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Space science and meteorology spectrum allocations in the UK



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Introduction

'Space science' is an umbrella term that covers both Earth observation and space related scientific research. Earth observation (EO) satellites observe the earth and its atmosphere, using visible light or radio spectrum from a unique vantage point. The information it provides is used for a wide range of purposes including weather forecasting, environmental monitoring, climate change research as well as a number of commercial activities. Radio astronomy and space research contribute to our knowledge of space and the evolution of the universe. The following services fall under this category:

- Earth Exploration Satellite Service (EESS)
- Space Research Service (SRS)
- Space Operation Service (SOS)
- Radio Astronomy Service (RAS)
- Meteorological Satellite Service (MetSat)
- Meteorological Aids Service (Met-Aids)
- Radiolocation Service Note: this only for wind profiler and weather radars)
- Standard Time and Frequency signals)

These services can be split in two broad categories:

- *passive services* (RAS, EESS and Space Research Service), that measure naturally-occurring radiation often at very low power levels. This information provides useful data to help further understand the Earth and universe. The frequency bands are often determined by the specific physical properties being investigated (e.g. molecular resonance).
- *active services* that make use of a variety of technologies (e.g. radiodetermination) to carryout measurements, observations or transfer the collected data. These active applications are relatively less sensitive to interference compared to passive sensors.

Given the low levels of radiation being monitored these services often use very sensitive receivers. In most cases the equipment is not able to discriminate between these natural radiations and man-made radiations. For this reason, a number of bands have been harmonised across the world for the use by passive services only. Even low level man-made signals may have a degrading impact on the sensor/receiver performance and impact on the data being collected. International Telecoms Union (ITU) Radio Regulation (RR) footnote 5.340 prohibits any emissions in the band thus enables the passive services to deploy and operate their systems with the highest reliability. In addition, footnote 5.149 urges administrations to take all practicable steps to protect the Radio Astronomy Service from harmful interference in a number of specific frequency bands.

The UK hosts some important radio astronomy sites, including Jodrell Bank and Cambridge observatories. The UK also benefits from (and contributes to) European Space Agency (ESA) missions, and plays an important role in various international space research missions including missions to explore other planets.

Allocation of spectrum

The allocation and use of certain frequency bands are harmonised across the world. These rules are set out in the ITU Radio Regulations.

Frequencies for space science and meteorology use in the UK

Frequency Band	Typical Applications	Protection
8.3 – 11.3 kHz	Meteorological Aids. (Passive only) lightning detection system.	
13360 – 13410 kHz	Radio Astronomy - Only likely to be used at sunspot minimum.	
25550 – 25670 kHz	Radio Astronomy - Only likely to be used at sunspot minimum.	
37.75 – 38.25 MHz	Radio Astronomy - All sky survey at CLFST.	
80.5 – 82.5 MHz	Radio Astronomy - Scintillation studies and mapping radio sources.	
150.05 – 152.00 MHz	Radio Astronomy - MERLIN mapping of radio sources and by CLFST for all sky survey.	RSA protection granted for CA and JB. No protection for CB.
232 – 236 MHz	Radio Astronomy – Pulsars at Jodrell Bank	
401 – 403 MHz	Meteorological Aids Meteorological-Satellite (Earth-to-space)	
403 – 406 MHz	Meteorological Aids	
406.1 – 410.0 MHz	Radio Astronomy - MERLIN observations, pulsars and mapping radio sources at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere. Used at Chilbolton.	
606 – 614 MHz	Radio Astronomy - Pulsar observations and VLBI measurements.	
915 – 917 MHz	Radiolocation - boundary layer wind profiler use at Camborne and Isle of Man.	
962 – 970 MHz	Radio Astronomy – Pulsars at Jodrell Bank	
1217.6 – 1237.6 MHz	Passive sensing of water vapour from GPS signals.	
1290 – 1295 MHz	Radiolocation - boundary layer wind profilers at Wattisham, Dunkeswell and Chilbolton	
1350 – 1380 MHz	Radio Astronomy – Red shifted hydrogen line studies and MERLIN at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere.	
1380 – 1400 MHz	Radio Astronomy – Noting 5.339 permits 1370-1400 MHz to be used on a secondary basis. Red shifted hydrogen line studies and MERLIN at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere.	

