

Frequencies for Radio Astronomy

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At present the scope of research in radio astronomy is limited by the allocation of frequencies, some of which have to be shared with other radio services. When the International Telecommunications Union reconsiders all frequency allocations next year, astronomers are hoping for an improvement.

THE allocation of bands of frequencies to the many radio services is a matter for agreement between nations. A series of conferences, arranged by the International Telecommunications Union (ITU), have dealt with various parts of the spectrum and with various services, so that there is now an agreed allocation for all frequency bands from 10 kHz to 40 GHz. In this agreement, the needs of scientific research must be presented, along with those of all radio services, by national administrations and not directly by the scientists. Coordination of the individual national proposals must therefore be achieved through the combined action of three international scientific unions, IAU (astronomy), COSPAR (space) and URSI (radio), which jointly delegate members to an Inter-Union Commission for the Allocation of Frequencies for Radio Astronomy and Space Science (IUCAF). This Commission discusses the scientific case for protecting various frequency bands for space research and radio astronomy, and informs scientists and administrations throughout the world of the desirable and practical steps that can be taken to improve and extend the allocations.

There will be a new World Administrative Conference of the ITU in June 1971, covering frequency allocations for all space activities, notably for satellite communications. IUCAF has made several suggestions for revising the allocations, especially for radio astronomy; these have been passed on to national administrations, and there is reason to hope that most of the IUCAF suggestions will become firm proposals with a good chance of acceptance at the conference.

Space research seems to be fairly well catered for in the existing regulations, apart from a difficulty in obtaining the use of some low frequency bands for ionospheric research. IUCAF is seeking an improvement in the protection of the "guard bands" around standard frequency transmissions for this purpose.

The more complex problem of radio astronomy is set out in the table, which lists existing allocations together with the latest IUCAF proposals. Two kinds of allocation are required: a series of bands to cover the whole spectrum at roughly octave intervals, for continuum radiation, and some individual bands to cover the most important radio spectral lines.

Some bands already allocated are shared with other services, such as "fixed and mobile", that is communications such as taxi radio. This is only possible when radio observatories and the other users are geographically widely separated; even so, sharing is often a serious limitation on the sensitivity of the radio astronomical work. There are also differences between the three "regions" of the world, defined by ITU. In any table the word "shared" covers a range of meanings. The ITU regulations include "secondary allocations", "shared allocations" and various forms of footnotes; all these are here designated as "shared".

The table represents the present state of discussions. There will be many more discussions during the coming

Table 1. EXISTING ALLOCATIONS OF FREQUENCIES TO RADIO ASTRONOMY AND PROPOSED CHANGES

Frequency band	Present status	Proposed changes
Approx. 10 MHz (bandwidth 20 kHz)	None	This band is needed for low-frequency observations, especially of extragalactic sources
Approx. 20 MHz (bandwidth 20 kHz)	None	As at 10 MHz. Proposals for a band at 22 MHz are expected
37.75-38.25 MHz	Shared	Improved protection is needed, although sharing may be necessary
73-74.6 MHz	Region 2 only (N. and S. America)	No extension to other regions seems possible
150.5-153 MHz	Region 1 only (Europe). Shared	No improvement seems possible
404-410 MHz	Shared	Small regional differences should be removed, giving an international allocation
606-614 MHz	Allocated to television, but so far unused	IUCAF asks for this band to be allocated to radio astronomy
1,400-1,427 MHz (the hydrogen line)	Exclusive allocation to radio astronomy	An extension to lower frequencies—down to 1,390 MHz—is needed for observation of galaxies with large redshifts
1,664.4-1,668.4 MHz (the OH line)	Shared	Protection is sought from airborne transmitters in this band, and an extension to 1,660-1,670 MHz seems possible
1,612 and 1,720 MHz (other OH lines)	None	Some local protection is sought for individual observatories observing these lines
2,690-2,700 MHz	Exclusive allocation to radio astronomy	An extension down to 2,670 MHz, on a shared basis, is requested for wide-band observations of extragalactic sources
4,990-5,000 MHz	Exclusive in Region 2 (N. and S. America), shared elsewhere	Improvement of protection, and an extension down to 4,950 MHz, both seem possible and are requested by IUCAF
10.62-10.70 GHz	Exclusive allocation to radio astronomy (with some exceptions)	An extension down to 10.60 GHz is requested
15.35-15.40 GHz	Exclusive allocation to radio astronomy (with some exceptions)	No change is proposed
19.3-19.4 GHz	Exclusive to radio astronomy, with some exceptions	This band is needed for satellite communications, and will be relinquished by radio astronomers
23.0-23.5 GHz	Proposed for exclusive allocation to radio astronomy	Replacement for the 19.3-19.4 GHz band; also covers some NH ₃ and H ₂ O lines
31.3-31.5 GHz	Exclusive to radio astronomy with some exceptions	No change is proposed
40-240 GHz	A series of bands, for example, 88-92 GHz	It is proposed to preserve wide bands in this region initially for reception only

There are also requests for some protection to be given to observations of the three following spectral lines: formaldehyde, 4.825-4.835 MHz; formaldehyde, 14.485-14.515 GHz; water vapour, 22.21-22.26 GHz.

year, and many weeks of work at the conference itself. IUCAF has asked to have an observer at the conference, so that the scientific case for the various proposals is available at all times. Fortunately many of the people concerned with formulating the next international agreement realize that the electromagnetic spectrum is a natural resource that can be despoiled as effectively as any other, and it is to be hoped that considerable improvement will be obtained in the status of frequency allocations for scientific research.