[EE] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS03]Small Bodies in the Solar System: Current Understanding and Future Prospects

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Wed. May 23, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)
In this session, we welcome presentations regarding small bodies in the Solar System from a variety of approaches (i.e., laboratory experiments, observations, explorations, theoretical modeling, and sample analyses). Especially this year, the Hayabusa2 spacecraft is about to rendezvous with its mission target (Ryugu, C-type asteroid), and ready to make remote-sensing observations for acquiring detailed information of the primordial body. Taking account of the situation, we aim to organize our current understanding of these primordial bodies and further discussing future prospects in this research field.

[PPS03-P25]Video Observations of Faint Meteors with Tomo-e PM

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There are vastly different sizes of objects in the solar system, from the Sun, which is obviously the largest object in the solar system, to beta-meteoroids, which are small particles pushed away by radiation into interstellar space. The size distribution of small bodies in the solar system is important to understand the origin and the evolution of the solar system. Particles smaller than about 1 mm are usually referred as to interstellar dust particles (IDPs). The IDPs are rapidly (up to a few thousand years) removed by a radiation pressure or the Poynting-Robertson effect. Present activities of solar system small bodies are reflected in the size distribution of the IDPs. The IDPs in interplanetary space are, however, difficult to investigate directly, since they are too small to be observed and too sparsely distributed for in-situ investigation.

Tons of IDPs fall down to the Earth per day. Interacting with atmosphere, they lose part of their kinetic energy in a form of emission. This phenomenon is called meteor. Thus, we can derive physical parameters of single particles by investigating meteors. The size distribution of the IDPs around the Earth can be examined through the luminosity function of meteors. Fainter meteors should be observed to constrain the size distribution of smaller IDPs.

To efficiently detect faint meteors, a high sensitivity video camera with a large aperture is preferred. We have been developing a new wide-field CMOS mosaic camera, Tomo-e Gozen, for the 1.05-m Kiso Schmidt Telescope. The camera is composed of four individual camera modules, each of which is equipped with 21 CMOS image sensors. Tomo-e Gozen can monitor a sky of about 20 deg^2 continuously at up to 2 Hz. The camera will start its operation with a single module in February, 2018. A limiting magnitude of Tomo-e Gozen is expected to be about 18.5 mag. in the V-band for 0.5 s integration, corresponding to a meteor limiting magnitude of about 13 mag. in the V-band. Tomo-e Gozen mounted on the 1.05-m Kiso Schmidt Telescope will be the world-largest video camera, and thus will be an ideal facility to observe faint meteors. As a pathfinder project for Tomo-e Gozen, we have developed a prototype mosaic CMOS camera, Tomo-e PM. Tomo-e PM is equipped with 8 CMOS sensors, which has an ability to continuously obtain images of about 2 deg^2 at 2 Hz. A limiting magnitude of the Tomo-e PM is as good as of Tomo-e Gozen. Tomo-e PM is still a powerful facility to observe faint meteors.

We performed meteor observations with the Tomo-e PM mounted on the 1.05-m Kiso Schmidt Telescope. The observations were carried out on 2016-04-11 and 2016-04-14. The lunar ages were 3.6 and 6.6 on 2016-04-11 and 2016-04-14, respectively. Net observing time was about 10.6 hours in total. Tomo-e PM detected 2,220 unique meteor events. The video rate absolute magnitudes of the detected meteors ranged from 4.0 to 10.0 mag. in the V-band. The result clearly demonstrates that the Tomo-e Gozen has an ability to investigate meteors fainter than 10 mag. Since no significant meteor shower activity was reported, most of the detected meteors were expected to be sporadic meteors.

We approximate the luminosity function of meteors by an exponential distribution: $\log_{10} N(<M) = \log_{10} N_0 + M \log_{10} r$, where $N(<M)$ is the number of meteors brighter than M-th magnitude, N_0 is the number of meteors brighter than zeroth magnitude, and r is the slope of the luminosity function or the meteor index. The parameters N_0 and r were constrained by a fitting based on a statistical model. The present results suggest that r = 3.1±0.4 and $\log_{10} N_0$ =-5.5±0.5. The present results are roughly consistent with the luminosity functions obtained for sporadic meteors in literature. We have demonstrated that a wide-field CMOS camera mounted on a large telescope has advantages in observing faint meteors. With Tomo-e Gozen, we are able to efficiently investigate variations in the luminosity function of faint meteors with a sufficiently large number of samples.