

## Report of Division F “Planetary Systems and Astrobiology” 2019

The report is organized as following:

1. Discussion among the members
2. Diffusion and conference participation
3. Recognition to members of the Planetary Systems and Astrobiology community
4. Highlights of the Commission and WGs activities

Annexes: reports from Commission and WGs

### 1. Discussion among the members

#### i. Creation of a new Commission: Physics of Small Solar-System Bodies and "Dwarf Planets"

In 2015 there was a reorganization of Divisions and Commissions in the IAU. The former Division III “Planetary Systems Sciences”, became Division F “Planetary Systems and Bioastronomy”, and lately “Planetary Systems and Astrobiology”. New commissions were created. The former Commission 15 “Physical Study of Comets & Minor Planets” was one of the most numerous in the former Div. III. But, in the new structure there were no commissions to deal with this topic. Nevertheless, the small bodies community is still one of the largest groups among the members of Div. F. A clear example of that is the number of over 500 attendees at the conference “Asteroids, Comets, Meteors” held every 3 years.

Therefore, we decided to present a proposal for a new Commission “Asteroids, Comets and Transneptunian Objects”. For the preparation and promotion of the proposal, a task group was created.

The main objectives of the group are:

- Prepare a proposal to create a Commission under Division F
- Have a census of the Div. F members interested in the topic of physics of Small Solar-System Bodies and "Dwarf Planets"
- Define the scientific topics cover by this Commission
- Call for a support from Div. F members

The members of the task group are: M.A. Barucci (Chair), I. Belskaya, R. Gil-Hutton, M. Ishiguro, D. Kovetz Prialnik, J. Masiero, D. Takir.

The timeline for their work is:

- Produce a first draft for the Commission proposal ready by April 2020.
- Ask for the support of the Div. F members interested in the topic by signing an online form.
- Complete the proposal by late 2020 and submit it to the IAU Executive Committee before the General Assembly 2021.

Colleagues interested in supporting this proposal can read and sign it at:

<http://asteroidfamilies.net/SmallBodiesCommission/proposal-for-a-new-commission/>

#### ii. Naming process in case of the discovery of a potential new planet in the Solar System

After a question raised by a journalist to the IAU President and a request from her, the Div. F Steering Committee discussed the possible actions to take in the event a new planet is discovered in our Solar System. The discussion also included the presidents of the WG-SBN and WG-PSN.

Two issues were addressed:

- a) A naming process in case a new planet is discovered.
- b) Specifications or a metric for the IAU planet definition.

The majority of the Div. F SC thought that it is too premature to discuss a possible process to define a name, when there are not definitive and indisputable evidences that planet 9 can exist yet.

However, some ideas were exchanged on how this process could be.

In addition, we recognize that a clear metric for the IAU 2006 planet definition should exist. What are the precise limits between planets, "dwarf planets" and Small Solar System Bodies? There are several TNOs that fulfil the criterion for "dwarf planets", in addition to the 4 already classified. Shall we proceed with the classification? The topic is still open.

### iii. Selection processes

The Div. F SC has participated in the selection process of the following calls:

- PhD Prizes 2018 & 2019
- Symposia 2020 & 2021, GA Focus Meetings 2021
- Junior membership 2020

## 2. Diffusion and conference participation

Several materials have been prepared for popularization.

In the frame of the IAU100's celebration of the 50th anniversary of the moon landing, the IAU100 office requested the Division to write a short essay about the contribution of the Apollo Moon program to the understanding of the origin of the Earth-Moon system.

Some of the questions addressed in the essay were:

- What have the Apollo Moon missions and Moon rocks contributed to our understanding of the Moon formation and evolution?
- What is the current scientific view(s) on how the Moon was formed?

