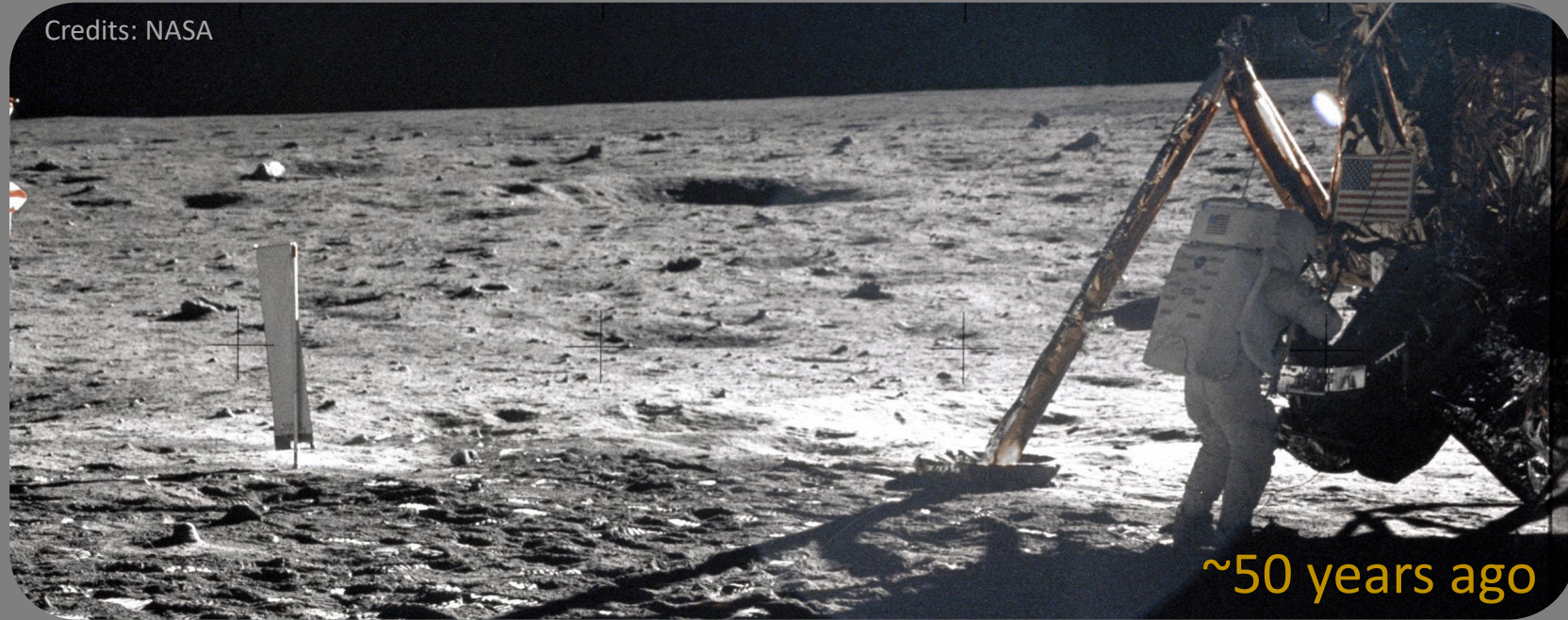


Highlights of IAU FM8: Planetary Astronomy via Telescopic and Microscopic Approaches

Masateru Ishiguro¹, Hong-Kyu Moon², Maria Antonella Barucci³, Ricardo A. Gil-Hutton⁴,
Makoto Yoshikawa⁵, Beth Ellen Clark⁶, Karri O. Muinonen⁷, Hikaru Yabuta⁸,
Amanda A. Sickafoose⁹, Young-Jun Choi², and Jeong-Eun Lee¹⁰

¹ Seoul National Univ., Korea, ² KASI, Korea, ³ Observatoire de Paris, France, ⁴ UNSJ, Argentina, ⁵ ISAS/JAXA, Japan, ⁶ Ithaca College, USA, ⁷ Univ. Helsinki, Finland, ⁸ Hiroshima Univ., Japan, ⁹ SAAO, South Africa, ¹⁰ Kyung Hee Univ. Korea

