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Statistical Studies of the Solar Radio Emission in the Years 1985–2000 at 220 MHz

ABSTRACT

Investigations of solar radio emission with frequency 220 MHz during last 16 years are presented. Basic Statistical parameters of data of solar radio emission are calculated.

Systematic observations of the solar radio emission were started at the Institute of Physics of the Maria Curie-Skłodowska University in January 1985. The Sun was observed daily in time interval from 7 a.m. to 15 p.m. UT at 220 MHz by radio interferometer with 18 λ baseline, located in Lub-

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lin (the geographical coordinates are 51º14’47’’ N and 22º32’37’’ E – obtained with GPS system).

Daily records consist of 16–18 interference maxima. A recording scale is 15 s.f.u./cm. Frequency bandwidth is 120 kHz and integrating time constant RC = 2 sec.

Our measurements have been performed for the period starting from the minimum solar activity in 1985 up to the end of December 2000, through the maximum solar activity registered in 1989.

Such an observation scale allows to perform the preliminary spectral analysis. The computer fitting (FFT analysis) leads to the fundamental period of the Sun activity equal to 10.5 years.

It is worth noticing that the well known 11-year period of the solar activity is treated as an average period estimated over hundreds years, whereas the currently investigated period is predicted to be considerably shorter – 10.5 years.

Our measurements consist of 5,845 daily values of the solar flux densities. In Figure 1 we present the daily flux densities of the Sun in years 1985 up to 31 December 2000, and in Figure 2 – the amplitude distribution of this radio emission.

We can see that the most frequent value is 15 s.f.u. (1 s.f.u. = 10 $W/m^2 \cdot Hz$: s.f.u. – solar flux unit). The mean value is 33.9 s.f.u. The smallest observed value is 10 s.f.u. and the highest one is 1,500 s.f.u. (March, 26, 1991).

To obtain the frequency spectra we have applied computer program for fast Fourier analysis. There are visible (Fig. 3) few peaks in this spectra: the strongest is one with 10.5 years period in solar activity (obtained with large error because the observation time is a little longer than the period).

In radio domain the Sun is considered as a very variable star. Besides of long term changes of radio flux densities with 11-year solar activity cycle there are observed outstanding occurrences lasting from seconds to minutes. Only noise storms can last hours or days. Flux densities in such events change very much. Types of outstandings occurrences are classified in detail (Ref. [2]).

During 16 year long period of observation we have registered many outstanding occurrences. Some of them are presented in figures below.

Table 1. Month and year mean values of the solar radio flux density in "solar flux units" in years 1985–2000

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Year mean
1985	15	15	15	40	18	15	15	16	15	20	16	16	18
1986	18	105	19	16	15	23	27	15	17	27	19	17	26
1987	17	17	19	19	15	20	15	16	16	26	18	16	18
1988	20	27	33	34	17	18	19	23	32	49	51	59	36
1989	88	48	43	40	39	68	24	70	75	41	74	75	60
1990	42	63	46	34	61	68	35	84	32	44	94	43	54
1991	42	54	183	33	54	90	58	32	41	49	42	99	65
1992	101	180	35	31	19	25	20	44	33	38	34	27	49
1993	19	48	64	30	26	58	24	25	26	30	37	28	35
1994	43	26	22	17	21	17	17	16	22	35	22	22	23
1995	21	22	23	18	19	17	15	16	16	20	19	20	19
1996	21	17	15	14	15	16	23	28	15	15	28	20	19
1997	21	25	17	25	17	18	16	22	62	19	44	20	26
1998	20	17	20	28	31	20	20	19	39	21	23	20	23
1999	20	54	20	18	17	22	19	23	19	28	38	23	25
2000	20	31	43	39	25	24	38	32	66	23	103	50	41

