

Report of Division F “Planetary Systems and Astrobiology” Annual Report 2022-23

Members:

Maria A. Barucci (President)
Kevin Heng (Vice-President)
Irina N. Belskaya (Commission F4 President)
Fabrizio Bernardi (Commission X2 President)
Margaret D. Campbell-Brown (Commission F1 President)
Jack J. Lissauer (Commission F2 President)
Joseph A. Nuth (Commission F3 President)
Zouhair Benkhaldoun
Hans J Deeg
Sylvio Ferraz-Mello
Jean Schneider
Dimitri Veras
Gonzalo Tancredi (Advisor - Past President)

1. Discussion among the members

Discussions among Division F and their commissions are continuously ongoing. This year was particularly exciting with the amazing data by JWST and in particular for the new Commission F4 – Asteroids, Comets and Transneptunian Objects.

The Div. F SC has participated in the Selection Process of the following IAU calls :

- Approval of new members
- PhD Prizes 2022
- Symposia 2024

2. Conference participation & diffusion

This year, meetings and workshops started to be again in presential allowing more deep discussions with different communities and young participants. Many remains in hybrid, important for large participation.

Few to be quoted:

- [SKA/MSE and multiwavelength synergies workshop](#) Jan 9 -13 2023, Bangalore, India
- [AGU Fall Meeting](#) Dec 12-16 2022, Chicago, USA
- [White Dwarfs as Probes of the Evolution of Planets, Stars, the Milky Way and the Expanding Universe](#) Oct 16 - Dec 17 2022, Santa Barbara, USA
- <https://aahttps://www.epsc2022.eu/>, Sept 18-23 Granada, Spain
- <https://aas.org/meetings/dps54>, October 2-7, 2022, London, Canada
- <https://iac2022.org/>, September 18-22, 2022, Paris, France
- [Division Days at GA XXXI](#), August 2022 Busan, Korea
- <https://www.cosparathens2022.org/>, July 16-24, Athens, Greece

Several meetings are planned for 2023, few to be quoted among many others:

- [Protostars & Planets VII](#) Apr 10 - 15 2023, Kyoto, Japan
- <https://iaaspace.org/event/8th-iaa-planetary-defense-conference-2023/>, 8th IAA Planetary Defense Conference, April 2-7, 2023, Vienna, Österreich
- [EGU General Assembly](#) April 23-28, 2023 Vienna, Österreich
- [Asteroids, Comets, Meteors \(ACM\) Conference](#) June 18 - 23 2023, Flagstaff, USA
- [Japan Geoscience Union Meeting 2023](#) 21-26 May 2023, Chiba, Japan
- [Origins of Solar Systems](#) June 11 - 16 2023, South Hadley, MA, USA
- [2003 Kavli-IAU Astrochemistry Symposium. Astrochemistry VIII - From the First Galaxies to the Formation of Habitable Worlds](#) July 10-14 2023, Traverse City, MI, USA
- [DPS 2023](#) 1-6 October, San Diego, CA, USA
- [Complex Planetary Systems II – Kavli-IAU Symposium 382 – July 3-7, 2023](#), Namur (Belgium)
- Origins 2023 - July 30 -August 4, jointly sponsored by ISSOL and Commission F-3, Quito, Ecuador. <https://www.usfq.edu.ec/en/events/origins-2023>

3. Highlights

The analysis from Ryugu sample returned by JAXA Hayabusa2 mission is ongoing and reveals the most chemically pristine material that any other Solar System material analyzed. A variety of organic molecules have been identified as well prebiotic molecules.

https://global.jaxa.jp/press/2022/10/20221021-1_e.html

<https://www.nature.com/articles/s41550-021-01551-5>

<https://www.space.com/asteroid-ryugu-samples-analysis-hyabusa2>

<https://www.science.org/doi/10.1126/science.abn9033>

First successful demonstration of transmission spectroscopy on exoplanetary atmospheres using multiple JWST instruments including detection of CO₂ in the transiting planet WASP-39b

<https://www.nature.com/articles/s41586-022-05269-w>

<https://www.nature.com/articles/s41586-022-05590-4>

<https://www.nature.com/articles/s41586-022-05591-3>

<https://www.nature.com/articles/s41586-022-05674-1>

Unexpected ring discovered around dwarf planet Quaoar. A kind of revolution has recently appeared in the field: another Kuiper belt object, Quaoar, hosts also a dense arc embedded in a continuous thinner ring, but that system lies outside Quaoar's Roche lobe and thus should theoretically not exist.

<https://www.observatoiredeparis.psl.eu/improbable-discovery-of-a.html>

https://www.esa.int/Science_Exploration/Space_Science/Cheops/ESA_s_Cheops_finds_an_unexpected_ring_around_dwarf_planet_Quaoar

DART IMPACT: September 26, 2022. DART (Double Asteroid Redirection Test) is the first space mission to demonstrate asteroid deflection by kinetic impactor.