1-1. Context



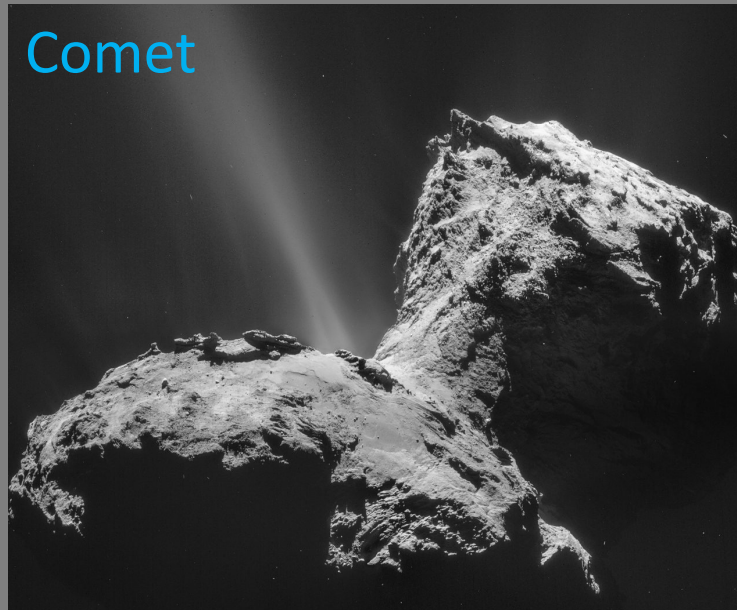
Invited talk : M. A. Barruci

Kuiper Belt



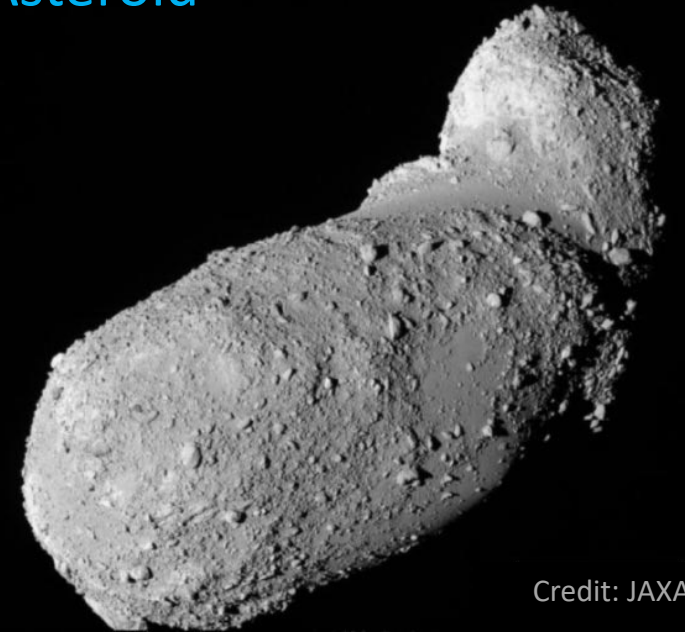
Credits: NASA/Johns Hopkins/ SWRI

Comet



ESA/Rosetta/NAVCAM

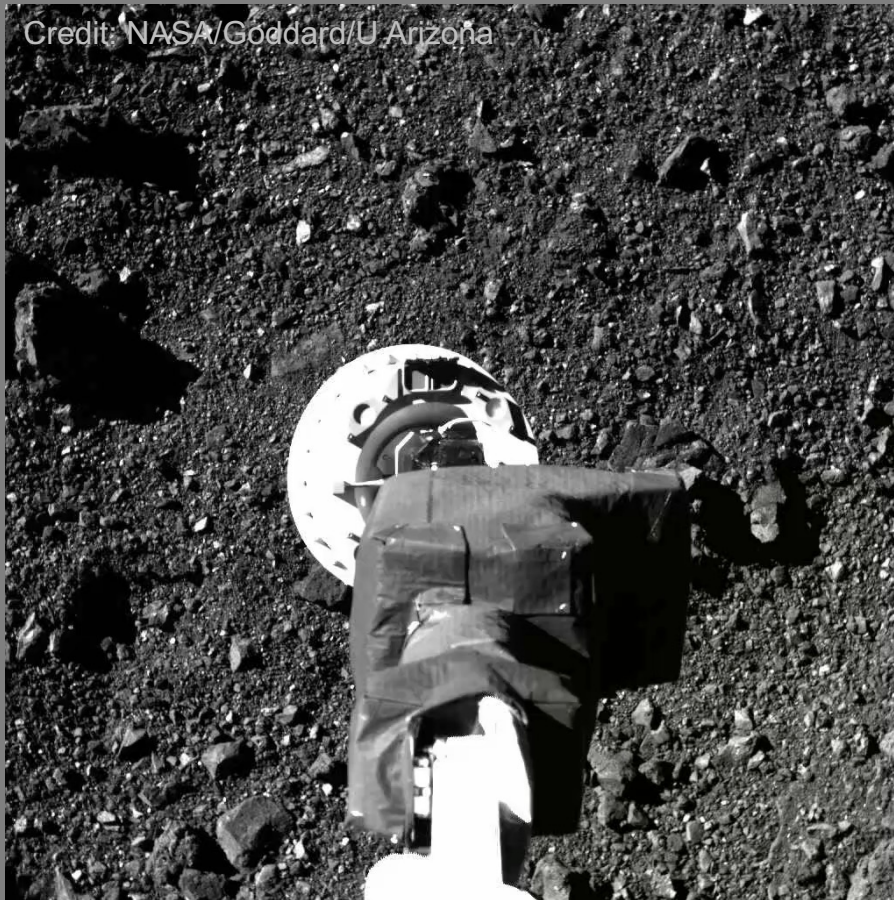
Asteroid



Credit: JAXA

1-1. Context

OSIRIS-Rex sampling from Bennu



Invited talk : Dante Lauretta

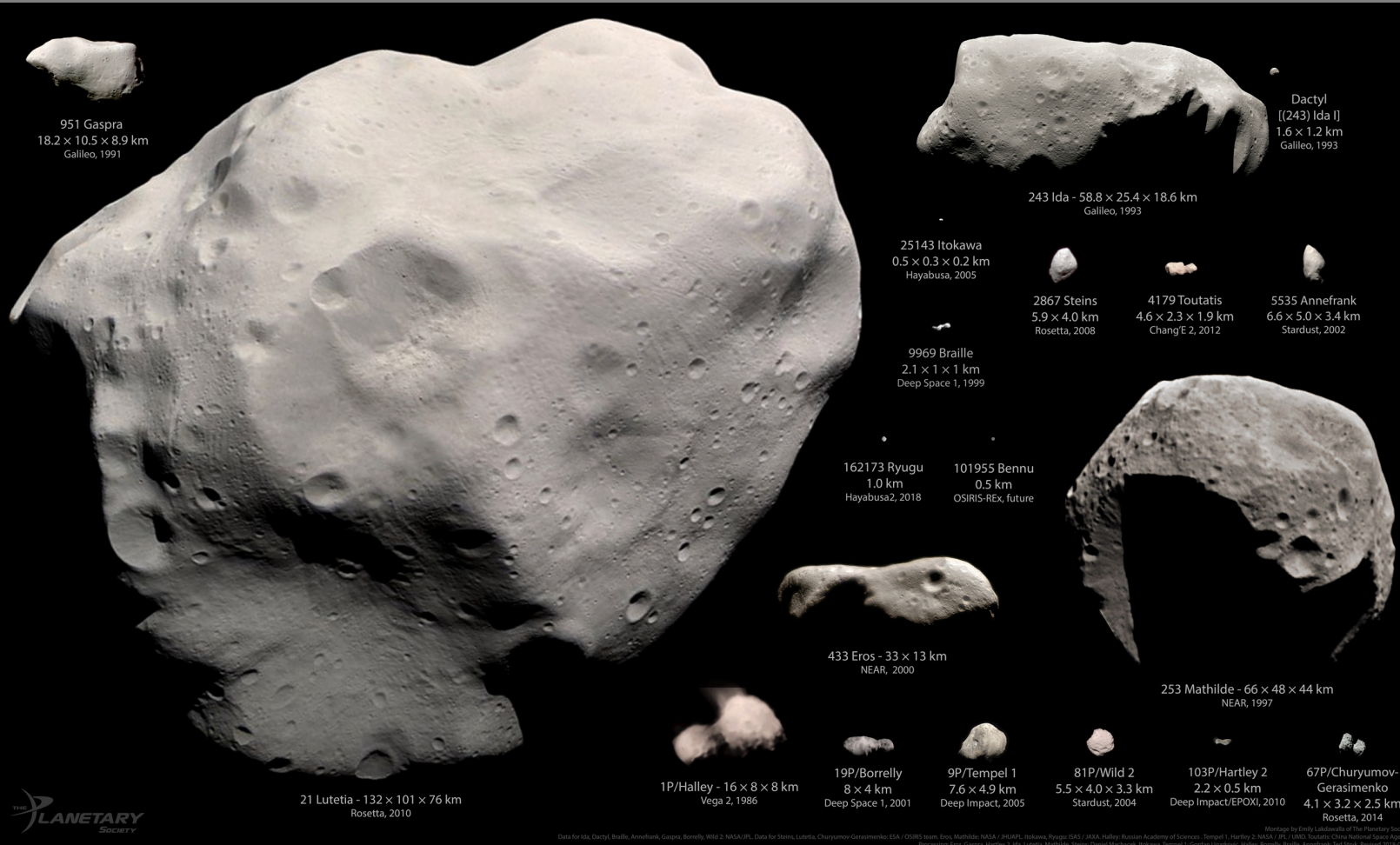
Hayabusa2 sampling from Ryugu



Tachibana et al. (2022)

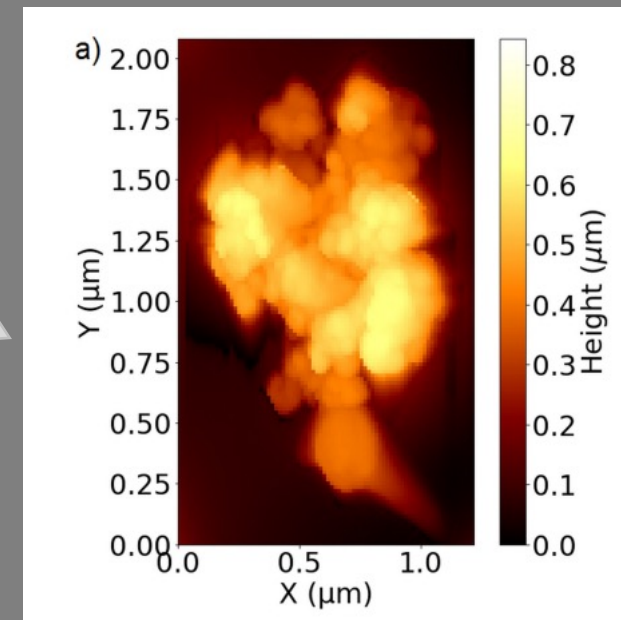
Invited talks : Seiichiro Watanabe
Shogo Tachibana

1-2. Context



1-100 km

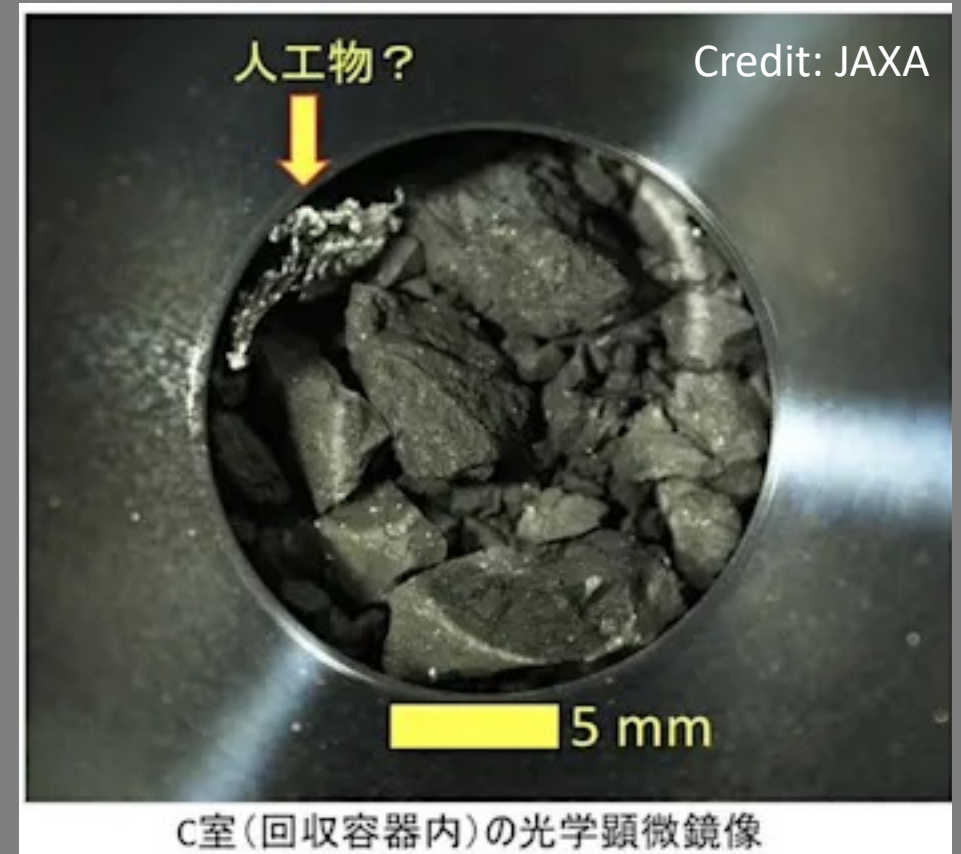
0.1-10 μm



Mannel et al. A&A 630, A26 (2019)

Dust growth--Invited talks : Woojin Kwon

1-3. Context



Invited talks : Shogo Tachibana



2. Objectives

- Planetary astronomers
 - Different techniques
 - A wide range of size scales
- Exchange ideas and findings

