

**DIVISION F**  
**COMMISSION 53**

**EXTRASOLAR PLANETS**  
*PLANÈTES EXTRASOLAIRES*

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**VICE-PRESIDENT**  
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**Ray Jayawardhana,**  
**Eiichiro Kokubo,**  
**Rosemary Mardling,**  
**Didier Queloz,**  
**Heike Rauer,**  
**Gang Zhao**

**ORGANIZING COMMITTEE**

## **1. History**

### *1.1. The Working Group on Extrasolar Planets : WGESP*

The IAU Working Group on Extrasolar Planets (WGESP) was created by the Executive Council as a Working Group of Division III. This decision took place in June 1999, that is only 7 years after the discovery of planets around the pulsar PSR B1257+12 and 4 years after the discovery of 51 Peg b. This working group was renewed for 3 years at the General Assembly in 2003 in Sydney, Australia. It was chaired by Alan Boss from Carnegie Institution of Washington. The WGESP members were Paul Butler, William Hubbard, Philip Ianna, Martin Kürster, Jack Lissauer, Michel Mayor, Karen Meech, Francois Mignard, Alan Penny, Andreas Quirrenbach, Jill Tarter, and Alfred Vidal-Madjar.

The task of the working group was to act as a focal point for international research on extrasolar planets and to organize the IAU activities in the field. In particular, one of the first task was to organize a comparative review of the techniques used to detect extrasolar planets and to establish the criteria for detections of varying degrees of certainty. As part of this activity, the working group was authorized to maintain lists of objects satisfying these criteria. This last point will be discussed in Sect. 4. One of the achievement of this working group was the writing of a “Working definition” of an exoplanet (see Sect. 3).

### *1.2. The Commission C53*

Latter on, the Commission 53 (C53) entitled “Extrasolar Planets” was created as a part of Division III in August 2006 at the IAU General Assembly that took place in Prague, Czech Republic. This commission was the logical successor to the IAU Working Group WGESP. The founding president of Commission 53 was Michel Mayor, who, in the original statement of the IAU, was acknowledged for “his seminal contributions to this new field of astronomy”. The first Vice-President was Alan Boss, and the first members of the Organizing Committee (OC) were Paul Butler, William Hubbard, Philip Ianna,

Martin Kürster, Jack Lissauer, Karen Meech, Francois Mignard, Alan Penny, Andreas Quirrenbach, Jill Tarter, and Alfred Vidal-Madjar.

From 2006 to 2015, the Commission 53 was chaired by the following Presidents and Vice-Presidents : Michel Mayor and Alan Boss (2006-2009), Alan Boss and Alain Lecavelier (2009-2012), Alain Lecavelier and Dante Minniti (2009-2015). In 2009-2012, Peter Bodenheimer, Andrew Collier-Cameron, Eiichiro Kokubo, Rosemary Mardling, Dante Minniti, and Didier Queloz were composing the Organizing Committee. Three new members joined the Organizing Committee in August 2012 : Ray Jayawardhana, Heike Rauer, and Gang Zhao.

In August 2015, 329 astronomers were members of Commission 53.

The Business Meetings, which took place in Rio de Janeiro (2009), in Beijing (2012) and in Honolulu (2015) offered the opportunity for the commission members to discuss in person the issues that concern the commission. In particular two of the thorniest issues that continue to generate inquiries and debates in the field of extrasolar planets were debated, namely how the exoplanets should be named, and what does constitute a discovery (and consequently, who should be given credit for the discovery).

## 2. Meetings

In the period of 2006-2015, international meetings focused on extra-solar planets were more and more frequent. They covered all of the aspects of that new chapter of astrophysics, from new instrumentation, detections, characterization and theory. As part of its activity, the Commission C53 expressed formal support to a number of IAU meetings.

In 2006-2009, two IAU symposia have been devoted to extra-solar planetary systems. In October 2007 in Suzhou, the IAU Symposium 249, *Exoplanets: Detection, Formation and Dynamics* and in May 2008 the IAU Symposium 253 *Transiting Planets* took place in Boston, USA. Both conferences were attended by more than 200 participants. The IAU Symposium 293 on the “*Formation, Detection, and Characterization of Extrasolar Habitable Planets*”, was held in August 2012 during the General Assembly in Beijing.

In the last triennium (2012-2015), three symposia were supported by the commission: the IAU Symposium 299, “*Formation and evolution of planetary systems*”, which took place in June 2013 in Victoria, Canada, the IAU Symposium 310, “*Complex planetary systems*”, which took place in July 2014 in Namur, Belgium, and the IAU Symp. 314, “*Young Stars & Planets Near the Sun*”, which took place in May 2015 in Atlanta, USA.

