Annual Report for 2023

# IUCAF

##### THE SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS

 **FOR RADIO ASTRONOMY AND SPACE SCIENCE**

**(ISC - IAU - URSI - COSPAR)**

1. **INTRODUCTION**

The Inter-Union Committee on the Allocation of Frequencies (IUCAF) was formed in 1960 by the International Astronomical Union (IAU) and the International Union of Radio Science (URSI), at the behest of URSI. The Committee on Space Research (COSPAR) joined the two Unions in supporting IUCAF around 1972, with a consequent change of name (but not the acronym).

The IUCAF brief is to study and coordinate the requirements of radio frequency spectrum allocations for passive radio sciences – radio astronomy, space research and remote sensing – and to make these requirements known to the national and international bodies that regulate the use of the radio spectrum.

IUCAF, like COSPAR, operates as an Affiliated Body of the International Science Council (<https://council.science/what-we-do/affiliated-bodies/>) where IAU and URSI are members. IUCAF is a Sector Member of the International Telecommunication Union’s Radiocommunication Sector (ITU-R) with observer status at the Space Frequency Coordination Group (SFCG) and its Lunar-Martian Spectrum Group (LMSG), see <https://www.sfcgonline.org/home.aspx>.

IUCAF is a global forum where spectrum management concerns of passive radio science in all ITU-R Regions are regularly addressed in a comprehensive manner. The group is expert in the underlying science, in the spectrum management needs of the science and in the workings of the spectrum regulatory regime that allocates spectrum and makes the rules for radio spectrum use. IUCAF has supported radio astronomy and passive radio science in Geneva since its inception in 1960 when the first spectrum band was allocated for exclusive use by passive research at 1 400 – 1 427 MHz.

IUCAF is online at <http://www.iucaf.org>. The first 40 years of IUCAF’s history are summarized at [www.gb.nrao.edu/sd03/talks/40\_years.pdf](http://www.gb.nrao.edu/sd03/talks/40_years.pdf).

1. **MEMBERSHIP AND MEMBER AFFILIATIONS WITH OTHER BODIES**

The IUCAF membership from the three adhering bodies during most of 2023 was:

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| URSI: | Dr. Haiyan Zhang | China |
|  | Dr. Steven Reising | USA |
|  | Dr. Ingemar Häggström | Sweden |
|  | Dr. Anastasios Tzioumis | Australia |
|  | Dr. Wim van Driel | France |
| IAU: | Dr. Harvey Liszt (Chair) | USA |
|  | Dr. Masatoshi Ohishi | Japan |
|  | Dr. Adrian Tiplady | South Africa |
| COSPAR: | Dr. Yasuhiro Murata | Japan |

The ITU-R Counselor for Study Group 7 (Science Services), Dr. Vadim Nozdrin, is a member ex-officio as specified in IUCAF’s Terms of Reference (see below).

Van Driel retired toward the end of 2023 and his designated successor, Dr. Liese Van Zee (USA), passed away unexpectedly in early 2024 before being formally inducted at the IAU General Assembly to be held in August 2024. The search for new members is underway.

IUCAF members participate in the activities of other bodies. Tiplady is a member of CRAF, the European Committee on Radio Astronomy Frequencies of the European Science Foundation (<https://www.craf.eu/>). Zhang, Ohishi and Tzioumis are members of the Radio Astronomy Frequency Committee in the Asia-Pacific region (RAFCAP; see <http://www.atnf.csiro.au/rafcap/>). Tzioumis is Chair of ITU-R Working Party 7D (Radio Astronomy). Ohishi, IUCAF’s Immediate Past Chair, is the official liaison between the IAU and the ITU and is the immediate past President of IAU Commission F3 (Astrobiology). He recently retired as Head of the Spectrum Management Office at the National Astronomical Observatory of Japan. Van Driel was until recently the Secretary of IAU Commission B4 on Radio Astronomy and a member of its Organizing Committee. Liszt is a member of the American Astronomical Society’s Committee for the Protection of Astronomy and the Space Environment (COMPASSE) and the IAU Executive Committee on WG Dark and Quiet Sky Protection, and served on the Steering Committee of the IAU Inter-Division Commission C.B4 on Protection of Existing and Potential Observatory Sites.

1. **IUCAF TERMS OF REFERENCE (Revised 2015)**

A revision to the statement of IUCAF’s composition, operating practices and Terms of Reference, originally dating to 1972 when IUCAF was the Inter-Union Committee on Allocation of Frequencies, was approved by ICSU’s Executive Board in 2015, see <http://www.iucaf.org/IUCAF_Terms_Of_Reference.pdf>.

