

RECOMMENDATION ITU-R RA.479-5*

Protection of frequencies for radioastronomical measurements in the shielded zone of the Moon

(Question ITU-R 149/7)

(1974-1978-1982-1990-1995-2003)

The ITU Radiocommunication Assembly,

considering

- a) that Resolution B16 of the 1994 XXIIth General Assembly of the International Astronomical Union (IAU) (see Annex 2) recommends that, once radio astronomy observations in the Shielded Zone of the Moon (SZM) commence, radiocommunication transmissions in the SZM be limited to the 2-3 GHz band, but that an alternate band at least 1 GHz wide be identified for future operations on a time-coordinated basis between radio astronomy and lunar communication systems;
- b) that radio astronomical discoveries resulting from observations from spacecraft above the atmosphere of the Earth will reveal unexpected new astronomical phenomena;
- c) that, in addition to the establishment of line-of-sight communication links for scientific and other purposes between the Earth and spacecraft, it may be necessary to establish links between stations on the far side of the Moon and other stations on or visible from the Earth;
- d) that Article 22, Nos. 22.22 to 22.25 of the Radio Regulations (RR) recognizes the necessity of maintaining the SZM as an area of great potential for observations by the radio astronomy service and by passive space research and consequently as free as possible from transmissions;
- e) that earth satellites with high apogees, satellites in the halo orbits near the Sun-Earth L_2 point, satellites in the Earth-trailing orbits, deep-space probes and transmitters located near, or on the Moon may each illuminate the shielded zone, where the Sun-Earth L_2 Lagrange point is detailed in Recommendation ITU-R RA.1417,

recommends

- 1 that, in planning the use of the radio spectrum, both nationally and internationally, account be taken of the need to provide for radio astronomy observations in the SZM;
- 2 that, in taking account of such a need, special attention should be given to those frequency bands in which observations are difficult or impossible from the surface of the Earth;
- 3 that the frequency spectrum should be used in the SZM in keeping with the preliminary guidelines contained in Annex 1;

* This Recommendation should be brought to the attention of Radiocommunication Study Groups 1 and 3.

4 that special attention be paid to emissions into the SZM from deep-space platforms, satellites in the halo orbits near the Sun-Earth L_2 point, satellites in the Earth-trailing orbits, or transmitters near or on the Moon;

5 that in the frequency bands which would be considered for joint use by active and passive space stations in the SZM, radio astronomy observations should be protected from harmful interference. To this end appropriate discussions between concerned administrations may be conducted;

6 that in-situ radiocommunication equipment developed for the environment of Mars or other planets should not be deployed in the SZM, but the choice of frequencies for the close proximity links in the SZM should follow the preliminary guidelines contained in Annex 1.

Annex 1

The protection of radio astronomy observations in the SZM

1 Introduction

The electromagnetic spectrum is now so heavily used on Earth that much of its potential value for passive scientific research has already been seriously affected. Because of the general increase in radiocommunications, especially involving earth satellites, spacecraft, and deep-space probes, it is important that frequency allocations by the International Telecommunication Union be coordinated to minimize interference with radio astronomy. In particular, since the far side of the Moon is the remaining accessible place where radio observations of the Universe are possible without interference over the whole radio spectrum, it is necessary to allocate frequencies for active use by deep-space probes, lunar satellites, scientific instrument packages and research stations on the lunar surface in such a way that interference with such passive observations is avoided.

Part of the Moon's surface is always protected from interfering signals generated on and near the Earth because the Moon always presents nearly the same side towards the Earth. It has a period of rotation about its axis equal to its period of revolution around the Earth, but because its orbit is slightly elliptical and inclined, observers on Earth can see somewhat more than half the surface of the Moon. If, in addition, the Moon is viewed from an earth satellite in an orbit of 100 000 km radius, another small fraction is seen. The remaining invisible portion of the Moon's surface is that which lies more than 23.2° beyond the mean limb of the Moon as seen from the centre of the Earth. The SZM consists of the shielded area of the Moon's surface together with an adjacent volume which is shielded from interference originating within a distance of 100 000 km from the centre of the Earth (Article 22, RR No. 22.22.1).

2 General preliminary guidelines for the use of the electromagnetic spectrum in the SZM

The SZM is expected to be free from terrestrial interference over the whole frequency spectrum. It is a unique site for scientific observations. As it is expected that radioastronomical and other scientific experiments will soon be carried out in this zone, it is essential to regulate the activities of the radio services whose facilities may illuminate it. Account must be taken of the requirements of earth satellites, deep-space probes and transmitters located in the SZM, on the understanding, however, that it is desirable to maintain the SZM as a zone free from radio interference and hence of great value for passive observations.

The use of the frequency spectrum by services with facilities which are located in the SZM or which illuminate it could be based on the following preliminary set of guidelines, which will need to be reviewed when additional information is received.

The entire radio-frequency spectrum in the SZM is designated as available for passive users (the radio astronomy service and other passive users as defined in the RR), with the following exceptions:

- frequency bands currently available and allocated in the future to the space research service, and those frequency bands in the space operation service, the Earth exploration-satellite service and the radiodetermination-satellite service, that are required to support space research;
- frequency bands currently available or allocated in the future for radiocommunication and for space research transmissions within the lunar shielded zone.

Except for these essential transmissions, it is intended to keep the SZM free from man-made transmissions. In the planning of such transmissions, it is desirable to avoid the areas of the spectrum of greatest astronomical importance and to provide frequency flexibility in transmitting systems.

The proposed guidelines do not impose any restriction on existing or future terrestrial radio services or on existing or future space radio services, the transmitters of which are switched on at a distance of less than 100 000 km from the centre of the Earth.

Under the proposed guidelines, existing or future space radio services for which transmitters are switched on at a distance of more than 100 000 km from the Earth and which operate in accordance with the RR should coordinate their activities with the radio astronomy service. It is essential that provisions governing compatibility between the radio astronomy service and other services, based on the technical features of the services, be specified by a decision adopted by the ITU.

3 Protection of radioastronomical observations in the SZM

For radioastronomical observations, the SZM presents unique advantages, which have been long recognized. In addition to offering the closest to an interference-free environment, advantages of the SZM for radio astronomy include the lack of a substantial atmosphere, which allows the study of regions of the electromagnetic spectrum which are inaccessible from the Earth. In particular, lack of a lunar ionosphere allows study of the spectra of celestial sources between about 50 kHz and