A two-page essay was produced and some slides. The text is available at:

*"Scientific History of the Moon's Formation"* (<https://www.moonlanding50.org/science>)

Supporting the actions of the IAU Press Office, the Division collaborated in the following IAU announcements:

Naming of New Interstellar Visitor: 2I/Borisov

<https://www.iau.org/news/pressreleases/detail/iau1910/>

Naming of (486958) 2014 MU69, Nicknamed Ultima Thule

<https://www.iau.org/news/announcements/detail/ann19001/>

(486958) 2014 MU69 officially named Arrokoth

<https://www.iau.org/news/announcements/detail/ann19067/>

Dr. Masatoshi Ohishi (President of Comm. F3) was designated as the liaison between the Div. F and the IAU Office for Astronomy Outreach (IAU OAO).

Some of the conferences where the Div. F President had participated with some role related to the Division and/or the IAU:

- Third Workshop Astronomy in the Andes region (12-16 November 2018, Lima Perú) organized by the IAU Andean Regional Office. The situation of Astronomy in Perú and their participation at the IAU were addressed.
- 6th IAA Planetary Defense Conference (29 April – 3 May 2019, College Park, MA, USA) organized by International Academy of Astronautics. We expressed the importance of this conference series for the Division.
- Meeting with the Div. F VicePresident A. Barucci and members of the WG-SBN during the ESPC-DPS (15–20 September 2019), Geneva, Switzerland. A discussion about the designation of 2I/Borisov was done.
- Latino-American Regional IAU Meeting (3-9 November 2019), Antofagasta, Chile. We promoted the participation of young latino-american astronomers in the Division.

### **3. Awards to members of the Planetary Systems and Astrobiology community**

Some members of the Planetary Systems and Astrobiology community have received important recognitions during 2019.

Tim Lichtenberg (Switzerland) was awarded the 2018 IAU PhD Prize. Dr. Lichtenberg received his PhD in 2018 from the ETH Zurich, with the thesis “Thermal Evolution of Forming Planets: Isotope Enrichment, Differentiation & Volatile Retention”.

Martin Turbet (France) was one of the two recipients in 2019 of the grant provided by The Gruber Foundation (TGF) Fellowship Programm, with the auspice of the IAU. The title of the awarded thesis was: “Habitability of planets using numerical climate models. Application to extrasolar planets and early Mars”.

Michel Mayor and Didier Queloz obtained the The Nobel Prize in Physics 2019 "for the discovery of an exoplanet orbiting a solar-type star." It is the first time that a Nobel Prize is awarded for a discovery in Planetary Sciences. Their discovery has set the path to the ever-growing field of exoplanets, which is nowadays one of the driving forces of our Division. Mayor and Queloz have been actively participating in the IAU, leading the Exoplanets Commission. On behalf of the entire Division, a warm greeting was sent to Mayor and Queloz in occasion of the Nobel Prize ceremony in December 2019.

### **4. Highlights of the Commission and WGs activities**

Under the auspice of Commissions F1 and F3, the following triennial international conferences are organized: “Meteoroids” and “Astrobiology”, respectively. The last “Meteoroids” conference was held in Bratislava (Slovakia), from June 17 – 21, 2019. The next “Astrobiology” conference will be held in Vredefort Dome (South Africa), from November 9-13, 2020.

A series of similar conferences is being organized without the auspice of any specific commission, because of the lack of one, namely the “Asteroids, Comets & Meteors”, which was planned for June 2020, but it has been postponed to 2021.

At the last Executive Committee of the IAU, we presented these cases and asked that the IAU should have some kind of support for these conferences series; since they cannot be considered as regular IAU Symposia, but they should be under the umbrella and support of the IAU.

The Division had accepted the invitation to be part of the Working Group “Impact of Magnetic Activity on Solar and Stellar Environments”, which was under Div. E. Now, the WG had become an Inter-Division WG among the divisions: E, F and G.