Frequency Band	Typical Applications	Protection
1400 – 1427 MHz	Radio Astronomy - Hydrogen line studies, pulsars observations and mapping radio sources. Used at Chilbolton. Passive Earth sensing - Soil moisture measurements.	RSA protection granted for CA, DA DE, JB, KN and PI.
1610.6 – 1613.8 MHz	Radio Astronomy - MERLIN and hydroxyl line studies. Used at Chilbolton.	RSA protection granted for CA, DA DE, JB, KN and PI. No protection for CB.
1660.0 – 1660.5 MHz	Radio Astronomy - MERLIN and hydroxyl line studies.	RSA protection granted for CA DA DE JB KN PI
1660.5 - 1668.0 MHz	Radio Astronomy - MERLIN and hydroxyl line studies. Used at Chilbolton.	RSA protection granted for CA, DA DE, JB, KN and PI. No protection for CB.
1668 - 1670 MHz	Radio Astronomy - MERLIN and hydroxyl line studies. Used at Chilbolton.	RSA protection granted for CA, DA DE, JB, KN and PI. No protection for CB.
1690 – 1698 MHz	Meteorological-Satellite (space-to-Earth)	RSA for Receive-only Earth stations (ROES) available.
1698 – 1700 MHz	Meteorological-Satellite (space-to-Earth)	RSA for Receive-only Earth stations (ROES) available.
1700 – 1710 MHz	Meteorological-Satellite (space-to-Earth)	RSA for Receive-only Earth stations (ROES) available.
1718.8 – 1722.2 MHz	Used at Chilbolton.	
2290 – 2300 MHz	Radio Astronomy – VLBI measurements and pulsars. Used at Jodrell Bank.	
2655 – 2670 MHz	Radio Astronomy – VLBI measurements and pulsars. Used at Jodrell Bank.	
2670 – 2690 MHz	Radio Astronomy – Mapping radio sources and pulsars. Used at Jodrell Bank.	
2690 – 2700 MHz	Radio Astronomy – Mapping radio sources, pulsars, and possibly MERLIN observations. Used at Chilbolton.	RSA protection granted for CA, DA DE, JB, KN and PI.
4600 – 4825 MHz	Radio Astronomy – Cosmic microwave studies and MERLIN measurements at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere	
4825 – 4835 MHz	Radio Astronomy – Cosmic microwave studies and MERLIN measurements at Cambridge, Darnhall, Defford, Knockin, Pickmere	
	Radio Astronomy – Formaldehyde (H ₂ CO) line studies and MERLIN measurements at Jodrell Bank	

Frequency Band	Typical Applications	Protection
4835 – 4950 MHz	Radio Astronomy – Cosmic microwave studies and MERLIN measurements at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere.	
4950 – 4990 MHz	Radio Astronomy – Cosmic microwave studies at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere.	
4990 – 5000 MHz	Radio Astronomy – Mapping radio sources and pulsars at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere. Used at Chilbolton.	No protection for CB.
5250 – 5570 MHz	Active Earth sensing – Synthetic Aperture Radar, altimeters, scatterometers and WindRAD.	
5600 – 5650 MHz	Radiolocation – weather radars at 15 locations.	
6425 – 7250 MHz	Passive Earth sensing – Advanced Microwave Scanning Radiometers.	
6650.0 – 6675.2 MHz	Radio Astronomy – Methanol (CH ₃ OH) line studies and MERLIN measurements at Cambridge, Darnhall, Defford, Jodrell Bank, Knockin, Pickmere.	
7145 – 7750 MHz	Space research and Active sensing – data downlinks, telemetry and control.	
7750 – 7900 MHz	Space research and Active sensing – data downlinks, telemetry and control. Meteorological-Satellite (space-to-Earth)	RSA for Receive-only Earth stations (ROES) available.
8025 – 81750 MHz	Earth Exploration and Space research – data downlinks, telemetry and control.	
8175 – 8215 MHz	Earth Exploration and Space research – data downlinks, telemetry and control. Meteorological-Satellite (Earth-to-space)	
8215 – 8400 MHz	Earth Exploration and Space research – data downlinks, telemetry and control.	
8400 – 8500 MHz	Radio Astronomy – VLBI measurements at Cambridge, Jodrell Bank. Space research – data downlinks.	
8535 – 8660 MHz	Active space sensing – Major planetary radar facilities at Goldstone, Green Bank, Arecibo and Socorro. Active Earth sensing.	
9300 – 9900 MHz	Active space sensing – Synthetic Aperture Radio (SAR)	
10.60 – 10.68 GHz	Radio Astronomy – Cosmic background studies. Passive Earth sensing – Advanced Microwave Scanning Radiometers.	

