

# XXXIst GENERAL ASSEMBLY

## RESOLUTIONS PRESENTED TO THE XXXIst GENERAL ASSEMBLY

### RESOLUTION B1

#### **in support of the protection of geodetic radio astronomy against radio frequency interference**

*Proposed by the IAU Commission A2 (Rotation of the Earth) and the IAU Commission A1 (Astrometry)*

The XXXI General Assembly of the International Astronomical Union,

#### **recognizing**

1. that the International Astronomical Union (IAU) is a Sector Member of the Radiocommunication Sector of the International Telecommunication Union (ITU-R),
2. that in Article 5 of the Radio Regulations of the ITU (RR) [1] a number of frequency bands are allocated to the radio astronomy service (RAS) on a primary and secondary basis,
3. that footnote RR No. **5.149** [1] lists several additional frequency bands not allocated to the RAS in the Table of Frequency Allocations in Article 5, and specifies “*administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference*” within bands covered by this footnote,
4. that footnote RR No. **5.340** [1] lists a number of frequency bands where no emissions are allowed,
5. that provision No. **29.9** of Article **29** of the RR [1] states that “*In providing protection from interference to the radio astronomy service on a permanent or temporary basis, administrations shall use appropriate means such as geographical separation, site shielding, antenna directivity and the use of time-sharing and the minimum practicable transmitter power*”,
6. that Recommendation ITU-R RA.769-2 [2] and Report ITU-R RA.2131-0 [3] specify the protection criteria used for radio astronomy measurements, including VLBI systems;

#### **noting**

7. that within the radio window of the Earth atmosphere, only a few narrow bands are allocated to the RAS in the frequency range 2 – 14 GHz on a primary or secondary basis;

## considering

8. that IAU Resolution B4 2015 [4] states that *"radio astronomy observations consist of the reception of extremely weak signals from cosmic sources, that radio astronomy receivers have exceptionally high sensitivity, which results in high susceptibility to interference caused by man-made radio signals"*, and *"that radio frequencies are a limited resource that must be shared"*,
9. that the Earth Orientation Parameters (EOP), a product that depends on geodetic radio astronomy using the Very Long Baseline Interferometry (VLBI) observation method, are indispensable for many critical applications (IAU Resolution No B7, 1997) [5], such as precise orbit determination, operation of global navigation satellite systems (GNSS), spacecraft launch and operations, time keeping, and precise navigation on land, sea, in air and space,
10. that geodetic radio astronomy provides the International Celestial Reference Frame (ICRF) (IAU Resolution B2 2018) [6], to which all other reference frames, such as the Planetary and Lunar Ephemerides, Gaia Celestial Reference Frame, reference frames at other wavelengths are referred to and that is essential for the most precise determination of the EOP,
11. that geodetic radio astronomy contributes also to the International Terrestrial Reference Frame (ITRF) (IAU Resolution B1 2018) [7], which is fundamental for positioning, surveying and geo-referencing the phenomena of geodynamics and global change, and its method, VLBI, is the only technique that provides the direct tie between the ICRF and ITRF by means of the EOP,
12. that the IAU has mandated the International Earth Rotation and Reference Systems Service (IERS) [8] to produce and disseminate the products that fall under considering 9 – 11 (IAU Resolution No. B 2 1985) [9] and hence is dependent on high quality data from geodetic radio astronomy,
13. that the International VLBI Service for Geodesy and Astrometry (IVS) [10] is the IAU Service Organisation (IAU Resolution No. B1.1 2000) [11] providing geodetic radio astronomy data and products to the IERS, space agencies, space and other industries, satellite operators, public administrations, and scientific institutions, on a regular basis,
14. that geodetic radio astronomy observations have been carried out since the early 1980s using frequencies in the frequency ranges 2.2 – 2.35 GHz and 8.1 – 8.9 GHz outside of the narrow allocated RAS bands, but the increasing number of applications, such as wireless local area networks (WLAN), mobile networks, synthetic aperture radar (SAR), satellite constellations, and other active services constrain the VLBI community to consider new frequency bands for its indispensable observations,
15. that the IVS implements a modern geodetic radio astronomy observing system, namely the VLBI Global Observing System (VGOS) [12], that requires observation bandwidth in the frequency range of 2 – 14 GHz in order to address the accuracy goals complying with the United Nations (UN) societal goals on sustainable development [7, 13, 14] as well as for the related scientific questions [15, 16],

16. that the frequency range of 2 – 14 GHz is allocated mostly to other active radio services, whose signals have a potential to interfere with geodetic radio astronomy observations and will have an essential impact on the radio astronomy equipment and the quality of acquired data,
17. that the increasing number of active services in the frequency range of 2 – 14 GHz limits the use of that range for radio astronomy in general and for geodetic radio astronomy in particular (IAU Resolution No. A 2 1988) [17],
18. that emissions from spaceborne or airborne platforms can be particularly severe sources of interference to the RAS (IAU Resolutions Nos. 3 1979, B 3 1985, and A 3 1991) [18, 19, 20] and that these cannot be avoided by choice of site for an observatory or by local means of protection, such as site shielding;

### **recommends**

19. to support the exploration of new observation bands for geodetic radio astronomy in the frequency range of 2 – 14 GHz outside of the existing RAS bands,
20. to promote cooperation with the national spectrum authorities for the protection of the observing sites of the global geodetic radio astronomy network to maintain the mission of geodetic radio astronomy for satisfying the societal and scientific needs,
21. to support a “Proposal for a draft new Question regarding the VLBI Global Observing System (VGOS)” to ITU-R [21],
22. administrations to consider a new Agenda Item at the World Radiocommunication Conference 2027 (WRC-27) [22] or as soon as possible, addressing the spectrum needs of geodetic radio astronomy in the frequency range of 2 – 14 GHz and the local protection of the few globally distributed geodetic radio astronomy observatories that form the global geodetic VLBI network;