As part of the General Assembly in Honolulu, one symposium and several focused meetings were supported by the Commission 53 : the IAU Symposium 320, “*Solar and Stellar Flares and Their Effects on Planets*”, the focused meetings FM1 “*Dynamical Problems in Extrasolar Planets Science*”, FM8 “*Statistics and Exoplanets*”, FM13 “*Brightness Variations of the Sun and Sun-like Stars*”, and FM15 “*Search for Water and Life’s Building Blocks in the Universe*”.

## 3. Definition of an exoplanet

In February 2003, the WGESP published a statement on the definition of an exoplanet. Most importantly, this statement starts by warning that “rather than try to construct a detailed definition of a planet which is designed to cover all future possibilities, the WGESP has agreed to restrict itself to developing a **working definition** applicable to the cases where there already are claimed detections, *e.g.*, the radial velocity surveys of companions to (mostly) solar-type stars, and the imaging surveys for free-floating objects in young star clusters. **This is a gradualist approach with an evolving definition,**

guided by the observations that will decide all in the end. The WGESp thought that, when new claims of discovery would be made, it could have been needed to revise the definition, but this circumstance never happened.

Emphasizing again that this was only a working definition, subject to change as we learn more about the census of low-mass companions, the WGESp has agreed to the following statements:

(a) Objects with true masses below the limiting mass for thermonuclear fusion of deuterium (currently calculated to be 13 Jupiter masses for objects of solar metallicity) that orbit stars or stellar remnants are "planets" (no matter how they formed). The minimum mass/size required for an extrasolar object to be considered a planet should be the same as that used in our Solar System.

(b) Substellar objects with true masses above the limiting mass for thermonuclear fusion of deuterium are "brown dwarfs", no matter how they formed nor where they are located.

(c) Free-floating objects in young star clusters with masses below the limiting mass for thermonuclear fusion of deuterium are not "planets", but are "sub-brown dwarfs" (or whatever name is most appropriate).

These statements were a compromise between definitions based purely on the deuterium-burning mass or on the formation mechanism, and as such did not fully satisfy anyone on the WGESp. However, the WGESp agreed that these statements constitute the basis for a reasonable working definition of a "planet" at this time and expected this definition to evolve as our knowledge improves.

In 2011 the Extrasolar Planets Encyclopaedia raised the upper mass limit for inclusion in the Encyclopaedia to 25 Jupiter masses, based on the "brown dwarf desert" as an empirical indicator of two different populations, the "exoplanets" and the "binaries". This point has been discussed in details at the Business Meetings, in particular in Beijing. Although there is no general consensus on what should be considered the upper mass limit for exoplanets (one is based on the internal luminosity source, i.e., contraction versus deuterium burning, and the other on the observed distribution of the masses of low mass companions to stars, which presumably speaks directly to formation mechanisms), it is clear that the existing catalogs should include objects with mass above 13 Jupiter masses to avoid any bias in the statistical analysis. It is advised that the published catalogs should also make clear to the users what is the upper mass limit considered for inclusion in them.

The above definition does not attempt to address the lower mass limit for the range of bodies that should be considered as planets, other than to say that the lower mass limit should be same as that used for our Solar System. In 2006, the IAU adopted a definition for Solar System planets where the definition of a planet is given as: "A celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighbourhood around its orbit. Unfortunately, for exoplanet systems, we can be sure of (a) (a body "in orbit around" and considering "a star or a stellar remnant" in spite of "Sun"), but not of (b) [even for transiting systems], much less (c). Hence the above definition in practice cannot be applied to determine the lower mass limit for exoplanets. However, at least up to now, this is not problem for exoplanets. This is because, with the exception of certain pulsar planets, all the extrasolar planets discovered to date are more massive than the planet Mars. The C53 OC thus has not seen fit to modify this *Working Definition*, though the situation may well change in the future.

With expected progress in knowledge, the question of the definition of what constitutes an “exoplanet” evidently is one that will continue to be discussed and debated in the exoplanet community in the coming years.

#### 4. Catalog of exoplanets and discovery credit

The WGESP maintained a list of planetary candidates that met its criteria for acceptance as planets up until its demise in August 2006. This list also established a criterion for discovery credits, namely **the date of submission for publication in a refereed journal**. C53 has decided not to continue to maintain this list of exoplanets, because it has no material or financial support from the IAU for it. Moreover, there is an immense popularity and greater usefulness of the catalogs developed and maintained by various teams in the worlds. These catalogs can be accessed through the WEB and provide tools to plot or extract the available information on the planetary systems. Nonetheless, it must be kept in mind that none of them operates with the imprimatur or preference of the IAU. In other words, there is no official IAU catalog.