Frequency Band	Typical Applications	Protection
10.68 – 10.70 GHz	Radio Astronomy – Cosmic background studies. Used at Chilbolton. Passive Earth sensing – Advanced Microwave Scanning Radiometers.	ITU RR footnote 5.340 applies to the band. RSA protection granted for CA, DA, JB, KN, PI, and DE.
10.7 – 12.5 GHz	Fixed Satellite – main reception band used by Eumetsat in Europe.	
13.25 – 13.75 GHz	Active Earth sensing – Synthetic Aperture Radio (SAR), altimeters and scatterometers.	
14.47 – 14.50 GHz	Radio Astronomy – for Formaldehyde (H ₂ CO) line studies at Cambridge, Jodrell Bank.	
15.35 – 15.40 GHz	Radio Astronomy – Mapping radio sources.	ITU RR footnote 5.340 applies to the band. RSA protection granted for CA, DA, JB, KN, PI, and DE.
17.20 – 17.30 GHz	Active Earth and space sensing	
18.60 – 18.80 GHz	Passive Earth sensing – Advanced Microwave Radiometers (AMR), Advanced Microwave Scanning Radiometer (AMSR) and Microwave Imaging Mission.	
22.00 – 22.21 GHz	Radio Astronomy – MERLIN observations and water (H ₂ O) line studies.	RSA protection granted for CA, DA, JB, KN, PI, and DE.
22.21 – 22.50 GHz	Radio Astronomy – MERLIN observations and water (H ₂ O) line studies. Used at Chilbolton. Passive Earth sensing – Special Sensor Microwave Imager Sounder	RSA protection granted for CA, DA, JB, KN, PI, and DE. No protection for CB.
22.81 – 22.86 GHz	Radio Astronomy – Ammonia (NH ₃) line studies. Used at Chilbolton.	RSA protection granted for JB and CA. No protection for CB.
23.07 – 23.12 GHz	Radio Astronomy – Ammonia (NH ₃) line studies. Used at Chilbolton.	RSA protection granted for JB and CA. No protection for CB.
23.6 – 24.0 GHz	Radio Astronomy – MERLIN observations and ammonia (NH ₃) line studies. Used at Chilbolton. Passive Earth sensing – Microwave Imaging Mission, microwave sounding and microwave radiometers	ITU RR footnote 5.340 applies to the band. RSA protection granted for CA, DA, JB, KN, PI, and DE.
31.3 – 31.5 GHz	Radio Astronomy – Cosmic microwave studies. Used at Chilbolton. Passive Earth sensing – Microwave sounders	ITU RR footnote 5.340 applies to the band. RSA protection granted for CA, DA, JB, KN, PI, and DE.
31.5 – 31.8 GHz	Radio Astronomy	