### **resolves**

23. to express the view that the most effective protection of geodetic radio astronomy sites would be through radio quiet or coordination zones,
24. to encourage studies by the VLBI community possibly together with national spectrum authorities on the impact of the increasing radio frequency interference to geodetic radio astronomy observations, to support *“site testing and maintenance to avoid generating interference or importing interfering devices”*, and to support *“monitoring the ambient spectrum and tracking the occurrence of interference”* [23],
25. to encourage astronomers, geodesists and scientists of related disciplines, to work proactively in protecting radio astronomy service observations in the frequency range 2 – 14 GHz and to join the efforts of the European Committee on Radio Astronomy Frequencies (CRAF) and elsewhere,
26. to send a copy of this Resolution to administrations that operate or host geodetic radio astronomy network stations which use the frequency range 2 – 14 GHz for observations, and

where active radio services are operating or are planned to operate in the same frequency range,

27. to bring this Resolution to the attention of the Director of the United Nations Statistical Commission (UNSC) [24], to the Director of United Nations Office for Outer Space Affairs (UNOOSA) [25] and to the Secretary General of the International Telecommunication Union (ITU) [26].

## References

- [1] ITU Radio Regulations 2020, <http://handle.itu.int/11.1002/pub/814b0c44-en>
- [2] ITU “RA.769-2: Protection criteria used for radio astronomical measurements” 2003, <https://www.itu.int/rec/R-REC-RA.769/en>
- [3] ITU “Supplementary information on the detrimental threshold levels of interference to radio astronomy observations in Recommendation ITU-R RA.769” 2008, <https://www.itu.int/pub/R-REP-RA.2131>
- [4] IAU Resolution B4 “Protection of Radio Astronomy Observations in the Frequency Range 76 - 81 GHz from Interference Caused by Automobile Radars.” 2015, [https://www.iau.org/static/resolutions/IAU2015\\_English.pdf](https://www.iau.org/static/resolutions/IAU2015_English.pdf)
- [5] IAU Resolution No B7 1997, [https://www.iau.org/static/resolutions/IAU1997\\_French.pdf](https://www.iau.org/static/resolutions/IAU1997_French.pdf)
- [6] IAU Resolution B2 “on The Third Realization of the International Celestial Reference Frame” 2018, [https://www.iau.org/static/resolutions/IAU2018\\_ResolB2\\_English.pdf](https://www.iau.org/static/resolutions/IAU2018_ResolB2_English.pdf)
- [7] IAU Resolution B1 “on Geocentric and International Terrestrial Reference Systems and Frames” 2018, [https://www.iau.org/static/resolutions/IAU2018\\_ResolB1\\_English.pdf](https://www.iau.org/static/resolutions/IAU2018_ResolB1_English.pdf)
- [8] International Earth Rotation and Reference Systems Service (IERS), <https://www.iers.org/>
- [9] IAU Resolution No. B 2 1985 “Reference Frames”, [https://www.iau.org/static/resolutions/IAU1985\\_French.pdf](https://www.iau.org/static/resolutions/IAU1985_French.pdf)
- [10] International VLBI Service for Geodesy and Astrometry (IVS), <https://ivscc.gsfc.nasa.gov/>
- [11] IAU Resolution No. B1.1 “Maintenance and establishment of reference frames and systems” 2000, [https://www.iau.org/static/resolutions/IAU2000\\_French.pdf](https://www.iau.org/static/resolutions/IAU2000_French.pdf)
- [12] International VLBI Service for Geodesy and Astrometry. IVS Technology. VGOS System Development, <https://ivscc.gsfc.nasa.gov/technology/vgos-general.html>
- [13] United Nations Initiative on Global Geospatial Information Management (UN-GGIM) “Global geodetic reference frame” E/C.20/2013/4/Add.1, <http://ggim.un.org/knowledgebase/Attachment2069.aspx?AttachmentType=1>
- [14] United Nations General Assembly Resolution adopted by the General Assembly on 26 February 2015 “69/266. A global geodetic reference frame for sustainable development”, <http://ggim.un.org/knowledgebase/Attachment157.aspx?AttachmentType=1>
- [15] Plag, H.-P. & M. Pearlman (eds.) 2009: Global Geodetic Observing System. Meeting the Requirements of a Global Society on a Changing Planet in 2020. Springer Dordrecht Heidelberg London New York, <https://doi.org/10.1007/978-3-642-02687-4>
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- [17] IAU Resolution No. A 2 1988, [https://www.iau.org/static/resolutions/IAU1988\\_French.pdf](https://www.iau.org/static/resolutions/IAU1988_French.pdf)
- [18] IAU Resolution No. 3 1979, [https://www.iau.org/static/resolutions/IAU1979\\_French.pdf](https://www.iau.org/static/resolutions/IAU1979_French.pdf)
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- [20] IAU Resolution No. A 3 1991, [https://www.iau.org/static/resolutions/IAU1991\\_French.pdf](https://www.iau.org/static/resolutions/IAU1991_French.pdf)
- [21] ITU-R 2020 “Proposal for a draft new Question regarding the VLBI Global Observing System (VGOS)”: <https://www.itu.int/md/R19-SG07-C-0018/en>
- [22] World Radiocommunication Conference (WRC): <https://www.itu.int/en/ITU-R/conferences/wrc/>
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