IAU

Astronomy for All
IAU 31st GA BUSAN 2022
August 2 - 11, 2022, Rep. of Korea

International Astronomical Union
XXXI General Assembly
BUSAN 2022
August 2 (Tue) - 11 (Thu), 2022
BEXCO, Busan, Rep. of Korea

Symposia

- IAU3368: Machine Learning in Astronomy: Possibilities and Pitfalls
- IAU3369: The Dawn of Cosmology & Multi-Messenger Studies with Fast Radio Bursts
- IAU3370: Winds of Stars and Exoplanets
- IAU3371: Honoring Charlotte Moore Sitterly: Astronomical Spectroscopy in the 21st Century
- IAU3372: The Era of Multi-Messenger Solar Physics
- IAU3373: Resolving the Rise and Fall of Star Formation in Galaxies
- IAU3374: Astronomical Hazards for Life on Earth

Focus Meetings

- FM 1: Physics of Relativistic Jets on All Scales
- FM 2: Towards a World Standard for Dark and Quiet Sky Protection
- FM 3: Consensus Cosmic Shear in the 2020s
- FM 4: UV Insights to Massive Stars and Young Stellar Clusters
- FM 5: Beyond the Goldilocks Zone: the Effect of Stellar Magnetic Activity on Exoplanet Habitability
- FM 6: Dynamics of the ICM: Radio and X-ray Observations and Theory
- FM 7: Astronomy for 21st Century Astronomy
- FM 8: Planetary Astronomy via Telescopic and Microscopic Approaches
- FM 9: Stellar Synthetic Spectra to Study Stellar Populations in the Gaia Era
- FM 10: Synergy of Small Telescopes and Large Surveys for Solar System and Exoplanetary Bodies Research

Division Meetings

- Division A Fundamental Astronomy
- Division B Facilities, Technologies and Data Science
- Division C Education, Outreach and Heritage
- Division D High Energy Phenomena and Fundamental Physics
- Division E Sun and Heliosphere
- Division F Planetary Systems and Astrobiology
- Division G Stars and Stellar Physics
- Division H Interstellar Matter and Local Universe
- Division J Galaxies and Cosmology

Institutional Meetings

- Office for Astronomy Outreach
- Office of Astronomy for Development
- Office for Young Astronomers
- Office of Astronomy for Education
- Executive Committee Working Groups
 - Astronomy for Equity and Inclusion
 - Dark and Quiet Sky Protection (as part of FM 2)
 - Global Coordination of Ground and Space Astrophysics
- Junior Members
- Women in Astronomy

THE KOREAN ASTRONOMICAL SOCIETY
한국천문학회

KASI 한국천문연구원
Korea Astronomy & Space Science Institute

Ministry of Science and ICT **KCFST** Korean Federation of Science & Technology Societies **Dynamic BUSAN** **KOREA TOURISM ORGANIZATION** **bto** **BUSAN**

See the websites on GA 2022: www.iauga2022.org
<https://www.iau.org/news/announcements/detail/ann22001/>

1-2. Organization Committee Members

SOCs

- **MOON, Hong Kyu** KASI, Republic of Korea
- **ISHIGURO, Masateru** Seoul National University, Republic of Korea
- **BARUCCI, M. Antonella** Observatoire Paris-Site de Meudon, France
- **GUIL-HUTTON, Ricardo A.** Universidad Nacional de San Juan, Argentina
- **YOSHIKAWA, Makoto** ISAS/JAXA, Japan
- **CLARK, Beth Ellen** Ithaca College, USA
- **MUINONEN, Karri O.** University of Helsinki, Finland
- **YABUTA, Hikaru** Hiroshima University, Japan
- **SICKAFOOSE, Amanda A.** SAAO, South Africa
- **CHOI, Young-Jun** KASI, Republic of Korea
- **LEE, Jeong-Eun** Kyung Hee University, Republic of Korea

LOCs

- **LEE, Hee-Jae, BAEK, Seulmin** (KASI) **BACH, Yoonsoo**, and **GEEM, Jooyeon** (SNU)



Planetary Astronomy via Telescopic and Microscopic Approaches

A Focus Meeting to be held at the XXXI IAU General Assembly in Busan, Republic of Korea on August 2–11, 2022

[SLACK workspace & Room Allocation](#) ▾ [Overview](#) [Key topics](#) [SOC](#) [FM8 Program](#) [Registration](#) ▾ [Program](#) ▾ [Abstract](#) ▾

[Hotel & Tour](#) ▾ [Sponsorship & Exhibition](#) ▾ [General Information](#) ▾ [COVID-19 Travels Updates](#) ▾



SLACK workspace & Room Allocation

SLACK workspace

Please join the SLACK workspace “IAUGA 2022 Networking Lounge”, and visit your channel assigned to each meeting.

Room Allocation Plan

It was uploaded to the SLACK workspace and attached to this email.

Notes for Speakers and Chair

The latest information is given at <https://ysbach.github.io/iau2022fm8/>

The Room number for FM8 is **Rm106**

ABOUT

The Focus Meeting 8 “Planetary Astronomy via Telescopic and Microscopic Approaches” is sponsored by the [International Astronomical Union \(IAU\)](#) and will take place at the venue of the XXXI IAU General Assembly in Busan, Republic of Korea on August 2–11, 2022

**XXXI IAU GENERAL ASSEMBLY IS
POSPONED TO AUGUST 2022**



<https://iau2021fm8.kasi.re.kr/>

iau2022fm8

LOC documents for IAUGA 2022 FM8 “Planetary Astronomy via Telescopic and Microscopic Approaches”

[View On
GitHub](#)

FM8


“Focus Meeting 8” at the 31st IAU General Assembly (2022, Busan, S. Korea). The title is **Planetary Astronomy via Telescopic and Microscopic Approaches**.

This is a small website to host information by FM8 LOCs **at one single place**.



Instructions (Guidelines)

- **Chairs & Co-chairs:** [»link«](#)
- **In-room Speakers:** [»link«](#)
- **Remote Speakers:** [»link«](#)
- **e-Posters:** [»link«](#)

Virtual Meeting Platform

- Go to the [»meeting platform«](#).
- **Remote speakers** should use  Zoom for presentation (see guideline above)

Contents & Schedules

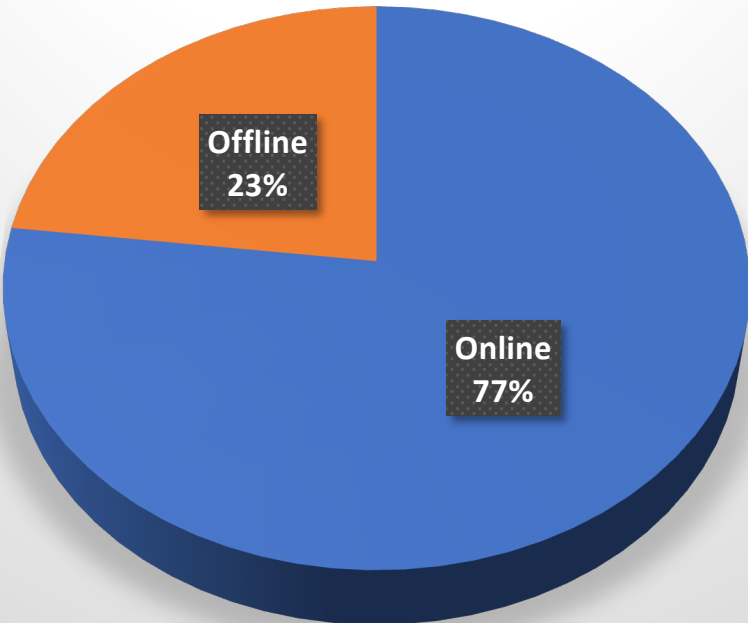
-  [»Talks«](#)
-  [»e-Posters«](#)
- There is **no e-Talk** in FM8.
- FM8 website by KASI: [»link«](#)
 - Info on this FM, SOC members, etc.
- [ALL Programs at a glance \(IAUGA\)](#)
- General time schedule:

Daily Schedule of GA2022			
Time Zone (daylight saving time applied)			
sessions	Central Europe GMT + 2	Busan GMT + 9	Central US GMT - 5
morning plenary	01:15 – 02:45	08:15 – 9:45	18:15 – 19:45

<https://ysbach.github.io/iau2022fm8/>

4. Summary of presentations

- Date:
 - August 2(Tue)–3(Wed), 2022
- Number of Presentations:
 - 43 Presentations
 - 12 Invited Presentations
 - 31 Contributed Presentations (13 oral and 18 e-Poster)
 - 13 Countries and regions
- Number of Attendances (Aug 2, 11:00 am, 1st session):
 - ~200

