

Final Scientific Programme:

August 2 (Tue)

09:45-10:30 **Morning e-poster Session**

10:30-11:00 Sei-ichiro Watanabe [Invited] [Remote] Scientific discoveries of the Hayabusa2 mission, sample return from C-type asteroid Ryugu

11:00-11:30 Dante Lauretta [Invited] [Remote] OSIRIS-REx – Status of NASA's Near-Earth Asteroid Sample Return Mission

11:30-12:00 Beth Ellen Clark [Invited] [Remote] Overview of Space Weathering on Asteroid (101955) Bennu

12:00-13:30 **Lunch**

13:30-13:45 Sunho Jin Determination of space weathering timescale and consideration of a possible event occurred on Itokawa

13:45-14:00 Yoonsoo Bach Thermal radiation pressure as a possible mechanism for losing small particles on asteroids

14:00-14:15 Youngmin JeongAhn Change of the Apophis' spin state during the 2029 Earth encounter

14:15-14:30 Oleksiy Golubov Tangential YORP torque due to the asteroid surface roughness

14:30-15:00 Jin Beniyama [Invited] Subsecond Photometry of Tiny Near-Earth Objects with Tomo-e Gozen

15:00-15:00 **Break**

15:15-15:45 Patrick Michel [Invited] [Remote] The impact process on small bodies: review of current knowledge and implications on the Solar System history

15:45-16:00 Gonzalo Tancredi Dust trails generated on the DART experiment

16:00-16:30 Irina Belskaya [Invited] [Remote] The potential of optical polarimetry for asteroid studies

16:30-16:45 Jooyeon Geem Polarimetric Study on the Hydrates Asteroids

August 3 (Wed)

09:45-10:30 **Morning e-poster Session**

10:30-10:43	Takafumi Ootsubo	Hydrated silicates on evolved cometary nuclei observed in the mid-infrared
10:43-10:56	Karri Muinonen	Asteroid physical characteristics from Gaia photometry
10:56-11:09	Mingyeong Lee	Laboratory study for the light scattering on planetary regolith with 3D printed models
11:09-11:22	Flora Paganelli	Next Generation Ground-Based Planetary Radar Science at NRAO
11:22-11:35	Surhud More	The search for Planet Nine using the Subaru Telescope
11:35-11:48	Amelia Yu	Previously Undiscovered Exoplanets Detected with Deep Learning in the Data Collected by the Kepler Space Telescope
11:48-12:01	Hangbin Jo	Numerical study of low-velocity dust ejection from Phaethon and its connection to the Geminid meteoroid stream
12:00-13:30	Lunch	
13:30-14:00	Tomoko Arai [Invited] [Remote]	DESTINY+ asteroid flyby of Geminid parent Phaethon
14:00-14:30	Yuri Aikawa [Invited] [Remote]	Chemical link between protostellar cores, protoplanetary disks, and primordial objects in the Solar system
14:30-15:00	Maria Drozdovskaya [Invited] [Remote]	Chemical Provenances of Cometary Volatiles
15:00-15:15	Break	
15:15-15:45	Woojin Kwon [Invited]	A brief story of grain growth in young stellar objects
15:45-16:15	Shogo Tachibana [Invited] [Remote]	Multi-Scale Understanding of C-type Near-Earth Asteroid (162173) Ryugu from Proximity Exploration by Hayabusa2 Spacecraft to Microanalysis of Returned Material
16:15-16:45	Maria Antonietta Barucci [Invited] [Remote]	Observing small bodies from light points to micro-particles

List of Invited Speakers

Sei-ichiro Watanabe

Dante Lauretta

Beth Ellen Clark

Jin Beniyama

Patrick Michel

Irina Belskaya

Tomoko Arai

Yuri Aikawa

Maria Drozdovskaya

Shogo Tachibana

Woojin Kwon

Maria Antonietta Barucci

Gender distribution of speakers invited talks: 5 males, 7 females

Gender distribution of speakers invited talks who accepted the invitation: 5 males and 7 females

Gender distribution of speakers contributed talks: 14 males and 17 females (including 13 oral and e-Posters)