Frequency Band	Typical Applications	Protection
33.65 – 34.35 GHz	Passive Earth sensing – Advanced Microwave Radiometer	
35.20 – 35.50 GHz	Meteorological Aids	
35.50 – 36.00 GHz	Active Earth sensing - Synthetic Aperture Radio (SAR), altimeters and precipitation radars. Passive Earth sensing – Microwave radiometers, Special Sensor Microwave Imager Sounder. Meteorological Aids	
36.00 – 40.00 GHz	Active Earth sensing - Synthetic Aperture Radio (SAR), altimeters and precipitation radars. Passive Earth sensing – Microwave radiometers, Special Sensor Microwave Imager Sounder.	
42.5 – 43.5 GHz	Radio Astronomy – Silicon monoxide (SiO) line studies and MERLIN observations.	RSA protection granted for CA
48.94 – 49.04 GHz	Radio Astronomy – Carbon mono-sulphide (CS) line studies.	RSA protection available
50.20 – 50.40 GHz	Passive Earth sensing - Microwave Imaging Mission, Microwave Sounders	ITU RR footnote 5.340 applies to the band.
51.40 – 52.60 GHz	Radio Astronomy	
52.60 – 54.25 GHz	Passive Earth sensing - Microwave Imaging Mission, Microwave sounders. Astronomy also uses part of the band	ITU RR footnote 5.340 applies to the band.
54.25 – 60.80 GHz	Passive Earth sensing – Microwave Imaging Mission, Microwave sounders. Radio Astronomy also uses part of the band	
63.27 – 63.28 GHz	Passive Earth sensing - Special Sensor Microwave Imager Sounder.	
64 – 65 GHz	Radio Astronomy	
76.0 – 77.5 GHz	Radio Astronomy	
77.5 – 79.0 GHz	Radio Astronomy	
79 – 86 GHz	Radio Astronomy	
86 – 92 GHz	Radio Astronomy - Spectral line studies at Cambridge Passive Earth sensing – Microwave sounding and Microwave imaging	ITU RR footnote 5.340 applies to the band.

Frequency Band	Typical Applications	Protection
92 – 94 GHz	Radio Astronomy	
94.0 – 94.1 GHz	Radio Astronomy Active space sensing - Precipitation and Cloud profiling radars	
94.10 – 100 GHz	Radio Astronomy Passive Earth sensing	
100 – 102 GHz	Radio Astronomy Passive Earth sensing	ITU RR footnote 5.340 applies to the band.
102 – 109.5 GHz	Radio Astronomy Passive Earth sensing	
109.5 – 111.8 GHz	Radio Astronomy Passive Earth sensing	ITU RR footnote 5.340 applies to the band.
111.8 – 114.25 GHz	Radio Astronomy Passive Earth sensing	
114.25 – 116 GHz	Radio Astronomy Passive Earth sensing	ITU RR footnote 5.340 applies to the band.
116 – 122 GHz	Passive Earth sensing - Microwave Imaging and Sub-millimeter Radiometer	
123 – 130 GHz	Radio Astronomy	
130 – 134 GHz	Radio Astronomy Active Earth sensing	
134 – 136 GHz	Radio Astronomy	
136.0 - 148.5 GHz	Radio Astronomy	
148.5 – 151.5 GHz	Radio Astronomy Passive Earth sensing	ITU RR footnote 5.340 applies to the band.
151.0 – 158.5 GHz	Radio Astronomy Passive Earth sensing - Microwave Sounding Mission	
164 – 167 GHz	Radio Astronomy Passive Earth sensing - Microwave Sounders	ITU RR footnote 5.340 applies to the band.

Frequency Band	Typical Applications	Protection
182 – 185 GHz	Radio Astronomy Passive Earth sensing - Microwave Sounders and Microwave Imaging.	ITU RR footnote 5.340 applies to the band.
190 – 191.8 GHz	Passive Earth sensing - Microwave Sounders and Microwave Imaging.	ITU RR footnote 5.340 applies to the band.
200 – 209 GHz	Radio Astronomy	ITU RR footnote 5.340 applies to the band.
209 – 217 GHz	Radio Astronomy	
226.0 – 231.5 GHz	Radio Astronomy Passive Earth sensing - Microwave Sounders and Microwave Imaging.	ITU RR footnote 5.340 applies to the band.
238 – 241 GHz	Passive Earth sensing – Ice Cloud Imager	
241 – 248 GHz	Radio Astronomy Passive Earth sensing – Microwave Limb Sounder and Ice Cloud Imager.	
248 – 250 GHz	Radio Astronomy	
250 – 252 GHz	Radio Astronomy	ITU RR footnote 5.340 applies to the band.
252 – 275 GHz	Radio Astronomy	