Session FM8, Planetary Astronomy via Telescopic and Microscopic Approaches							
Date		2022-08-02 (TUES)					
Time (KST, GMT+9)	Program		Category	Speakers			Type of Participation
	Program	Slot		Name	Abs_no.	Title	
09:45-10:30	Morning e-Poster						
10:30-11:00	Morning Oral Session	FM8-1	Invited	Sei-ichiro Watanabe	757	Scientific discoveries of the Hayabusa2 mission, sample return from C-type asteroid Ryugu	remote
11:00-11:30			Invited	D. Lauretta	3073	OSIRIS-REx – Status of NASA’s Near-Earth Asteroid Sample Return Mission	remote
11:30-12:00			Invited	Beth Ellen Clark	2882	Overview of Space Weathering on Asteroid (101955) Bennu	remote
12:00-13:30	Lunch						
13:30-13:45			Contributed	Sunho Jin	914	Determination of space weathering timescale and consideration of a possible event occurred on Itokawa	in-room
13:45-14:00	<div><div>Participants</div></div>						in-room
14:00-14:15							in-room
14:15-14:30							in-room
14:30-15:00							in-room
15:00-15:15							
15:15-15:45							remote
15:45-16:00							in-room
16:00-16:30							remote
16:30-16:45							in-room

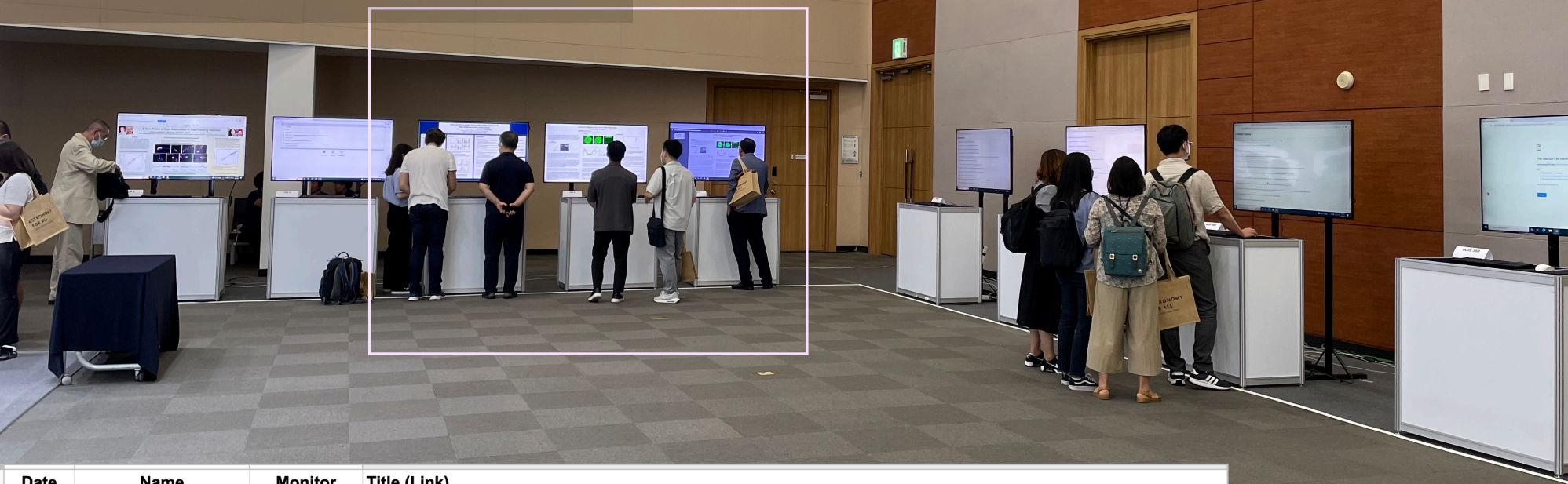
5. Oral Session



5. Oral Session



6. e-Poster



Date	Name	Monitor	Title (Link)
Morning, 09:45-10:30 AM			
Aug 2	Eunjin Cho	MONITOR1	Early activity in Jupiter Trojans after being captured and their influence on the surface co
	Gulchehra Kokhirova	MONITOR1	Results of Photometric Observations of Comet P/2019 LD2 at the Sanglokh Observatory
	Jaekyun Park	MONITOR2	2-micron Mapping of the Jovian Polar Haze using Juno/JIRAM data
	Jamila Chouqar	MONITOR2	Atmospheric properties of sub-Neptune atmospheres: TOI-270 system
	Joseph Masiero	MONITOR3	Asteroid Polarimetric-Phase Behavior in the Near-Infrared
	Oleksiy Golubov	MONITOR3	Harnessing the Yarkovsky effect to measure densities of probable M-type near-Earth as
Morning, 09:45-10:30 AM			
Aug 3	Dukhang Lee	MONITOR1	Thermal design of a suite of two optical cameras mounted on a rover for lunar mid-latitude
	Hideaki Fujiwara	MONITOR1	High-Resolution Mid-Infrared Observations of Planetary Rings from the Ground
	Minsup Jeong	MONITOR2	Introduction to GrainCams for Lunar Surface Exploration Mission
	Chae Kyung SIM	MONITOR2	Korea's Scientific Payloads on the Lunar Surface through the NASA/CLPS initiative
	Kilho Baek	MONITOR3	Asymmetric space weathering in northern and southern hemispheres on the Moon
	Alejandra Meza	MONITOR3	The role of continents on the global surface temperature of an Earth-like planet
	Evening, 16:45-17:30 (04:45-05:30 PM)		
	Ilseung Han	MONITOR1	Grain Growth and Dust Segregation Revealed by Multi-wavelength Analysis of the Class
	Minbae Kim	MONITOR1	The light field camera simulation based on ray-tracing for CLPS/GrainCams
	Mirel BIRLAN	MONITOR2	Color indexes survey of NEOROCKS Near Earth Objects targets
	Seonghyun Kim	MONITOR2	Thermal Escape of Hydrogen and Helium in the Solar System
	Yeonji Lee	MONITOR3	Resolution of Wobble Method for Detecting Planets
	Yongjae Yu	MONITOR3	Brecciation and Magnetic Lock-in of Chondrites



5. FM8 Highlights of Talks (1): S. Watanabe



Scientific discoveries of the Hayabusa2 mission, sample return from C-type asteroid Ryugu

- Initial analysis of returned sample has just been finished
- Highly porous rubble pile-asteroid with top shape
- Lower abundance of chondrules and CAIs
- The presence of CO₂ in fluid inclusions in a large iron sulfide crystal
- 20,000 organic molecules, including >10 amino acids
- Originated from a region beyond Saturn's orbit (farther than those of CCs other than CI)
- The formation age of 1.5-2.6 Myr after CAI formation, movement inward during aqueous alteration phase.

A. Keshava

• Etc

5. Highlights of Talks (2): D. Lauretta



OSIRIS-REx – Status of NASA's Near-Earth Asteroid Sample Return Mission

- Summary of OSIRIS-REx Mission so far
- Low thermal inertia (Large boulders with dust cover)
- Contact location (salt-and-pepper appearance, two primary lithologies)
- Contact dynamics (very soft surface): After 6 sec of contact, the SC retained a downward
- Displaced volume is $\sim 12 \text{ m}^3$
- Nearly cohesionless ($< 0.001 \text{ Pa}$) granular material
- Stowed an estimated sample mass of $\sim 250 \text{ g}$
- Possible evidence for carbonaceous vein, organics, and interlayer water?
- Earth Return 2023

• Etc.

5. Highlights of Talks (3): B. Clark

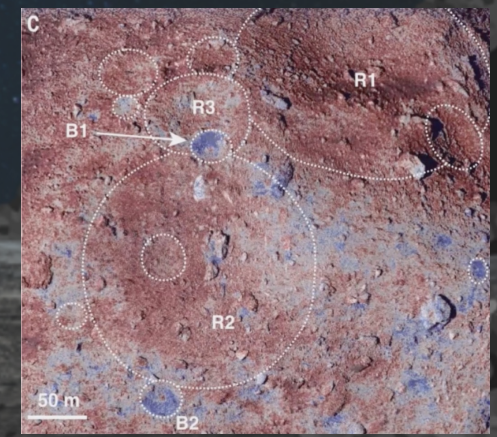


Overview of **Space Weathering** on Asteroid (101955) **Bennu**

- Review of Bennu's space weathering and comparison with Ryugu
- The artificial crater after TAG indicated a flatter and darker appearance
- **Strong latitude dependence of albedo, band depth, and spectral slope** → solar wind influx
- From the craters, the surface becomes brighter and bluer
- **Red** craters on Bennu and **blue** craters on Ryugu
- A working model for Space weathering was suggested.



DellaGuistina et al., 2020



Morota et al., 2020

5. Highlights of Talks (4): J. Beniyama

Subsecond Photometry of Tiny Near-Earth Objects with Tomo-e Gozen



- Investigation of the unexplored region in the D-P diagram by quick (ToO) **video observations** (**exp=0.5 s**)
- They discovered 42 tiny(~20 m) NEOs
- Truncated D-P profile ($T_p > \sim 10\text{s}$): dynamical ages, tensile strength, and tangential YORP are discussed.

