (CPLEE) on the moon revealed the presence of high-energy photoelectrons between 40 and 200 eV emitted from the lunar surface [3].

The high energy component of photoelectrons extends the photoelectric sheath above the surface. The dynamics of dust grains above the surface is known to be affected by the vertical structure of photoelectric sheath [2]. Thus in this study we extrapolate the energy distribution function of photoelectrons assuming some types of functions and investigate the effect of high energy component of photoelectrons on the vertical structure of photoelectric sheath and the dust motion in it.



Figures: Examples of extrapolated energy distribution function of photoelectrons (top) and the resunting dynamics of a dust grain launched with 0.2m/s from the surface of Eros (bottom).

References: [1] Feuerbacher et al. (1972) *GCA* 3, 2655. [2] Senshu et al. (2015) *PSS* 116, 18. [3] Reasoner and Burke (1972) *JGR* 78, 5844.