The commission OC received requests for changing “the discovery credit” rule stated in the previous paragraph. First, it must be strengthened that the subject is not “discovery rights”, because there is no formal rights associated with the discovery of an exoplanet. At the end, the OC decided that it was not its role to solve existing disputes, but simply to state the rules. It is also agreed that the rule should not be changed to be adapted to a particular case or request. As a consequence, the rule remained that the credit of the discovery is related to and time-stamped by the submission to a refereed paper, provided that the paper is accepted for publication (this last condition came out at the Beijing 2012 GA).

The question if some additional criteria should be applied for the discovery credit, e.g., the time between submission and acceptance, or the false-alarm probability, remains to be addressed. It was suggested that a Working Group might be established to consider these criteria, perhaps composed of astronomers who do not study exoplanets, who could be expected to produce a rule that would be accepted as being fair and unbiased by the experience of particular cases.

#### 5. Naming conventions for extrasolar planets

##### 5.1. *Nomenclature*

There should be a distinction between a “public” name and a “nomenclature” name. The nomenclature names are used by astronomers to designate uniquely and unambiguously all objects discovered in the Universe. There have never been formal or official recommendations from the IAU about the nomenclature scheme for exoplanets. The nomenclature designation has been defined by practice by the discoverers : it is composed of the host star’s name followed by lower case letters, in order of discovery.

Despite several propositions, the C53 OC decided against changing the current system of nomenclature names for exoplanets, which is geared toward the clarity of astronomical databases of stars and exoplanets.

A nomenclature issue dealt with the preferred means for naming exoplanets in systems of binary stars, e.g., Alpha Cen AB, where the planets could orbit either of the binary stars or could orbit both stars, i.e., a circumbinary planet. Again the nomenclature has been defined in practice by the discoverers. The need of guidelines for the nomenclature may appear more strongly in the coming years, if more complex systems appear. The idea of a specific working group has been suggested at several occasions.

### 5.2. *NameExo Worlds*

In parallel to the nomenclature names, a procedure has been set-up to give “common names” (or “public names”) to a subset of exoplanetary systems. This procedure has been established in 2014 at the request of General Secretary following an immense pressure from the public (including large number of emails, petitions, sent to the IAU, which is recognized at the organization with legitimacy to give names to celestial objects). The process has been defined using the inputs from various IAU groups like the Commission C55 on “Communicating Astronomy with the Public” and the working group “Planetary System Nomenclature” (WGPSN). In this context, the Division F has set up a Working Group “Exoplanets for the public” (A. Cameron, A. Lecavelier, C. Lintott, E. Mamajek, G. Marcy, D. Queloz). The purpose of this working group involving experts on exoplanets, was to provide expertise to the EC-Working Group “Public Naming of Planets and Planetary Satellites” and to provide advice in the procedure of public naming of exoplanets.

In a first step, 20 planetary systems have been selected, and name candidates has been proposed for them by astronomy clubs registered at the IAU. At the time of writing, the vote for the selection of the final names is opened to the public through the Internet and collected more than 500 000 votes.

## 6. The new commission C.F2 “Exoplanets and the Solar System”

In the process of the reorganization of IAU commissions structure, it has been suggested to merge the Commission 16 (Physical study of planets and satellites) with the Commission 53, to create a new commission that includes both the solar system and extrasolar planetary systems. The motivation from this suggestion stems in part from the realization that the field of extrasolar planets is evolving from one primarily of discovery into one of characterization as well, where the Solar System’s planets are key objects of study for comparative planetology. This led to the proposal of a new commission “Exoplanets and the Solar System” that has been accepted by the Executive Committee.

The scientific topics of this new commission are:

- Search and characterization of exoplanets and their satellites
- Investigation of solar system planets and their satellites
- Observation and modeling related to the origin of the planets and planetary systems
- Modeling of planetary atmospheres, surfaces and interiors
- Laboratory work in support of such investigations

About 300 members has joined this commission in mid-August. The number of members is steeply increasing since the re-opening of the application for IAU members who are members of less than three commissions.

The Organizing Committee of the C.F2 Commission is composed of

- President: Alain Lecavelier
- Vice-President: Jack Lissauer
- Ex-officio members (co-proposers): Regis Courtin, Mark Lemmon, Dante Minniti
- Elected members: Alessandro Morbidelli, Patrick Michel, Feng Tian, Paul A.

Wiegert.

The commission will encourage and trigger meetings and activities contributing to the dialog between exoplanets and solar system communities. It will be in charge of forming specific Working Groups to deal with specific issues that still need to be addressed.