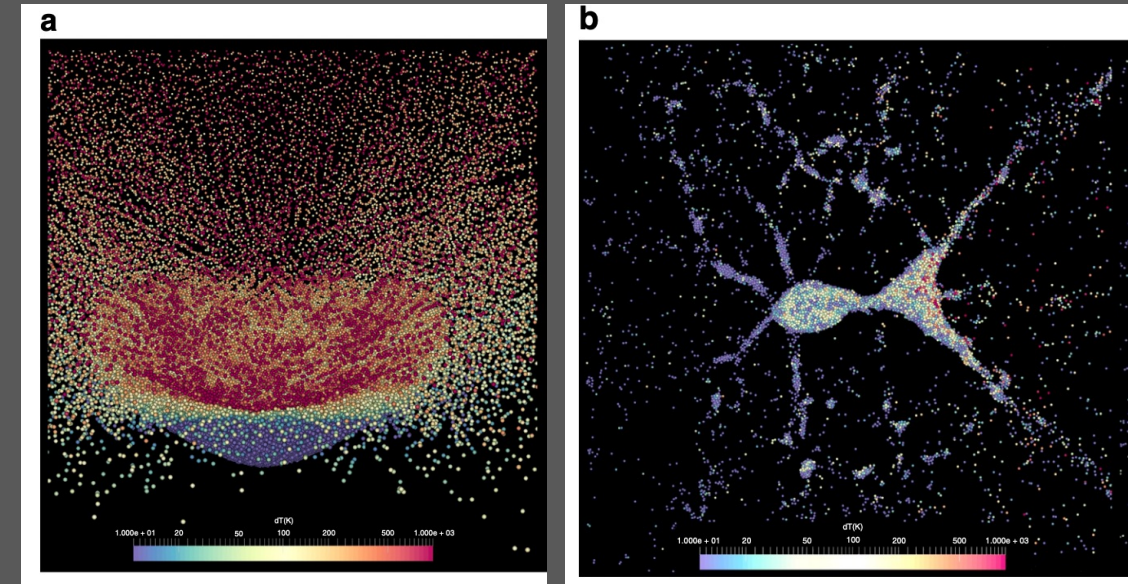
5. Highlights of Talks (4): P. Michel



The impact process on small bodies:

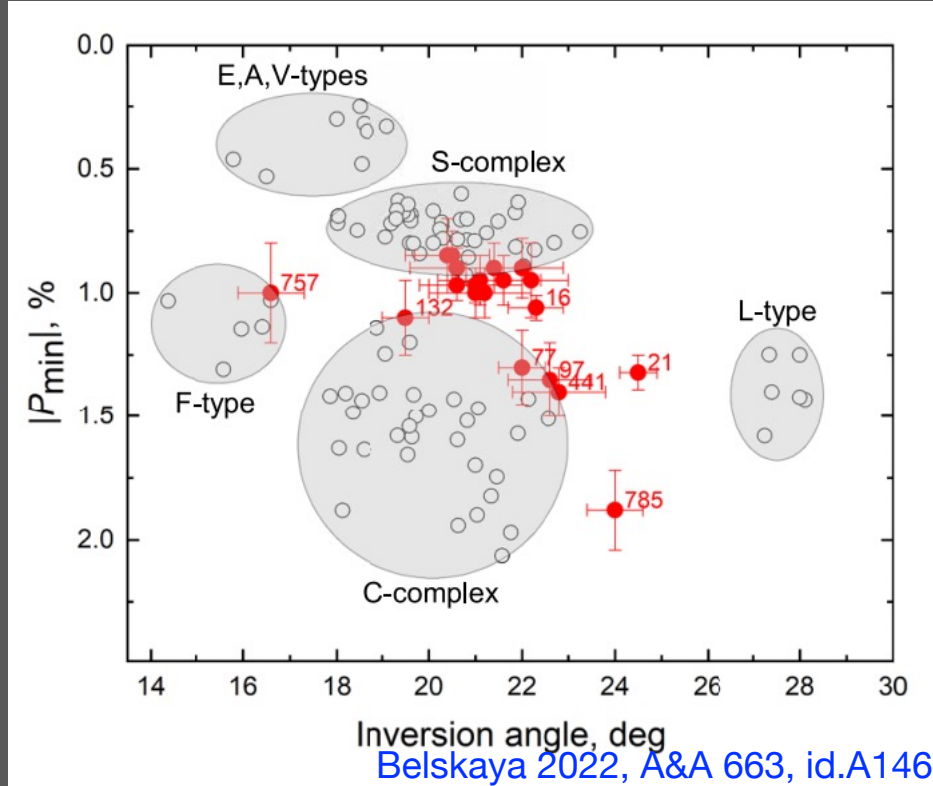
Review of current knowledge and implications on the Solar System history

- Simulation of disruption: fragmentation and gravitational phases. Simulations reproduce asteroid families and suggest that **objects > a few 100 m are rubble piles**
- Degree of heating and compaction as a result of the impact disruption. Bennu and Ryugu need not be formed from a different parent body!
- We learned from his talk that **impact processes are studied through telescopic (e.g., families) and microscopic approaches (sample analyses)**.
- SCI and DART impacts are mentioned.



5. Highlights of Talks (4): I. Belskaya

The potential of optical polarimetry for asteroid studies



Asteroid physical characteristics from Gaia photometry by K. Muinonen

- Lightcurve inversion from ESA Gaia Data Release 3 photometry: 150,000 Solar system objects and 60,000 reflectance spectra
- Theoretical modeling and classification via polarimetric and photometric functions and spectrometry (regolith scatterers, composition, porosity, roughness)

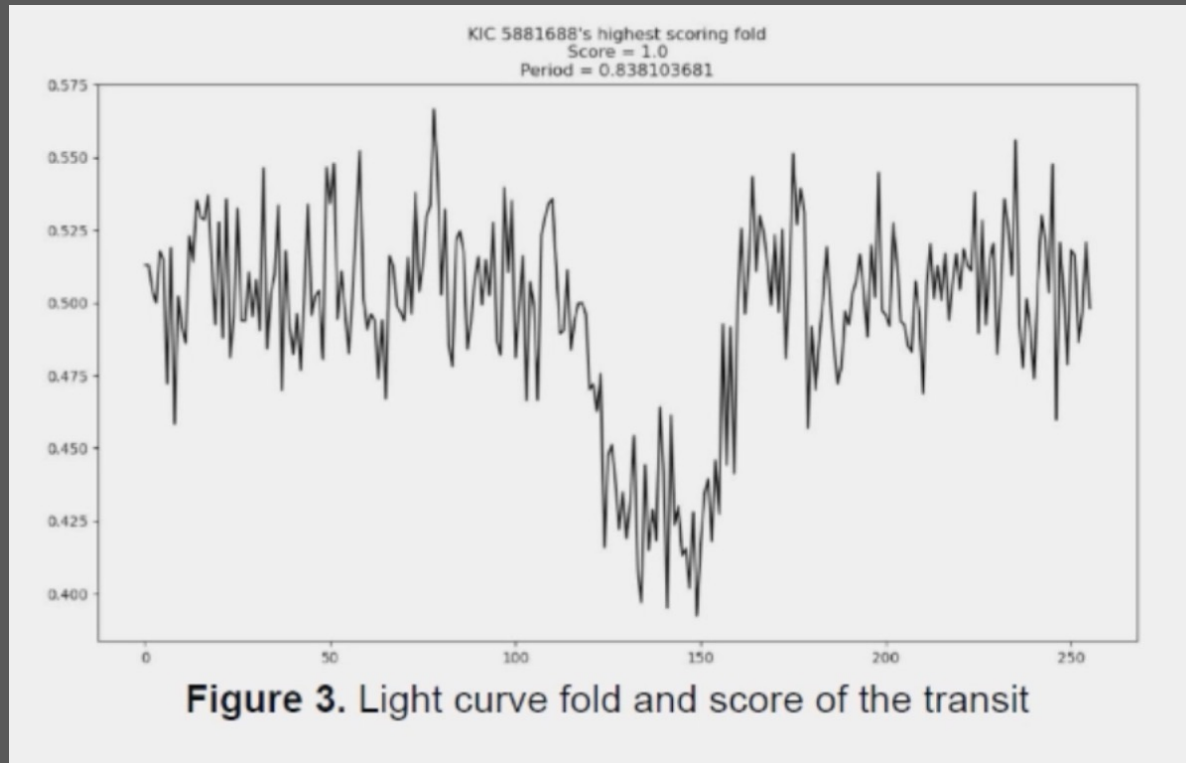
- Useful for albedo determination. Effective tool for asteroid taxonomy. Particle size and textures are also determined. Polarimetry can solve the degeneracy of spectroscopic data.
- Need for further laboratory data, a better model, and synergy of various techniques

→ Related presentations (Ch-polarimetry) by J. Geem,
→ (3D printed model) M. Lee



5. Highlights of Talks (4): A. Yu

Previously Undiscovered **Exoplanets** Detected with **Deep Learning** in the Data Collected by the Kepler Space Telescope
(Amelia Yu, Henry M. Gunn High School)



- From the huge amount of data taken by the Kepler mission, she applied artificial intelligence (Deep Learning) using an open-source library for machine learning, she successfully detected 15 new, previously undiscovered exoplanets

