

Annual Report for 2021

IUCAF

THE SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY AND SPACE SCIENCE (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 online at <http://www.iucaf.org>.

2. MEMBERSHIP AND MEMBER AFFILIATIONS WITH OTHER BODIES

There was no change to the composition of IUCAF during 2021, and IUCAF is still seeking a replacement IAU committee member for one who resigned in 2018. At the end of 2020 the IUCAF membership from the three adhering Unions was:

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), Mr. Vadim Nozdrin, is a member ex-officio by virtue of his ITU-R position, as specified in IUCAF's Terms of Reference. IUCAF also has an informal group of correspondents, in order to improve its global geographic representation and for consultation on specific issues, for instance concerning astronomical observations in the optical and infrared domains.

IUCAF members also 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 is Chair of the Radio Astronomy Frequency Committee in the Asia-Pacific region (RAFCAP) whose members also include Ohishi and Tzioumis (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.

3. IUCAF TERMS OF REFERENCE (Revised 2015)

A revision to the statement of IUCAF’s composition, operating practices and Terms of Reference (TOR), 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](http://www.iucaf.org/IUCAF_Terms_Of_Reference.pdf).

4. INTERNATIONAL & REGIONAL SPECTRUM MANAGEMENT MEETINGS ATTENDED BY IUCAF MEMBERS DURING 2020

Radio frequency spectrum management meetings were moved online during 2021. IUCAF participated in the following international and regional regulatory meetings:

03/01-03/12	Working Party 5D (IMT=Mobile Telecom)	ITU-R
04/12-04/16	Working Party 7D (Radio Astronomy)	ITU-R
05/10-05/21	Working Party 5B (Radar and airborne mobile)	ITU-R
05/20-05/21	Committee on Radio Frequencies – CORF	US NAS
05/25-06/02	Working Party 1A (Spectrum engineering)	ITU-R
06/07-06/18	Working Party 5D	ITU-R
09/16-09/23	Working Party 7D	ITU-R
10/04-10/15	Working Party 5D	ITU-R
11/03-11/12	Working Party 1A	ITU-R
11/29-12/10	Working Party 5B	ITU-R

IUCAF submitted three documents containing four compatibility studies to these ITU-R Working Party meetings:

To WP1A, Document [1A/143](#) “Proposed revisions to preliminary draft new Report ITU-R SM.[WPT.BEAM.IMPACTS] - Impact studies and human hazard issues for wireless power transmission via radio frequency beam,” concerning potential interference from out of band emissions into the spectrum band 23.6 – 24 GHz that is reserved for passive radio science, originating in proposed use of an ISM band at 24.1 GHz for wireless device charging.

To WP5B, Document [5B/418](#) “Proposed update on working document towards a preliminary draft new Report ITU-R [NON-SAFETY AMS CHARACTERISTICS AND SHARING NOSTUDIES] related to agenda item 1.10 - Technical characteristics, operational scenarios, spectrum needs, coexistence, and sharing studies of non-safety aeronautical mobile systems in the frequency bands 15.4-15.7 GHz and 22-22.21 GHz,” detailing interference from proposed airborne wireless mesh networks into the adjacent bands at 15.35 – 15.4 GHz (reserved for passive radio science) and 22.21 – 22.5 GHz (allocated to radio astronomy).

To WP5D, Document [5D/788](#) “Proposed update on the working document towards sharing and compatibility studies of HIBS under agenda item 1.4 - Compatibility between HIBS and the radio astronomy service operating in the frequency band 2 690-2 700 MHz,” detailing interference from proposed use of IMT base stations on high altitude platform systems circulating at 20 km altitude.

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

5. IUCAF BUSINESS MEETINGS

IUCAF business was discussed by email as matters arose during the year 2021.

6. 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 2021.

7. THE IUCAF ROLE

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’s 60th birthday was observed in 2020 at the Fifth International IUCAF School on Spectrum Management in Stellenbosch, South Africa that was described in the 2020 Annual Report. IUCAF’s early history was recounted by Dr. Brian Robinson in “Frequency Allocation: The First Forty Years,” Annual Reviews of Astronomy and Astrophysics, 1999, vol. 37, pp 65-96, available at <https://tinyurl.com/y5vsgb6x>.

The practice of reserving narrow portions of the radio frequency spectrum for radio astronomy expanded after 1960 so that bands shared by radio astronomy and satellite remote sensing now provide crucial information used to improve weather forecasting and to quantify the effects of climate change. On this basis, IUCAF also provides an interface between the radio astronomy and satellite remote sensing communities via the Space Frequency Coordination Group. IUCAF is currently participating in the SFCG’s Lunar Martian Spectrum Group that is planning the use of radiocommunications on and around

the Moon and most especially in the Shielded Zone of the Moon: the volume of space that is shielded from view of the Earth and protected for scientific use by international treaty, in the form of the ITU-R Radio Regulations.

8. CONTACT WITH ISC, THE IUCAF SPONSORING UNIONS (IAU, URSI, COSPAR) AND OTHER INTERNATIONAL ORGANIZATIONS

IUCAF maintains regular contact with its adhering Unions and the parent body ISC. These organizations play a strong supporting role for IUCAF, whose members are greatly encouraged thereby.