<https://dart.jhuapl.edu/News-and-Resources/index.php>

The James Webb Space Telescope has provided a beautiful picture of the Neptune Rings

<https://www.jwst.fr/wp-content/uploads/2022/09/neptunelabeled-1024x1024.png>

The James Webb Space Telescope observed far comets, such as Hale Bopp at 46 au.

<https://baas.aas.org/pub/2022n8i309p02/release/1?readingCollection=15dae834>

The TESS satellite has detected a system of 6 planets in Laplace resonance around the star TOI-1136

<https://doi.org/10.48550/arXiv.2210.09283>

The number of detected extrasolar planets is permanently growing

https://exoplanetarchive.ipac.caltech.edu/docs/exonews_archive.html

<http://exoplanet.eu/catalog>

Juice Mission was launched in April 14, 2023

https://www.esa.int/Science_Exploration/Space_Science/Juice

EUCLID mission will be launched in July 2023

https://www.esa.int/Science_Exploration/Space_Science/Euclid_overview

Appendices

Report from Commission F1: Meteors, Meteorites and Interplanetary Dust

The triennial conference of Commission F1, Meteoroids 2022, was held virtually from June 13-17. Oral presentations were pre-recorded by participants, and the sessions had short live presentations followed by discussion for each speaker. There were 126 presenters at the meeting, in addition to participants who did not submit posters or oral talks. The Scientific Organizing Committee consisted of the members of the Organizing Committee of Commission F1, with additional members nominated by members of the committee. The proceedings of this meeting, and additional papers in the scope of the Commission, will be published in a special issue of Planetary and Space Science; the deadline for submission is May 2023. Members of the F1 Organizing Committee are the guest editors for the issue. We look forward to the next Meteoroids meeting in 2025, which will be held in Perth, Australia.

Members of our Commission have also been participating in other meetings: the International Meteor Conference, organized by the International Meteor Organization, held their meeting in September/October 2022 in Hungary. The IMO is an amateur organization, but for decades there have been close ties between amateur and professional meteor astronomers. Our members have also organized a fireball workshop during the Meteoritical Society conference in Glasgow in August 2022.

Professionally, our members were involved in predictions of an outburst of the tau Herculis meteor shower and observations of the activity, and observations and recovery of asteroid 2023 CX1.

Our Working Group on Meteor Shower Nomenclature has been very active recently, and have recently drawn up new criteria for moving meteor showers from the working

list (with over 800 candidate showers) to the list of established showers (currently 112 showers).

Margaret Campbell-Brown, Commission F1 President

Report of Commission F2 “Exoplanets and the Solar System”

The disciplines covered by this Commission have been growing rapidly. As a consequence, our membership has increased to 430.

Exoplanets have attracted considerable attention, and the public has wanted popular names for some of their favorite planets. The IAU responded with two public naming campaigns, organized by the WG Exoplanets for the Public. Both campaigns were well-received by the public, but the exoplanet scientists in general have not adopted public names in the research literature.

Naming of exoplanets (and their host stars) through public naming campaigns during this decade is called out as an IAU-supported activity in the IAU Strategic Plan 2020-2030 (https://www.iau.org/static/administration/about/strategic_plan/strategicplan-2020-2030.pdf), which was approved by the IAU membership through the General Assembly in Vienna in 2018. This is part of the IAU’s plan to “continue oversee[ing] official assigning of names for celestial bodies and their features” and to involve “the general public in naming astronomical objects...”. To facilitate future efforts on this topic, at the request of Division F and Commission F2, the WG Exoplanets for the Public has been dissolved and replaced by a more broadly chartered Executive Committee Functional WG Exoplanetary System Nomenclature. Members of Commission F2 are supporting the new WG and the new campaign. A public competition to select names for up to 20 exoplanets is underway <https://www.nameexoworlds.iau.org>, with entries currently being judged. Lead authors of the publications announcing the discoveries of the planets being considered for naming have been invited to provide input on selecting names from among the winning and backup name pairs chosen by the various national campaigns involved with the latest NameExoWorlds campaign for the planet they discovered and its host star from.

IAU Symposium 370: Winds of Stars and Exoplanets and other conferences endorsed by Comm. F2 that could not be held as originally scheduled in 2021 due to the coronavirus pandemic were held in 2022.

Commission F2 endorsed the proposal to hold an IAU Symposium on “Planetary Science and Exoplanets in the Era of James Webb Space Telescope” in Capetown, South Africa during the IAU General Assembly in August 2024.

Commission President Jack Lissauer and Past President Alain Lecavelier des Etangs, wrote an article explaining the new working definition of an exoplanet that was adopted by the members of the Commission in 2018. This article was published in the journal *New Astronomy Reviews* in June 2022 and can be downloaded from <https://www.sciencedirect.com/science/article/pii/S138764732200001X?via%3Dihub> or in preprint format from <https://arxiv.org/pdf/2203.09520.pdf>

Jack Lissauer, Commission F2 President

Report from Commission F3: Astrobiology

The F3 Commission planned meeting for 2020 was postponed several times then cancelled due to COVID. We decided to join with ISSOL to plan a joint meeting called **Origins 2023** in Quito Ecuador from July 30 – August 4, 2023. ISSOL already had a local organizing committee in Quito working the logistics for a meeting and they were happy for us to co-sponsor the meeting. We added several members from Commission F-3 to the scientific organizing committee and the planned meeting is perfectly matched to our Commission's Astrobiology charter.