5. FM8 Highlights of Talks (1): T. Arai



DESTINY⁺ asteroid flyby of Geminid parent **Phaethon**



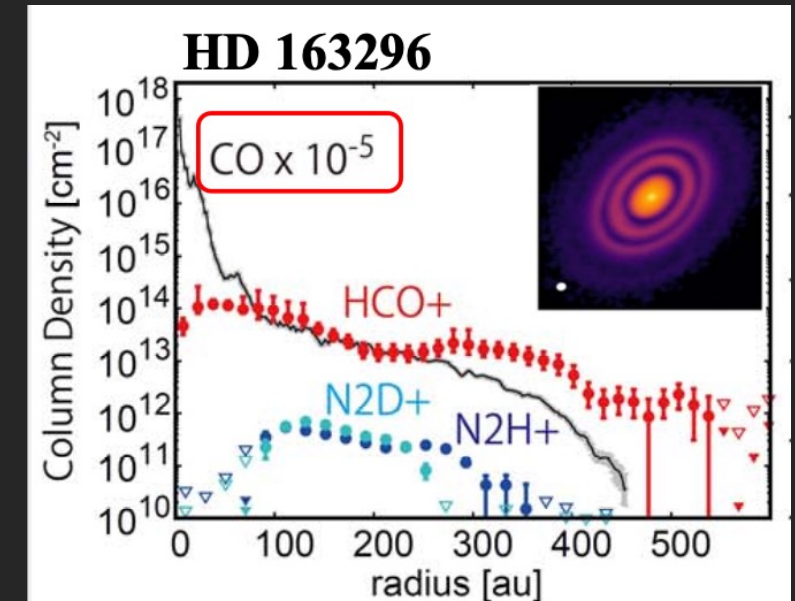
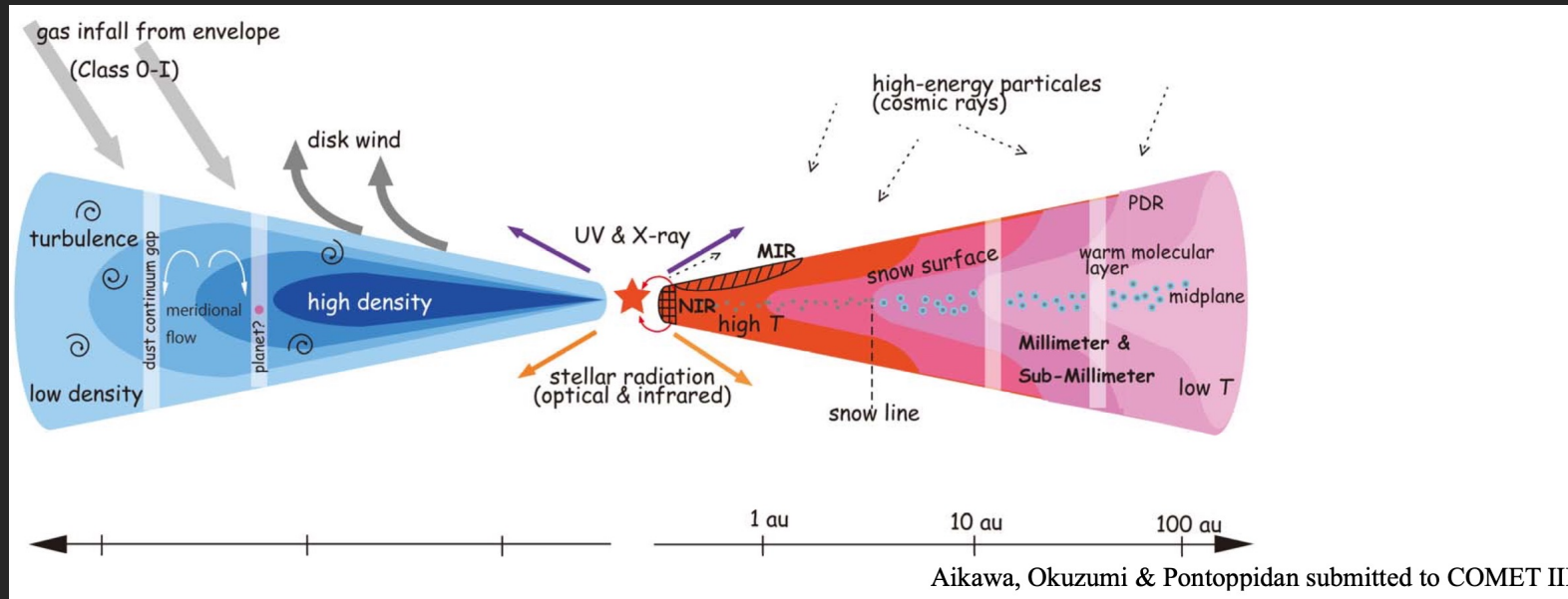
- Mission to explore Phaethon in 2028 (planned)
- Dust ejection mechanism for the active asteroid: Origins of cosmic dust
- In-situ dust analysis as well as imaging observation. The composition of interstellar dust will also be investigated.

→ Related presentations (dust ejection) by Y. Bach, Tancredi et al., Jo et al.

5. FM8 Highlights of Talks (1): Y. Aikawa



Chemical link between protostellar cores, **protoplanetary disks**, and primordial objects in the Solar system



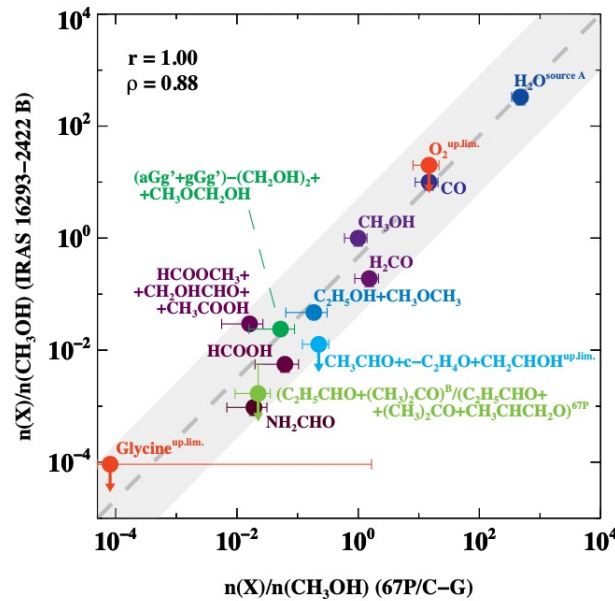
- Radio observations indicate CO snow line (20K) around 20-30 au from the stars. Weak turbulence at >10 au. ~40 molecular species are found in radio and IR. The dust distribution is decoupled with gas by sedimentation, radial drift, etc. She suggested the importance of elements depleted from gas because they should be in solids.