1. **INTERNATIONAL & REGIONAL SPECTRUM MANAGEMENT MEETINGS IN WHICH IUCAF PARTICIPATED DURING 2023**

In-person ITU-R meetings continued in 2023 and the IUCAF Chair spent eight weeks in Geneva during March-October, followed by five weeks in Dubai. IUCAF members participated in the following international meetings in 2023:

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| 03/27-04/06 | ITU-R Conference Preparatory Meeting (CPM) | Geneva |
| 05/10-05/12 | ISC Mid-term meeting | Paris |
| 05/30-06/07 | Space Frequency Coordination Group | Toulouse |
| 06/12-06/23 | ITU-R Working Party 5D  | Geneva |
| 07/10-07/21 | ITU-R Working Party 5B | Geneva |
| 10/05-10/12 | ITU-R Working Party 7D, Study Group 7 | Geneva |
| 11/13-11/17 | ITU-R Radio Assembly | Dubai |
| 11/20-12/15 | ITU-R World Radiocommunication Conference | Dubai |

Members also participated in national spectrum management proceedings, working in their capacities as spectrum managers at their respective institutions.

##### IUCAF BUSINESS MEETINGS

IUCAF business was discussed by email as matters arose during the year and during in-person attendance at meetings in Geneva and Dubai.

##### FINANCES

The IUCAF account is held and managed by URSI. Sustaining financial contributions of €5,000, €2,000 and €1,000 were gratefully received from IAU, URSI, and COSPAR, respectively, for calendar year 2023.

##### IUCAF’S WORK in 2023

**A**. **WRC-23**

2023 marked the culmination of the 4-year work cycle associated with the 2023 ITU-R World Radiocommunication Conference. The draft text of the revised Radio Regulations treaty was finalized at the Conference Preparatory Meeting in March-April to which IUCAF submitted a comprehensive White Paper and another document proposing revisions to WRC Agenda Item 1.2 dealing with International Mobile Telecommunications (IMT=cell phones). The protections for radio astronomy embodied in the draft treaty text for Agenda Items 1.2, 1.4 and 1.10 were crafted by IUCAF during the previous 4 years, as discussed in our earlier Annual Reports. These protections survived in varying forms and degrees in the final Treaty:

* For Agenda Item 1.2 proposing a new allocation to IMT at 10-10.5 GHz in the Americas, the protections for radio astronomy authored by IUCAF were removed at the behest of the United States, which opposed the allocation but did not entirely succeed in preventing it. The allocation was not made where radio astronomy and other science services would have been most affected – the US, Canada, Argentina and Chile - but radio astronomy in Brazil, Mexico and elsewhere will be more vulnerable than should have been the case. Allocations to IMT were made under Agenda Item 1.2 at 6-7 GHz where radio astronomy and passive remote sensing have no regulatory standing, with a strong prospect for future impairment.
* For Agenda Item 1.4 proposing to place cell phone base stations on high altitude platforms circulating at altitudes of 20 km (aka HIBS), several frequency bands were considered and eventually allocated for HIBS but radio astronomy had regulatory standing only at 2 690 – 2 700 MHz. IUCAF’s protections were adopted verbatim which would prevent operation of HIBS in direct line of sight at nearby frequencies. HIBS would be very damaging because platforms at 20 km are visible for at least 600 km and IMT signals are very strong.
* For Agenda 1.10 proposing in-air and air-ground broadband data networks at 15.4 and 22.2 GHz, IUCAF’s studies contributed to a curtailment of the proposed operation early in the work cycle, and a downgrade to secondary of allocations that were eventually made in Europe, Africa and Indonesia. In the usual course of events, there would be no need to include IUCAF’s proposed protections for radio astronomy because services using secondary allocations are by rule not allowed to create harmful interference. In this case, however, for reasons that remain to be explained, protections for radio astronomy were rewritten in somewhat softer and more general form and attached to the secondary allocations. The meaning of this unusual arrangement remains to be understood but in general the outcome of this Agenda Item was good for radio astronomy and science services.