The major international conference “Dark and Quiet Skies II for Science and Society”, <http://research.iac.es/congreso/quietdarksky2021/> sponsored by the IAU, the UN Office of Outer Space Affairs, the Government of Spain and the Instituto de Astrofísica de Canarias was about to occur in person on La Palma during October 3 – 7 2021 when eruption of a volcano on the island (!) forced the organizers to move the meeting online at the last minute. Over 1000 registrants attended online in numbers of a few hundred on each of five days, the last of which was largely devoted to radio astronomy. IUCAF members Liszt and Ohishi represented radio astronomy on the Scientific Organizing Committee and supervised the update of the radio astronomy working group report (<https://noirlab.edu/public/products/techdocs/techdoc051/>) that was presented on the final day of the recent meeting. The D&QS II meeting produced documents for consideration at the 2022 session of the Scientific and Technical Subcommittee (STSC) of the Committee on Peaceful Uses of Outer Space (COPUOS) as noted on their website at <https://www.unoosa.org/oosa/en/ourwork/copuos/stsc/2022/index.html>.

The Dark and Quiet Skies meetings were of special importance because they formulated recommendations outside the usual ITU-R regulatory regime that protects only the very small amount of radio spectrum that is formally allocated to astronomy and other passive science. The Dark and Quiet Skies meetings considered risks to astronomy of all kinds across the electromagnetic spectrum and concluded that satellites in low earth orbit should refrain from illuminating radio telescopes and radio quiet zones at all radio frequencies, with specific recommendations to accomplish this goal.

IUCAF participated remotely in the 2021 URSI GASS. The URSI Council requested an updated report covering the period since 2017, and it can be accessed at https://www.cv.nrao.edu/~hlistz/URSI/IUCAF-ReportToCouncil_2017-2021.docx. The IUCAF Chair delivered a presentation on spectrum matters that can be viewed at https://www.cv.nrao.edu/~hlistz/URSI/HSL_URSI_GASS_Rome2021.mp4.

9. 94 GHz COORDINATION AGREEMENT WITH THE EUROPEAN SPACE AGENCY (ESA)

Since 2005, NASA JPL has operated the 94.05 GHz CloudSat cloud profiling radar in the middle of a broad swath of spectrum that is allocated to and heavily used by radio astronomy. The powerful kW beam of this nadir-pointing radar saturates any receiver over which the satellite passes during its 16-day repeating orbital cycle, independent of the radio astronomy antenna pointing. More seriously, the radar could burn out the radio astronomy receiver in the worst case. A variety of modifications to radio astronomy operations and instruments have been made on this account, especially for moveable array antennas that

are transported in a zenith-pointing orientation with their super-cooled electronics operating. The unstable operations of this aging satellite have necessitated several last-moment accommodations on the part of radio astronomy.

To forestall this situation when ESA, with participation from the Japanese Space Agency JAXA, launches the EarthCare mission in 2023 with an even higher-power 94 GHz radar, IUCAF has for many years participated as an observer in meetings of the Space Frequency Coordination Group (SFCG) where EarthCare and other high power radars were discussed. This 15-year effort bore fruit in April 2021 when ESA and IUCAF signed a Memorandum of Understanding under which the EarthCare radar will be silenced when its beam passes close enough to a radio astronomy antenna that the radio astronomy receiver could be damaged.

IUCAF is grateful to ESA for agreeing to modify the EarthCare radar's operation, to JAXA for designing the radar in such a way that such an accommodation was possible, and to NASA which facilitated coordination by providing calculations and other support at SFCG.

The agreement may be accessed at [the IUCAF website](#).

10. OUTREACH, TRAINING AND THE SIXTH INTERNATIONAL IUCAF SCHOOL ON SPECTRUM MANAGEMENT FOR RADIO ASTRONOMY

IUCAF maintains its World Map of Radio Astronomy Sites and Radio Quiet Zones that has been viewed 70,000 times since its creation in 2008, see <http://tinyurl.com/yrvszk>. IUCAF continued to distribute its exceptionally popular IUCAF-logo fidget-spinner, thanks to a continuing grant from an anonymous donor. IUCAF is in the early planning stage for the Sixth International School on Spectrum Management for Radio Astronomy that will occur in the Asia Pacific Region in 2025. Presentations from the Fifth School in Stellenbosch in 2020 and earlier IUCAF schools are available on [the IUCAF website](#).

11. IUCAF CONCERNS IN 2021 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 the tables have turned. Allocations to science are fixed while the radio spectrum fills in with new radiocommunication systems, such as high power radars onboard satellites, collision avoidance radars on cars, 5G mobile phones, and broadband WiFi. Radio spectrum regulators authorize satellite mega-constellations in low earth orbit that have turned the dark and quiet night sky into a circus of artificially-generated radiation. Satellite trails from reflected sunlight are increasingly affecting optical/infrared astronomy, even from the Hubble Space Telescope that currently shows satellite trails in some 8% of its images. It was just such considerations, and the inability to raise them at ITU-R, which motivated IUCAF involvement in the Dark and Quiet Skies meetings. Concerns originating with radiocommunications and radio spectrum management have now spilled over into far wider concerns for the health of the environment that radio spectrum regulators are ill-equipped to handle.

Closer to home, succession planning and matters of engagement continue to be of concern. Many nations with major investments in radio astronomy and strong histories of

participation are not currently represented by astronomers in spectrum management, despite IUCAF prodding.

12. 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 support given by radio astronomy observatories, universities and national funding agencies to individual IUCAF members, allowing them to participate in the vital work of the committee. IUCAF especially appreciates the contributions of the organizations and individuals who made the last spectrum management school such a resounding success in 2020 just as the world was about to shut down.

Respectfully submitted,

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