5. FM8 Highlights of Talks (1): M. Drozdovskaya

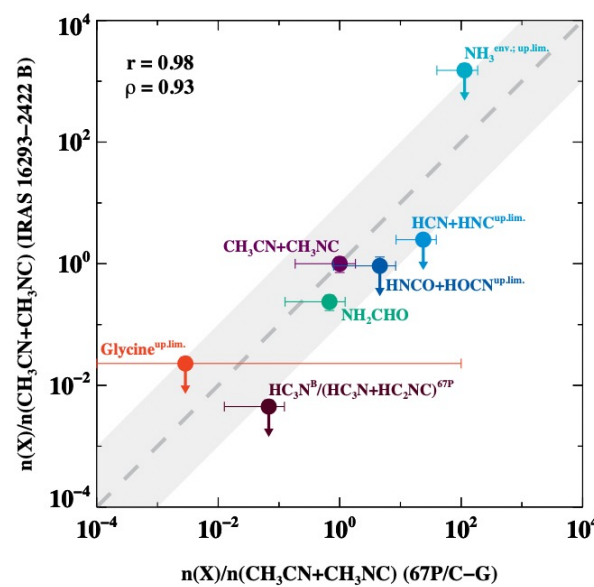


Chemical Provenances of Cometary Volatiles

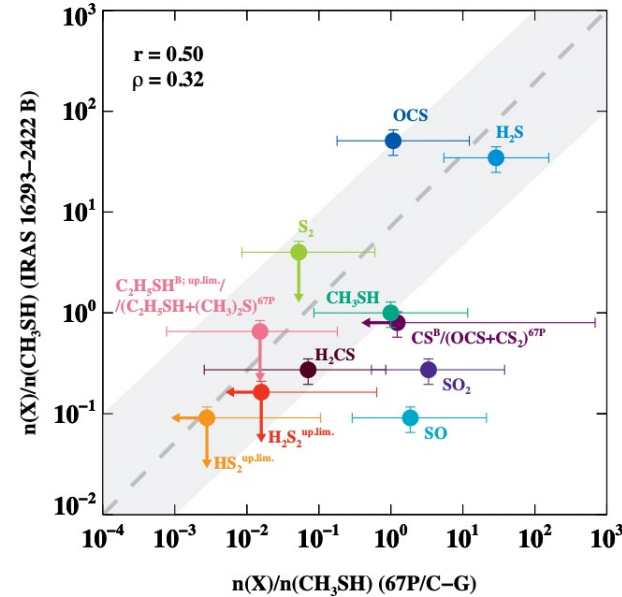
CHO-Family



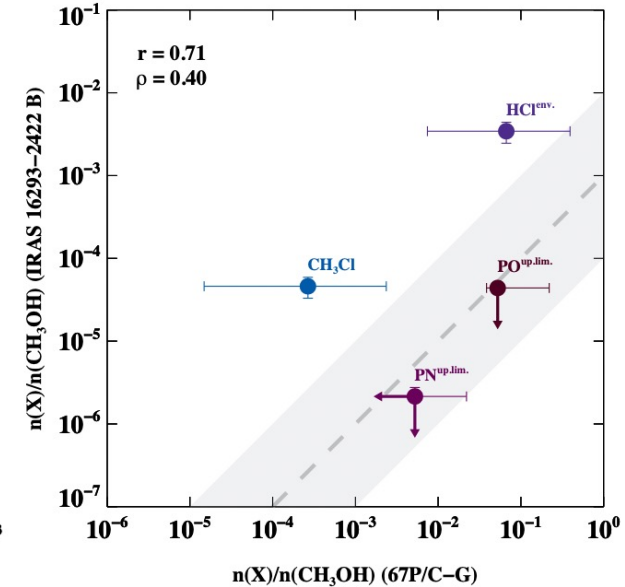
N-Family



S-Family



P & Cl-Family

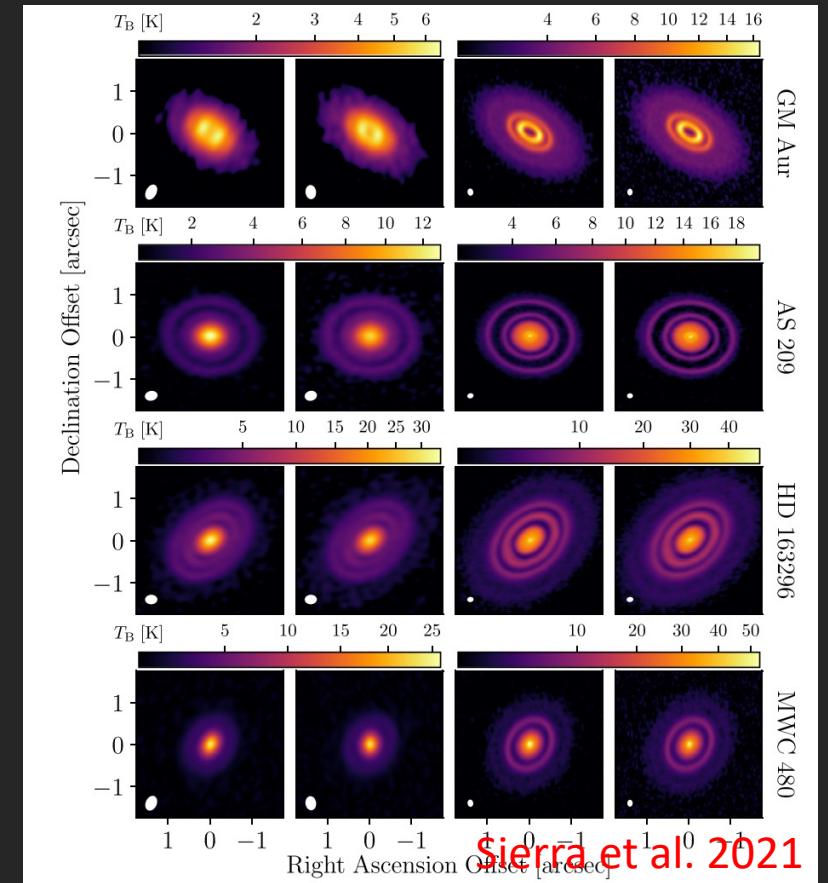
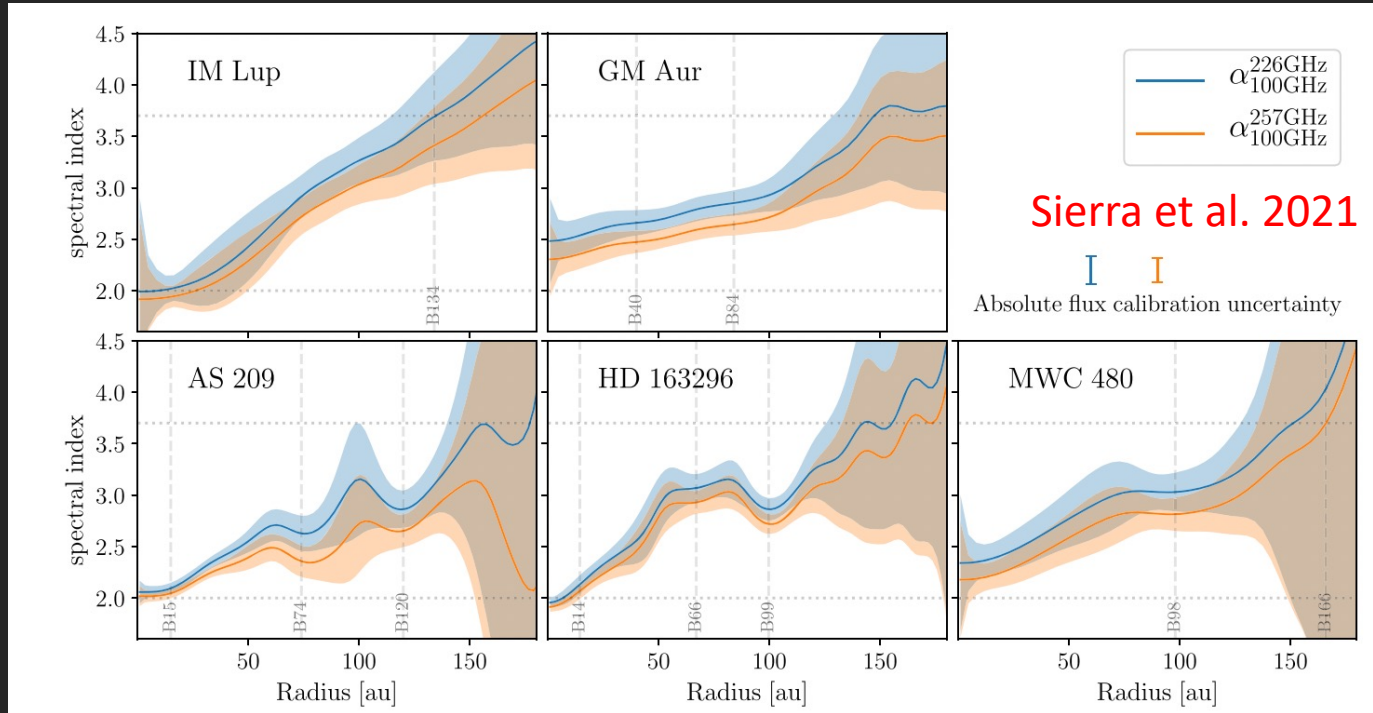


Drozdovskaya et al. MNRAS 490, 50–79 (2019)

- Comets keep a partial record of the physicochemical evolution of the planetary system. Volatiles are initially made in prestellar cores. Raw prestellar ingredients are then lightly chemically altered during the protostellar collapse and (likely) within the protoplanetary disk through gas-phase and solid-state processes.
- The expectation of comet ice sample return was mentioned.