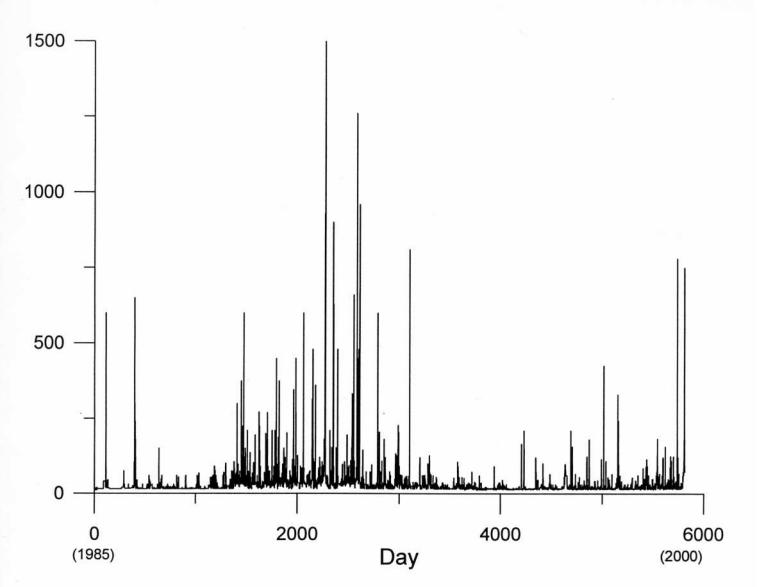

Fig. 1. Daily mean values of the solar radio flux density (1.I.1985–31.XII.2000)

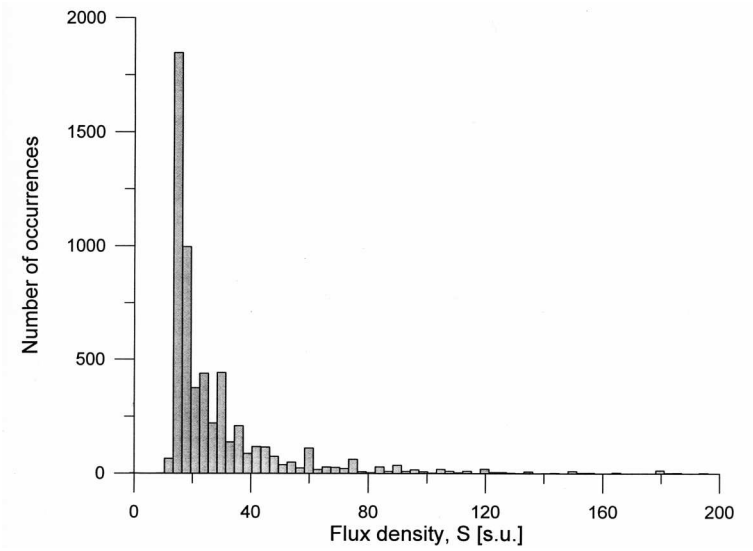

Fig.2. The amplitude distribution of the day mean flux density at 220 MHz

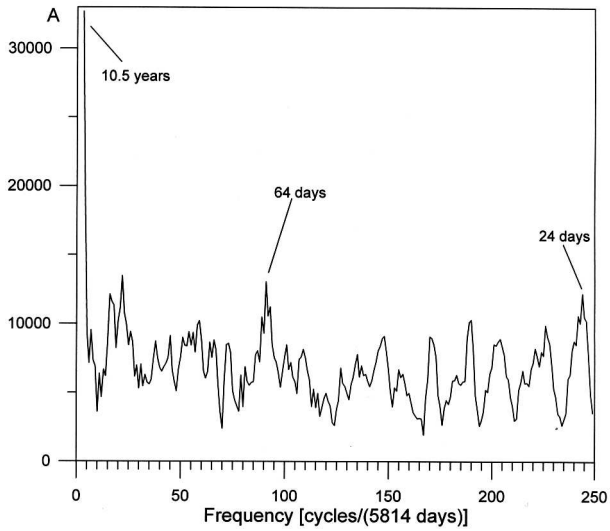

Fig. 3. Fourier spectrum of the daily flux densities
(A: intensity of the Fourier component)