List of Session Chairs

Karri Muinonen

Beth Ellen Clark

Maria Antonietta Barucci

Hikaru Yabuta

Patrick Michel

Irina Belskaya

Flora Paganelli

Olexiy Golubov

Jenong-Eun Lee

Chae-Gyung Sim

Summary of Scientific Highlights FM8

In this Focus Meeting, planetary astronomers around the globe joined in person and online to exchange ideas and recent findings on various topics in this field. Main Scientific Highlights are:

- Initial analysis of the returned sample from Hayabusa2 showed that Ryugu is a highly porous rubble pile asteroid with a lower abundance of chondrules and CAIs. The formation age is estimated to be 1.5-2.6 Myr after CAI formation.
- OSIRIS-REx revealed that large boulders are distributed on the surface of Bennu with dust cover. Dust particles are found to be with low thermal inertia. They are nearly cohesionless (<0.001 Pa) granular materials.
- The artificial crater formed after OSIRIS-REx TAG indicated a flatter and darker appearance. Strong latitude dependence of albedo, band depth, and the spectral slope is found to have correlations with solar wind influx.
- Sub-second video photometry revealed 42 tiny (~ 20 m) Near Earth Asteroids using the Tomo-e Gozen.
- Simulations for asteroid families suggest objects larger than a few 100 m are rubble piles. It was also found that Bennu and Ryugu need not be formed from different parent bodies.
- Lightcurve inversion from ESA Gaia Data Release 3 produced photometry of 150,000 and 60,000 reflectance spectra of small solar system objects. Theoretical modeling, polarimetric and photometric functions, and spectrometry are expected to reveal the composition, porosity, and roughness of regolith materials.
- From the huge amount of data taken by the Kepler mission, fifteen new previously undiscovered exoplanets were detected and confirmed with Deep Learning using an open-source library for machine learning,

- DESTINY⁺ is a planned mission to explore Phaethon in 2028. The dust ejection mechanism for this active asteroid will be explored with an in-depth study of the origins of cosmic dust. In-situ dust analysis and imaging observations will also be conducted.
- Radio observations revealed a CO snow line (20K) around 20-30 au from young stars. Weak turbulence at >10 au ~40 molecular species was found in radio and IR. The dust distribution is decoupled with gas by sedimentation, radial drift, and other mechanisms.
- Comets retain a partial record of the physicochemical evolution of the planetary system. Volatiles are initially made in prestellar cores. Raw prestellar ingredients are chemically altered during the protostellar collapse and (likely) within the protoplanetary disk through gas-phase and solid-state processes.
- Grain growth occurs in the early phase of Young Stellar Objects (YSOs), even in Class 0 YSOs. With spectral index, it was found that dust growth occurs in the early phase, even in mm to cm size scale.
- Elongated and flattened features were found in a multi scales. With the returned sample from the Hayabusa2 mission. No depletion of volatile elements was found.

Executive Summary

The Focus Meeting (FM) 8 Planetary Astronomy via Telescopic and Microscopic Approaches put together a number of science communities working on planets and small bodies in the Solar System and beyond. Before this two-day meeting, the communities responded to the call for contributions: 12 invited talks, 13 contributed oral talks, 12 e-Talks, and 18 e-Posters, for a total of 43 contributions. The number of attendees counted at 11:00 am on August 2nd was about 200.

FM8 focused on small Solar System bodies, dwarf planets, and analyses of returned samples. Dust in planetary systems, star formation, and astrochemistry were also

discussed in-depth. It was pointed out that in recent years, a series of sample return projects have enabled us to establish a “tight” link between telescopic and microscopic approaches. Planetary scientists are now analyzing extraterrestrial materials in the terrestrial laboratories distributed around the globe, under cutting-edge microscopes, and at the nanoscale. The Hayabusa2 mission has brought, and OSIRIS-REx mission will bring “pristine” carbonaceous materials from their target asteroids providing unique opportunity to analyze minerals and organic materials in the laboratories. It was also pointed out that the combination of theoretical, in-situ, and laboratory research is of utmost importance not only for understanding our Solar System but understanding chemical evolution in the other planetary systems.

In summary, it was agreed that we are currently making significant progress and growing sophisticated in Solar System research using telescopes, microscopes, and spacecrafts. At the same time, we should be able to establish a new frontier in research linking the Solar System, exoplanets, planet-forming regions, and astrobiology during the meeting, as discussed in Summary of Scientific Highlights FM8.

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