Annual Report for 2022

# IUCAF

##### THE SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS

 **FOR RADIO ASTRONOMY AND SPACE SCIENCE**

**(ICS - IAU - URSI - COSPAR)**

1. **INTRODUCTION**

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, IUCAF, was formed in 1960 by its adhering Scientific Unions, IAU, URSI, and COSPAR at the behest of URSI. 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 operates as an Affiliated Body of the International Science Council (<https://council.science/what-we-do/affiliated-bodies/>). 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), 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.

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**

There was no change to the composition of IUCAF during 2022 At the end of 2022 the IUCAF membership from the three adhering Unions 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 |

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

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 is 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 on Light Pollution, Radio Interference and Space Debris 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 2022**

In-person meetings resumed at ITU-R in 2022 and the IUCAF Chair spent 10 weeks in Geneva during the period April-October. IUCAF participated in the following international and regional regulatory meetings in 2022 (\* = remote participation):

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| 02/02-02/23\* | Working Party 5D (IMT=Mobile Telecom) | ITU-R |
| 03/29-04/08 | Working Party 5B (Radar/airborne mobile) | ITU-R |
| 04/25-04/29 | Working Party 7D (Radio astronomy)  | ITU-R |
| 04/26-05/05 | Working Party 7B (Space research) | ITU-R |
| 05/20-05/21\* | Committee on Radio Frequencies  | Washington, DC USA |
| 06/13-06/24 | Working Party 5D | ITU-R |
| 06/28-07/07\* | Working Party 1A (Spectrum engineering) | ITU-R |
| 07/11-07/22 | Working Party 5B | ITU-R |
| 07/19-07/27 | Space Frequency Coordination Group  | Palm Cove, Australia |
| 09/27-10/05 | Working Party 7B | ITU-R |
| 09/28-10/05 | Working Party 7D | ITU-R |
| 10/10-10/21 | Working Party 5D | ITU-R |
| 11/14-11/25\* | Working Party 5B | ITU-R |

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

##### IUCAF BUSINESS MEETINGS

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

##### FINANCES

The IUCAF budget 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 2022.

##### IUCAF’S WORK AT ITU-R IN 2022

In recent years, much of IUCAF’s activity occurred on a wider stage: The March 2020 spectrum management school <http://www.iucaf.org/sms2020/> in Stellenbosch South Africa and the October 2020 and 2021 UNOOSA Dark and Quiet Skies I and II meetings <https://iau.org/news/announcements/detail/ann22002/> where IUCAF members led the Radio Astronomy Working Groups. As noted in IUCAF’s 2021 Annual Report, IUCAF and ESA (in conjunction with JAXA) concluded an agreement forestalling illumination of radio astronomy sites by the 94 GHz radar on ESA’s Earthcare mission.

In 2022, IUCAF prepared for the March 2023 ITU-R CPM23-2 meeting in Geneva and the November-December 2023 ITU-R Radio Assembly and WRC-23 meetings in Dubai where the ITU-R Radio Regulations will be revised.

In all, IUCAF submitted 16 documents to ITU-R Working Parties:

* To WP1A, 1 document on impacts of wireless power transfer by microwave beam. Proposed WPT in the ISM band at 24 GHz could interfere harmfully in the passive service spectrum band at 23.6 – 24 GHz.
* To WP5B, 3 documents relating to WRC-23 Agenda Item 1.10, non-safety airborne mobile operations creating an “internet above the clouds” high-speed data link between aircraft. The originally-proposed operations were modified to disallow commercial in-air and air-ground mesh networks that held great potential for interfering with radio astronomy in spectrum bands around 15 and 22 GHz.
* To WP5D, 8 documents relating to WRC-23 Agenda Item 1.2 IMT at 10 – 10.5 GHz in the Americas, and WRC-23 Agenda Item 1.4 HIBS = IMT BS (base stations) on HAPS (HIgh altitude platform systems). IUCAF’s and other studies showed that HIBS will produce harmful interference to radio astronomy when they operate in direct line of sight. IMT operations at 10 GHz can perhaps be compatible at large separation distances with beam steering to avoid pointing at radio astronomy sites and strong attenuation of unwanted emissions.
* To WP7B, 1 document relating to WRC-23 Agenda Item 1.13, a proposed upgrade to primary of the secondary frequency allocation to the space research service at 14.8 – 15.35 GHz. Lack of published characteristics for proposed SRS systems complicated compatibility studies but the need for 60+ dB of attenuation of unwanted emissions was made apparent.
* To WP7D, 3 documents, relating to: i) lunar radio astronomy; ii) AI 1.13 (see above); iii) revision of Report ITU-R RA.2188 to recognize studies conducted at SFCG in support of the Memorandum of Understanding between IUCAF and ESA.

##### PROTECTION OF THE SHIELDED ZONE OF THE MOON

The Radio Regulations Articles Nos. 22.22 – 22.25 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 about the center of 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. The Radio Regulations also prohibit use of spectrum bands allocated to terrestrial mobile services (IMT) for direct communication *with or on* *satellites, including the Moon*. Frequencies allocated to the space research and space operations services are supposed to be used instead.

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. This is in obvious tension with the development of radiocommunication technology on and about the Earth.

Lunar radio astronomy could be severely compromised if the protections of the Radio Regulations are not incorporated in lunar radiocommunication infrastructure. Work to determine frequencies for cis- and trans-lunar radiocommunication is occurring in the SFCG’s Lunar Martian Spectrum Group, where IUCAF participates in the hope that a resolution favorable to radio astronomy and passive radio science can be reached.

1. **IUCAF CONCERNS IN 2022 AND BEYOND**

Until recently, improved access to spectrum for science ran through the radio frequency spectrum regulatory regime, by procuring and protecting allocated spectrum. But allocations to science are static while the spectrum fills in with new wideband radiocommunication systems that are especially problematic for radio astronomy. Perversely, radio spectrum regulators, with a narrow charge to protect allocated radio spectrum, authorize satellite mega-constellations that profoundly affect the visible appearance of the night sky and create problems of solar light reflection for optical and infrared astronomy.

Radio spectrum regulators at ITU-R and nationally have recently authorized satellite constellations that breach the Radio Regulations on the condition that they do not produce harmful interference. This is deemed to be innocuous but it represents a major step in the breakdown of the radio spectrum regulatory protections for radio astronomy and other radio services. IUCAF is working to bring this situation to the attention of radio spectrum regulators.

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 devoted to such concerns.

1. **ACKNOWLEDGEMENTS**

IUCAF is grateful for the organizational and financial support that has been given by ICS, 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

26 February 2023

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