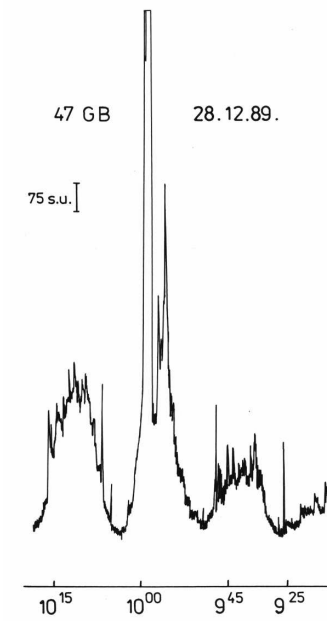

Fig. 4a. Great burst (47 GB type) observed in 28 XII 1989

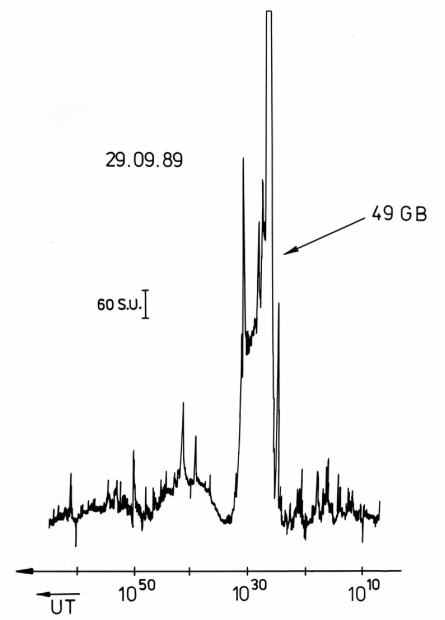

Fig. 4b. Major increase of the solar flux with duration longer than 10 min

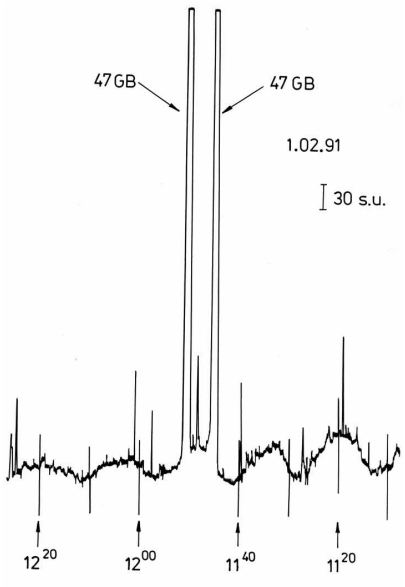

Fig. 4c. Infrequent event when two identical bursts appeared

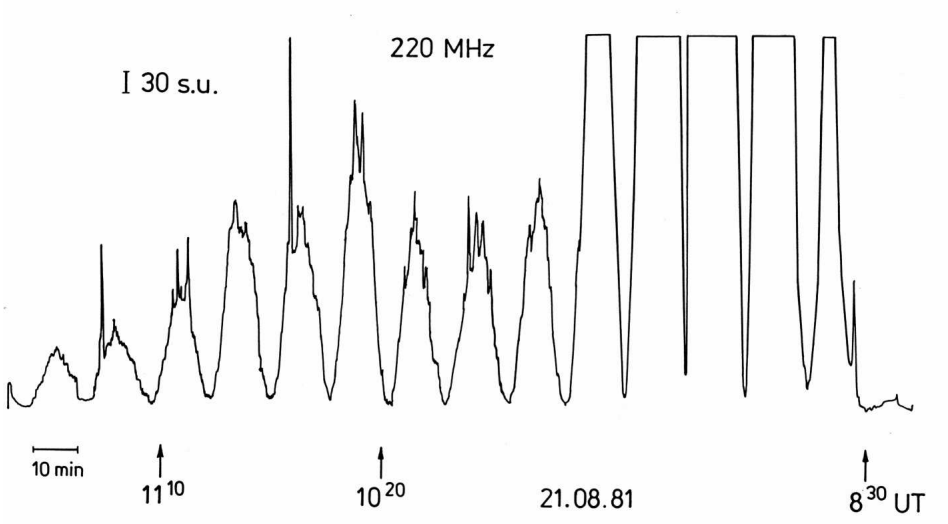

Fig. 4d. Morning increase in the solar radio flux density

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