OBSERVATIONS OF ULTRA-LOW-FREQUENCY RADIATION AT TWO CONJUGATE POINTS

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Fig. 1

Figure 1: Fig. 1

Abstract

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OBSERVATIONS OF ULTRA-LOW-FREQUENCY RADIATION AT TWO CONJUGATE POINTS

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Joint Soviet-French studies of observations of natural ultra-low-frequency (ULF) radiation at magnetically conjugate stations—Sogra (Arkhangelsk Region) and Kerguelen (a French island in the Indian Ocean)—have been carried out simultaneously on identical apparatus since July 1964. Recording of ULF radiation at both stations is performed continuously on a paper recorder; during bursts of ULF radiation, a tape recorder is switched on in parallel with the recorder. Spectral analysis of the magnetic tapes helps, in processing the visible records, to determine the type of ULF radiation.

Processing of the visible records for the period from July 1964 to March 1965 made it possible to obtain some new data on the properties of ULF radiation in the frequency band 1.5-3 kHz. As a result of the preliminary processing, three principal results were obtained.

Fig. 1. Choruses. 25 I 1965. *a*—Sogra, *b*—Kerguelen

1. Simultaneous observations at two conjugate points. The properties of ULF emissions observed at conjugate stations differ depending on the type of emission (hiss or chorus); moreover, the diurnal variations of these two phenomena are not identical (⁀1). Chorus emissions are very rarely observed simultaneously at both conjugate stations (this does not apply to the cases that will be described in the next section). Even when choruses appear simultaneously, the beginnings and endings of the phenomena usually do not coincide in time, and the shape of the envelope and the burst amplitude are different. Nevertheless, spectral analysis showed (Fig. 1) that the fine structure of the choruses is the same at the conjugate stations; a similar phenomenon had already been noted in (⁀2).

Fig. 2. Whistlers. 17 IX 1965. a –Sogra, b –Kerguelen

Figure 2: Fig. 2. Whistlers. 17 IX 1965. a –Sogra, b –Kerguelen

In contrast to choruses, bursts of hiss (during the indicated period, 38 cases of their occurrence were noted) at conjugate points, as a rule, begin and end simultaneously. The shape of the burst envelope is the same, and the amplitude is of the same order (Fig. 2).

2. Relation of choruses to ionospheric storms. During the year from March 1964 to March 1965, 13 ionospheric storms with a decrease of the critical frequencies of the $F2$ layer from the sliding median to 30-50% were recorded in the network of ionospheric stations of the USSR (see ([3])). Observations of ULF emissions were carried out in 11 of these 13 cases; moreover, in 7 cases both conjugate stations were operating, and in the other 4 only one station, Sogra or Kerguelen, was operating. In all 7 cases the choruses were noticeable at both operating stations. Moreover, in all 11 cases the choruses preceded the onset of negative ionospheric storms by 14-18 hours, and it may be concluded that choruses observed simultaneously at conjugate stations are precursors of negative ionospheric storms.

Fig. 2. Whistlers. 17 IX 1965. *a* **–Sogra,** *b* **–Kerguelen**

On the other hand, during the same year 9 positive ionospheric storms with an increase of the critical frequencies of the $F2$ layer from the sliding median to 30-45% were recorded (see ([3])), and this type of storm was never accompanied either by choruses or by whistlers. In addition, it turned out that choruses heard at only one of the stations usually preceded a local decrease of the critical frequencies of the $F2$ layer by 8-15%.

3. Absence of ULF emissions during magnetically quiet periods. A correlation can be established between the position of the outer boundary of the magnetosphere and the appearance of ULF emissions. A comparison of results obtained with the Elektron-2 satellite and observations of variations of the magnetic field at the Earth' s surface showed ([4]) that, when the outer boundary of the magnetosphere is located at a distance of 10-11 Earth radii and is sufficiently stable, the magnetic field at the Earth' s surface is very quiet; for several days in a row the daily sum K_p does not exceed 12-15, and stable Pc 4-5 micropulsations with periods greater than 50 sec are observed in telluric currents.

We carried out comparisons between cases of the appearance of ULF emissions in Sogra and Kerguelen and magnetically quiet periods according to K_p and according to magnetic-field observations at Kerguelen, kindly provided to us by R. Schlich (France). According to these data, over the 10 months from March to December 1964, 41 cases of undisturbed days were recorded, when stable micropulsations with periods greater than 50 sec were observed. On these days not a single case of emissions of the whistler type was detected, and only 1 case

of a very weak chorus.

It may therefore be concluded that on magnetically quiet days, when the outer boundary of the magnetosphere is located at a distance of about 10 Earth radii, conditions for the generation of ULF emissions are not created in the Earth' s exosphere.

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Note: Figure translations are in progress. See original paper for figures.