5. FM8 Highlights of Talks (1): W. Kwon

A brief story of grain growth in young stellar objects



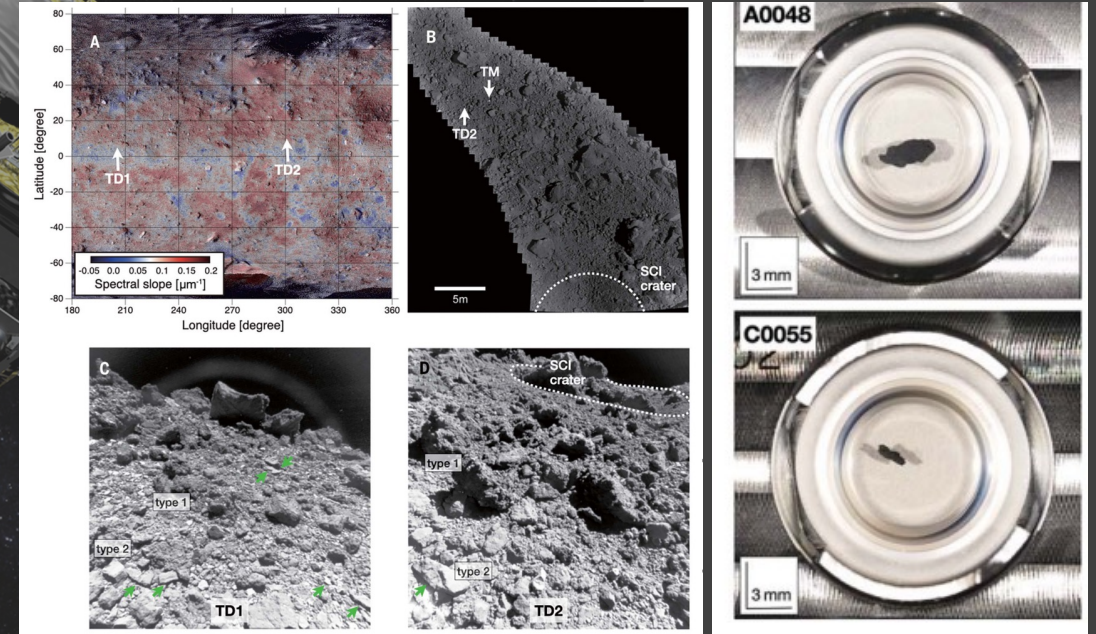
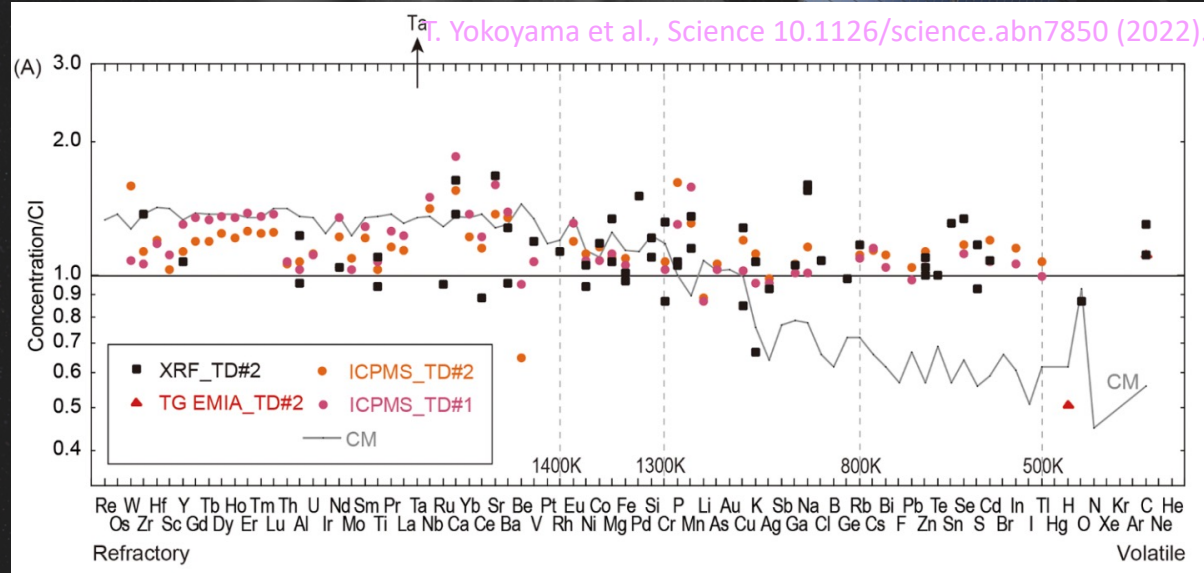
- Grain growth occurs early, even in Class 0 YSOs!
- Radial variation of grain growth, the radial drift of grains in protoplanetary disks
- Grain size determination via polarimetry

→ mm to cm size

5. FM8 Highlights of Talks (1): S. Tachibana



Multi-Scale Understanding of C-type Near-Earth Asteroid (162173) Ryugu from Proximity Exploration by Hayabusa2 Spacecraft to Microanalysis of Returned Material



[Tachibana et al. 2022, Science 375, Issue 658](https://doi.org/10.1126/science.375.658)

- Hayabusa2 highlight more focus on sample analyses
- Two touchdowns for samplings (TD1 3g, TD2 2g: multi-scale morphologies of surface materials (Tachibana+2022). Returned samples are representative of the surface materials
- Ryugu is the **freshest CI (most primitive) chondrite** ! Liquid water was there. Terrestrial weathering is mentioned.

5. FM8 Highlights of Talks (1): M. A. Barucci



Observing small bodies from light points to micro-particles

- **Comprehensive review** of small solar system bodies from point sources
- Appearance: Discovery of KBOs by Luu & Jewitt → spectroscopy, Herschel mission → New Horizons
- Size: 67P/CG by Rosetta: km-size → μm -size
- Compositional properties of each object are also reviewed
- A big picture from stellar nucleosynthesis to ISM, protoplanetary disk, planet formation, alternation process, impact events, etc. are given
- Future mission, MMX was mentioned.

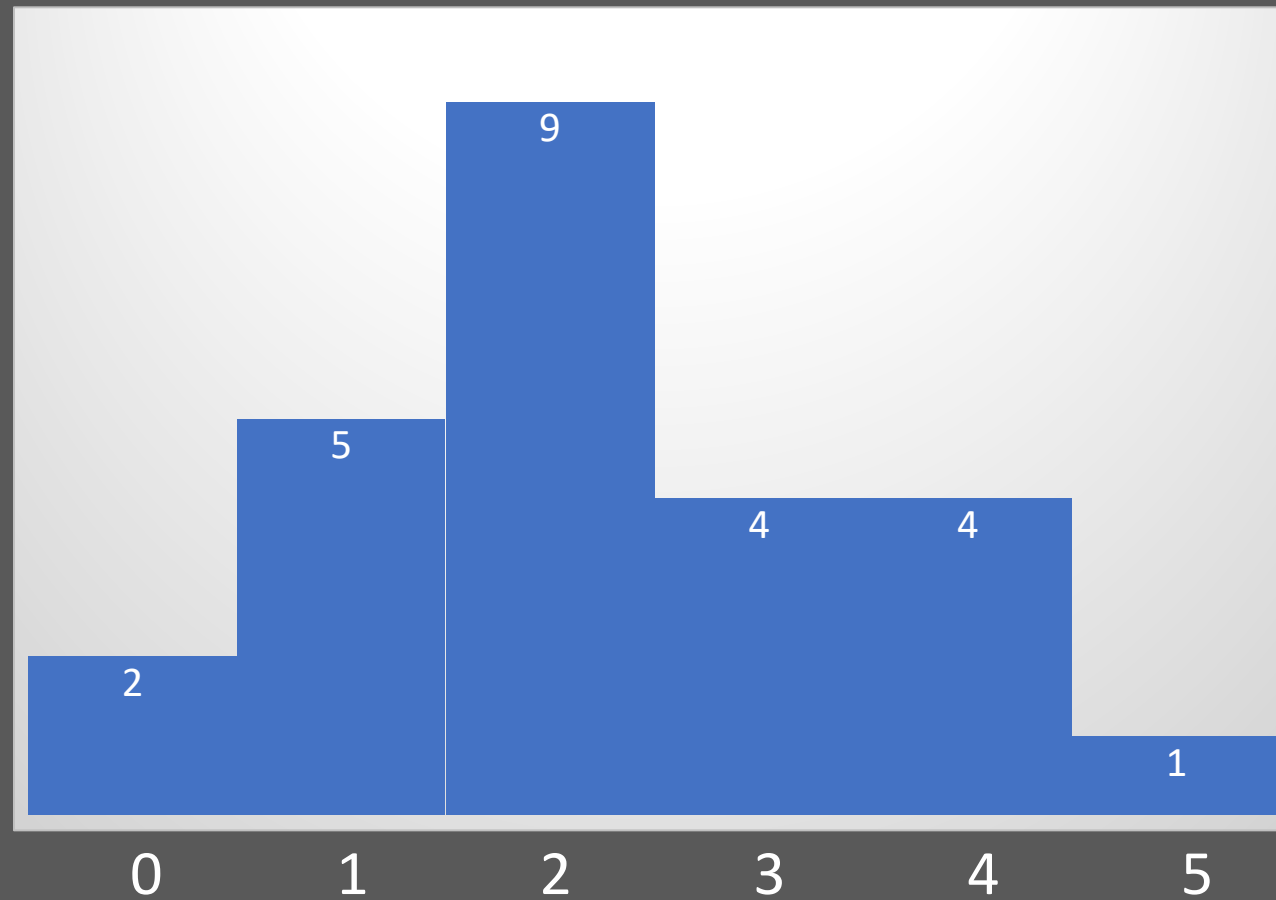
XXXIst General Assembly
International Astronomical Union
IAUGA 2022

This session ended

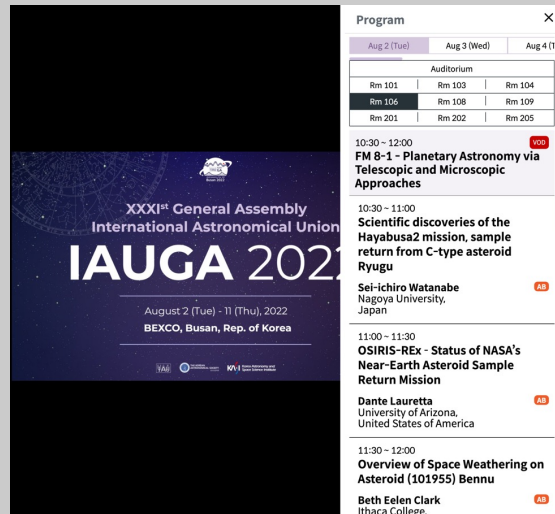


6. Active discussion

Number of Questions and Comments



In Total, 56 Question and Comments



Choose "Rm 106" on Aug 2 & 3



<https://virtual.iauga2022.org/>

Click "Session VOD"

For further detail,