Joseph A. Nuth, Commission F3 President

Commission F4 on Asteroids, Comets & TNOs

The F4 commission has 247 members, including 9 junior members. The research activity on asteroids, comets and TNOs through various approaches remains extremely productive as demonstrated by over 1400 peer-reviewed papers in 2022. The obtained new results were broadly discussed among OC and Commission members in order to highlight and promote the most important findings. The highlights have been posted on the IAU Commission F4 webpage.

The past year was marked by a successful space experiment aimed at testing an asteroid deflection technique, as reported by the Near-Earth Object Working Group. The NASA Double Asteroid Redirection Test (DART) mission successfully executed its intentional crash into Dimorphos, the satellite of asteroid Didymos. The immediate aftermath of the crash was imaged by the LICIACube cubesat by the Italian Space Agency. Telescopes around the globe and in space monitored these asteroids before and after impact, leading to the measurement of a change in the initial [orbital period of Dimorphos](#).

The [Data Release 3](#) by the ESA Gaia mission appeared in June 2022 is expected to be a primary source for further advancements in asteroids science in the coming years. JWST has started to collect data of small bodies in the main belt and outer solar system. The [analysis from Ryugu sample](#) returned by JAXA Hayabusa2 mission is ongoing and has revealed the most chemical pristine material that any other Solar System material analyzed. An unexpected ring was discovered around [dwarf planet Quaoar](#). New versions of databases and catalogues have been released for our community, including Solar system Open Database Network [SsODNet](#) and the [Catalogue of Asteroid Polarization Curves](#).

The spectacular results of small bodies study were widely popularized by OC and Commission members. Small body-related results were presented at various meetings and workshops and promoted through poster, oral and invited presentations.

The OC prepared the FM proposal for IAU GA 2024; participated in the meeting of the NASA Small Bodies Assessment Group (Jan 24-26, 2023, Pasadena, CA, USA).
Irina Belskaya, Commission F4 President

Commission X-2 annual report 2022

During 2022, optical observers and data processing centers (MPC, NASA, ESA, NEODyS) continued the consolidation of the adoption of the ADES format. MPC is continuing the migration to a cloud system than gives the possibility to scale up the available resources, when a higher data flow is expected from new generation surveys, such as Vera Rubin, NEO Surveyor, and Fly-Eye.

In 2022, JPL delivered updated satellite ephemeris files. NEP101 includes updated orbits for irregular Neptunian satellites and Nereid. URA116 includes irregular satellites of Uranus. JUP345 includes 15 new Jovian irregular satellites. JPL is also working on updating the orbits of the Moon, Mars, and Jupiter for upcoming flight missions.

Over last year, IMCCE worked on the improvement of their planetary ephemerides data, while in 2021, the astrometric observations of asteroids obtained with the GAIA DR2 were implemented in INPOP19a for linking the INPOP reference frame to the Gaia DR2 frame.

In 2022 the IAA - Russian Academy of Sciences (IAA-RAS) studied how the solar wind affects spacecraft ranging observations and published a paper with the findings [1]. IAA-RAS is continuing the research on the dynamical model of the Moon and LLR observations, and another project related to asteroid shape determination. IAA-RAS is also continuing to research on the dynamical model of the Moon and LLR observations, and another project related to asteroid shape determination, but these results are not published yet. Moreover, RAS submitted a proposal for an IAU GA Focus Group meeting dedicated to lunar science for 2024.

In 2022 the DART NASA mission successfully deflected Dimorphos, secondary asteroid of the Didymos binary system, and measurably changed its orbital period. IAWN conducted an observational campaign to observe asteroid 2005 LW3 during its November 2022 close approach to Earth. The goal of the campaign was to assess the timing accuracy of astrometric observations, which is useful to improve the astrometry error model and better assess the asteroids orbits and ephemerides.

The James Webb Space Telescope was used to observe comets, e.g., Hale Bopp. This new generation space telescope is a great asset to observe faint solar system bodies. In particular, if an asteroid has a non-negligible chance of hitting the Earth and is too faint for ground-based telescopes, JWST may provide additional positional measurements, which can rule out or not the impact occurrence.

The Small Body Assessment Group's Special Action Team compiled a report on the Apophis close approach to Earth in 2029 to discuss the effects of the encounter, scientific observations and observation strategies, and hazard assessment for spacecraft contact with the asteroid.

[1] <https://academic.oup.com/mnras/article-abstract/514/3/3191/6613528>

Fabrizio Bernardi, Commission X2 President