**B**. **Protection of spectrum bands allocated exclusively to passive services**

A matter of great general concern to IUCAF has been the gradual degradation of protection for use of the radio spectrum bands that are allocated exclusively to radio astronomy and other passive services subject to RR No. 5.340 (an article of the Radio Regulations) stating that all emissions are prohibited in those bands. In practice, this condition cannot be observed. Owing to the imperfect nature of the electrical apparatus used to generate radio signals, some level of soi-disant unwanted emissions is produced outside the intended bandwidth, and this does encroach and must be controlled.

It is a problem for radio astronomy that it has for whatever reason adopted protection criteria that allow the same degree of encroachment into the already-noisy bands that are shared with transmitting services and the supposedly quiet bands that aren’t. Worse, radio astronomy’s criteria have allowed for the gradual accumulation of uncoordinated successive encroachments that have proven to be beyond the ability of radio astronomy to influence or control. Paradoxically, some of the supposedly quietest spectrum bands are now subject to the strongest encroachments.

IUCAF has unsuccessfully attempted to rewrite the defective regulatory criteria for more than a decade and mounted its latest initiative at the very end of the preceding ITU-R work cycle. The ill effects of this problem were on abundant display at WRC-23 and IUCAF hopes that this will stimulate corrective action during the upcoming work cycle for WRC-27.

**C**. **Protection of radio astronomy and passive science in the Shielded Zone of the Moon**

Articles 22.22 – 22.25 of the Radio Regulations protect passive radio science in the Shielded Zone of the Moon (SZM), defined as the volume of space not in direct line of sight of a sphere of radius 100,000 km centered on the Earth. Transmissions in spectrum bands allocated to most terrestrial services and transmissions not necessary to support lunar operations may not produce harmful interference to radio astronomy observations in the SZM. In this way, a purposeful lack of inter-operability is built into the Radio Regulations to prevent the export of the Earth’s cluttered, peculiar (subject to the influences of the atmosphere, ionosphere, etc) and haphazardly-constructed spectrum environment to the Moon and its surroundings.

Lunar radio astronomy could be severely compromised if the protections of the Radio Regulations are not incorporated in lunar radiocommunication infrastructure or if the infrastructure is not designed to minimize its impact. Frequency use for the practical implementation of lunar radiocommunication is discussed by space agencies in the SFCG’s Lunar-Martian Spectrum Group where IUCAF provides guidance on the impacts to scientific use of the SZM. Frequency allocations for lunar radiocommunication were made the subject of Agenda Item 1.15 (WRC-27) at the recently concluded WRC-23 and IUCAF looks forward to participation in this work.

1. **IUCAF CONCERNS IN 2024 AND BEYOND**

WRC-27 Agenda Item 1, most directly dealing with new frequency allocations, is unusually fully populated with issues of concern to science services and items for which they are directly responsible. The space research group WP 7B is responsible for Agenda Item 1.15 revising frequency allocations for lunar radiocommunication. WP 7C (remote sensing) is responsible for three items including 1.18 shared with radio astronomy, and the radio astronomy group WP 7D is responsible for two items including AI 1.16 dealing with the impact of satellite mega-constellations on radio astronomy and radio quiet zones.

Of special concern is the advent of direct satellite – cell phone communication that heretofore has been forbidden but is now the subject of actions by national spectrum regulators and agenda items 1.11-1.13 at WRC-27. Allowing ordinary cell phones to communicate with satellites upsets basic tenets of radio astronomy’s operating model, which gains access to unallocated spectrum in remote locations and locations inside radio quiet zones. Operating in remote locations and quieting the terrestrial environment by coordination in radio quiet zones is mooted if the sky becomes noisy at those frequencies.

Initial planning is occurring for the sixth iteration of IUCAF’s international spectrum management school in 2025, last held in Stellenbosch, South Africa in March 2020.

Closer to home, succession planning and matters of engagement continue to be of concern. Recruitment is difficult when many nations having major investments in radio astronomy are unrepresented in international radio astronomical spectrum management and few observatories have even one person fully devoted to such concerns. The passing of our fully committed newest member was a significant setback.

1. **ACKNOWLEDGEMENTS**

IUCAF is grateful for the support of the International Science Council and the Council’s interest in IUCAF’s work. It is also grateful for the organizational and financial support that has been given by IAU, URSI and COSPAR over the past 60 years, especially the URSI secretariat. IUCAF also recognizes the enormous support given by radio astronomy observatories, universities and national funding agencies to the individual IUCAF members, allowing them to participate in the vital work of the committee.

Respectfully submitted,

Harvey Liszt, Chair

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Charlottesville, Virginia, USA

10 March 2024

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