2019 was a special year for the IAU for the celebration of its 100<sup>th</sup> anniversary. One of the central activities of the IAU100 program was the Name ExoWorlds contest (<http://www.nameexoworlds.iau.org/>). The IAU National Committees and the National Outreach Coordinators in each country received naming suggestions from the public for an exoplanet and the respective host star. A short list of selected names by each country were submitted to the NameExoWorlds Steering Group, chaired by two Div. F. members: A. Lecavalier des Etangs and E. Mamajek, also members of the Div. F WG “Exoplanets for the Public”. In December 2019 the official names were announced (<https://www.iau.org/news/pressreleases/detail/iau1912/>). 113 names for stars and the corresponding exoplanets were selected, corresponding to the same number of different countries. Over 780.000 people worldwide participated in this contest.

As mentioned above, a couple of designations of minor bodies by the WG-SBN had made into the IAU announcements and press releases. There are some remarks regarding those decisions. The WG-SBN promptly accepted the proposal for naming the New Horizon’s target (486958) 2014 MU69 as

"Arrokoth", in order to avoid confusion in publications with the nickname previously used "Ultima Thule".

In August 2019 an object with cometary appearance was discovered by amateur astronomer G. Borisov. The object was initially designated as C/2019 Q4 (Borisov). After some observations, the interstellar origin of the orbit was definitively confirmed. The object could then be incorporated into the recent new category of interstellar objects (I/), inaugurated with 1I/'Oumuamua. But, differently to the previous case, since this object had a cometary nature and it had already a provisional comet designation which included the discoverer's name, the WG-SBN decided to designate the new object as 2I/Borisov.

Gonzalo Tancredi  
Division F President

## **Annexes**

### **Commission F1 Meteors, Meteorites, and Interplanetary Dust**

Since 1992, one of the main and traditional activities of the Commission has been co-organizing the Meteoroids Conferences. Between June 17 and 21, 2019, the commission organized the tenth conference on this series, Meteoroids 2019, held at the Tatra Hotel in Bratislava, Slovakia. This site was selected at the end of the ninth conference held at ESA Estec in Noordwijk, the Netherlands, from June 6-10, 2016. Specifically, Slovakia was chosen for the tenth meeting because it was the location where the first Meteoroids conference occurred in 1992 and to celebrate the 80<sup>th</sup> birthday of one of the titans of the field, Prof. Vladimir Porubcan. The chair of the local organizing committee was Prof. Juraj Toth from Comenius University. The chairman of the Scientific Organizing Committee (SOC) was the President of C.F1 Dr. Diego Janches from GSFC/NASA. The SOC had 17 members and was nominated by the OC. Approximately 150 participants attended the week-long conference. Manuscript with the conference presentations are currently under review for special issue on Planetary and Space Science which is expected to be finalized in Summer of 2020. The team of Guest Editors for this issue are: D. Janches, J. Toth, A. Moorheas, M. Hajdukova, Q.-Z. Ye and R. Jedicke. Over 40 manuscripts have been submitted and are currently under review or have been accepted.

Diego Janches  
Commission F1 President

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### **Commission F2 “Exoplanets and the Solar System”**

Due to the coronavirus lockdown of the institutional office of the Comm. President, he was not able to have access to his records and he could not produce a full report.

On behalf of the OC of Comm. F2, the President sent several letters of endorsement for Symposia proposals for 2021.

Commission President Jack Lissauer and Past President Alain Lecavelier des Etangs (and president of the WG Exoplanets for the Public), are currently in the process of writing an article explaining the new working definition of an exoplanet that was adopted by the members of the Commission in 2018.

Jack Lissauer  
Commission F2 President

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### **Commission F3 “Astrobiology”**

The Commission F3 (Astrobiology) was established in August 2015 as the result of the IAU Commission reform. The subject of astrobiology is an interdisciplinary subject and our members come from diverse backgrounds, ranging from astronomy, biology, chemistry, earth science, geology, and planetary science. The Commission currently has 198 members and one associate, as of April 13, 2020. Members of its Organizing Committee are:

Masatoshi Ohishi, Japan (President), Joseph A. Nuth, U.S.A. (Vice President), Sun Kwok, China-Nanjing (Advisor as the immediate Past President), Hervé Cottin, France, Muriel Gargaud, France, Jesus Martinez-Frias, Spain, Sergio Pilling, Brazil, and Patricio Rojo, Chile.