Above 275 MHz

The following frequency bands in the range 275 - 1000 GHz are identified for use by administrations for passive service applications under RR footnote 5.565:

Radio astronomy service: 275 - 323 GHz, 327 - 371 GHz, 388 - 424 GHz, 426 - 442 GHz, 453 - 510 GHz, 623 - 711 GHz, 795 - 909 GHz and 926 - 945 GHz;

Earth exploration-satellite service (passive) and space research service (passive): 275 - 286 GHz, 296 - 306 GHz, 313 - 356 GHz, 361 - 365 GHz, 369 - 392 GHz, 397 - 399 GHz, 409 - 411 GHz, 416 - 434 GHz, 439 - 467 GHz, 477 - 502 GHz, 523 - 527 GHz, 538 - 581 GHz, 611 - 630 GHz, 634 - 654 GHz, 657 - 692 GHz, 713 - 718 GHz, 729 - 733 GHz, 750 - 754 GHz, 771 - 776 GHz, 823 - 846 GHz, 850 - 854 GHz, 857 - 862 GHz, 866 - 882 GHz, 905 - 928 GHz, 951 - 956 GHz, 968 - 973 GHz and 985 - 990 GHz.

Note: The use of the range 275 - 1000 GHz by the passive services does not preclude use of this range by active services. Administrations wishing to make frequencies in the 275 - 1000 GHz range available for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established in the above-mentioned 275 - 1000 GHz frequency range.

Locations of UK Radio Astronomy Observatories in the UK

Observatory	Location	Ordnance Survey National Grid Reference
Cambridge (CA)	Cambridge	TL 39400 54000
Chilbolton (CB)	Stockbridge, Hants	SU 37900 38500
Darnhall (DA)	Cheshire	SJ 64275 62265
Defford (DE)	Worcestershire	SO 90200 44700
Jodrell Bank (JB)	Cheshire	SJ 79650 70950
Knockin (KN)	Shropshire	SJ 32855 21880
Pickmere (PI)	Tabley, Cheshire	SJ 70404 76945

ITU Footnote 5.340

Certain frequency bands

"All emissions are prohibited in the following bands: 1400-1427 MHz, 2690-2700 MHz, except those provided for by No. 5.422, 10.68-10.7 GHz, except those provided for by No. 5.483, 15.35-15.4 GHz, except those provided for by No. 5.511, 23.6-24 GHz, 31.3-31.5 GHz, 31.5-31.8 GHz, in Region 2, 48.94-49.04 GHz, from airborne stations 50.2-50.4 GHz, 52.6-54.25 GHz, 86-92 GHz, 100-102 GHz, 109.5-111.8 GHz, 114.25-116 GHz, 148.5-151.5 GHz, 164-167 GHz, 182-185 GHz, 190-191.8 GHz, 200-209 GHz, 226-231.5 GHz, 250-252 GHz. (WRC-03)."

Further information

This document provides a high level overview of spectrum used by the Space Science and Meteorology services in the UK. Further information can be found in the following locations.

Information	Location
UK Space Agency	https://www.gov.uk/government/organisations/uk-space-agency
Met Office	http://www.metoffice.gov.uk/
Ofcom	https://www.ofcom.org.uk/
Science & Technology Facilities Council (STFC)	http://www.stfc.ac.uk/
Online Frequency Allocation Table (includes all UK and International footnotes).	http://static.ofcom.org.uk/static/spectrum/fat.html
Frequencies authorised for use by Ofcom (UKPFA)	http://spectruminfo.ofcom.org.uk/spectrumInfo/ukpfa
Ofcom's Space spectrum strategy	https://www.ofcom.org.uk/consultations-and-statements/category-1/space-spectrum-strategy
Ofcom's interactive data on the use of spectrum by the satellite and space science sectors	https://www.ofcom.org.uk/consultations-and-statements/category-1/space-spectrum-strategy/interactive-data