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Lunar Dust Monitor for the orbiter of the next Japanese lunar mission SELENE2

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The next Japanese lunar mission SELENE2, after a successful mission Kaguya (a project named SELENE), is planned to launch in mid 2010 and to consists of a lander, a rover, and an orbiter, as a transmitting satellite to the earth [1]. A dust particle detector is proposed to be onboard the orbiter that is planned to be in operation for one year or more.

Dust particles around the Moon include interplanetary dust, beta-meteoroids, interstellar dust, and possibly lunar dust that originate from the subsurface materials of the Moon. It is considered that several tens of thousands of tons of dust particles per year fall onto the Moon and supply materials to its surface layer. “Inflow” and “outflow” dust particles are very important for understanding material compositions of lunar surface.

In past missions, dust detectors onboard the Hiten and Nozomi (Hiten-MDC and Nozomi-MDC) measured the flues of dust particles in the lunar orbit [2, 3]. These observations by Hiten- and Nozomi-MDCs created a small dataset of statistics of dust particles excluding earth-orbiting dust once in a week, because the dust detectors had small sensitive areas, 0.01 m^2 and 0.014 m^2, respectively. The Lunar Dust EXperiment (LDEX) is designed to map a spatial and temporal variability of the dust size and density distributions in the lunar environment and will be onboard LADEE, which will be launched in 2012 [4]. LDEX will observe the lunar environment for 90 days in a nominal case or for a maximum of 9 months. It has a sensor area of 0.01 m^2 at 50 km altitude.

For a quantitative study of circumlunar dust, we propose a dust monitoring device with a large aperture size and a large sensor area, called the lunar dust monitor (LDM). The LDM is an impact ionization detector with dimensions 25 cm × 25 cm × 30 cm, and it has a large target (gold-plated Al) of 400 cm^2, to which a high voltage of +500 V is applied. The LDM also has two meshed grids parallel to the target. The grids are 90% transparent: the inner grid is 2 cm apart from the target and the outer grid is 15 cm from the target. We can deduce the mass and velocity information of the impacted dust particle from the recorded signal waveforms generated by the impacts of dust particles.

Dust particles around the Moon are classified based on their origins: interstellar dust, interplanetary dust, beta meteoroids, and possibly dust that originated on the Moon. They can be inferred from their kinematic properties: the velocities and the arrival directions. If the proportion of dust components around the Moon is determined by observation, we can increase our knowledge of the contribution of inflow and outflow dust particles to lunar surface materials.

References: [1] Matsumoto, K. et al., Joint Annual Meeting of LEAG-ICEUM-SRR (2008) LPI Contribution No.1446, 86. [2] Iglseder H. et al., Adv. Space Res. 17 (1996) 177-182. [3] Sasaki S., et al., Adv. Space Res., 39 (2007), 485-488. [4] Horanyi, M. et al., (2009) LPSC 40th, Abstract #1741.