As one of major scientific activities of the Commission, preparation towards the conference, Astrobiology 2020, is going on, which will be held between November 9 and 13, 2020 in Vredefort Dome – a World Heritage Site - located ~120 km southwest of Johannesburg, South Africa. Joe Nuth is the chair of the SOC and Axel Hoffman (South Africa) is the Chair of the LOC. The conference will include many exciting topics related to Astrobiology, and pre-, mid-, and post-conference field trips are also planned. The conference details can be found at its website, <https://astrobiology.uj.ac.za>. It is noted that a two-day astrobiology training school will also be held immediate before the Conference.

The Commission is keen about education and outreach, and runs a working group “Education and Training in Astrobiology” with Muriel Gargaud as the chair. Its activity report will be published separately.

Masatoshi Ohishi  
Commission F3 President

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### **Commission X2 Inter-Division A-F Commission Celestial Mechanics and Dynamical Astronomy**

The most important issue concerning Commission X2 is the transition currently taking place at the Minor Planet Center between the use of the old 80-column format for observations (known as the MPC1992 format) and the gradual adoption of the new Astrometry Data Exchange Standard (ADES), that was issued by Commission 20 at the IAU GA of 2015.

ADES addresses the shortcomings of the MPC1992 format, allowing much better characterization of each individual astrometric observation, something that, in turn, translates into better orbit solutions, allowing more detailed analyses of the small body motions.

The transition to ADES is particularly important in view of the increasing output of the Near-Earth Objects surveys, and of the recent discoveries of new classes of small bodies, like interstellar objects and apparently asteroidal objects coming from the Oort Cloud.

Giovanni B. Valsecchi  
Commission X2 Vice-President

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### **Working Group Small Bodies Nomenclature (WG-SBN)**

The main activities have been in the following areas:

1. WG-SBN responded very quickly to a request from the discoverer of (486958) 2014 MU69 and approved its final name "Arrokoth" coming from Powhatan/Algonquian language. The rapid response was to help avoid confusion in publications about New Horizon's Kuiper-belt target that was unofficially nicknamed "Ultima Thule".
2. WG-SBN supported the idea of public naming event for the dwarf planet and scattered disc object (225088)2007 OR10 and approved a name from Chinese mythology, "Gonggong". WG-SBN also approved the mythologically-related name "Xiangliu " for the satellite after working with the separate discovery team.
3. WG-SBN worked very rapidly to approve the final designation 21/Borisov for the second

interstellar object ever observed.

4. Started a discussion how to continue the Ceres Connection Program - naming of LINEAR discoveries for student winners of science fairs with its head. The original idea has been to support and increase an interest of young people in sciences. There is also an important portion of female students. On the other hand the program produces long lists of minor planets with similar citations named for students. A discussion will continue about honoring also the second place winners and student's mentors. Another question is about reducing just for international science fairs.

5. Made specific efforts to increase a portion of minor planet names honoring distinguished women personalities as well as minor planet names coming from underrepresented cultures and languages.

Jana Tichá  
Working Group Chair

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### **Working Group for Planetary System Nomenclature (WG-PSN)**

From 24 January 2018 to 09 April 2020, 213 new names have been assigned for planetary surface features (Mercury: 40, Venus: 2, the Moon: 13, Mars: 52, Ceres: 10, Bennu: 24, Ryugu: 13, Callisto: 1, Europa: 10, Ganymede: 1, Titan: 12, Pluto: 23, Charon: 12)

During this same time period the following additional actions have been taken:

- The Moon:
  - The theme for lunar craters was changed from: *“Deceased scientists and polar explorers who have made outstanding or fundamental contributions to their field. Deceased Russian cosmonauts are commemorated by craters in and around Mare Moscoviense. Deceased American astronauts are commemorated by craters in and around the crater Apollo. Appropriate locations will be provided in the future for other space-faring nations should they also suffer fatalities. First names are used for small craters of special interest”* to: *“Scientists, engineers, and explorers, as well as other persons connected with astronomy, planetary, or space research who have made outstanding or fundamental contributions to their field. Russian cosmonauts are commemorated by craters in and around Mare Moscoviense. American astronauts are commemorated by craters in and around the crater Apollo. Appropriate locations will be provided in the future for other space-faring nations. First names are used for small craters of special interest.”*
- Europa:
  - Approved the following descriptors and themes for use on Europa:
    - *Mensae: “Celtic gods and heroes”*
    - *Cavi: “Places associated with Celtic myths”*
    - *Fossae: “People associated with the Europa myth, or Celtic stone rows”*
- Bennu:
  - Approved the theme *“Birds and bird-like creatures in mythology, and the places associated with them”* for all feature types.
- Ryugu:
  - Approved the theme *“Names in stories and fairy tales for children”* for all feature types.
- Arrokoth:
  - Approved the theme *“Words for ‘sky’ in the languages of the world, past and present”* for all feature types.
- General: Themes/Categories: Removed the word "deceased" from all themes in which it occurred (Mercury, Moon, Mars, Phobos, Deimos). This is to bring consistency to the wording of all themes

in which planetary features may be named after people, proposals for which are accepted only after the three-year anniversary of the individual's death.

Rita Schulz  
Working Group Chair

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### **Working Group on Near Earth Objects**

During 2019, the NEO WG followed closely the activities related to planetary defense, and in particular supported the development of the NASA DART mission and the Hera mission study until its approval by the Member States of the European Space Agency during the ESA Council at Ministerial Level (Space19+) in November 2019. The first kinetic impactor test will now involve both DART and Hera, for a complete validation of this technique. Some members of the NEO WG participated to the organization of the Planetary Defense Conference held in College Park (Maryland, US) in spring 2019 and of a planetary defense session held at the joint DPS-EPSC meeting in Geneva in September 2019. A discussion started about the relevance of the concept of Potentially Hazardous Asteroids (PHAs) that has some limits and may need some revisions, but no conclusion was reached yet and this topic will keep being discussed until we reach a conclusion.

Patrick Michel  
Working Group Chair

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### **Commission F1 Working Group on Meteor Shower Nomenclature**

The Commission F1 Working Group on Meteor Shower Nomenclature has the task to assemble a list of meteor showers that can receive official names during the next IAU General Assembly and be added to the List of Established Showers. At the 2018 IAU General Assembly, the following members were appointed: P. Jenniskens (chair), D. Janches (president of Commission F1), T. Jopek (director Meteor Data Center), and group members: Maria Hajdukova, Josep Trigo-Rodriguez, Gulchehra Kokhirova, Robert Weryk, Althea Moorhead and Quanzhi Ye. Working group associates are Massashiro Koseki and Regina Rudawska. During the June 17-21 Meteoroids 2019 meeting in Bratislava, Slovakia, the Working Group adopted new procedures to maintain the IAU Working List of Meteor Showers and to submit new meteor shower detections to the Meteor Data Center that better define the shower's radiant extent, motion and shower duration. In late 2019, a report with these procedures was published as a peer-reviewed short communication in *Planetary & Space Science* (Jenniskens, Jopek, Janches, Hajdukova, Kokhirova, Rudawska, 2020. "On removing showers from the IAU Working List of Meteor Showers"; *Planetary and Space Science* 182, j.pss.2019.104821). Since that time, 172 showers were removed from the Working List. The pro-tempore list was canceled. At the moment, the list contains 112 established showers, 685 working showers and 24 names for shower complexes. The list is constantly being updated with new references to the literature. No new showers were submitted in this period, but the scientific work on meteor showers is rapidly increasing.

Peter Jenniskens  
Working Group Chair