RADIOASTRONOMY ON DECAMETER WAVELENGTHS AT MEUDON AND NANÇAY OBSERVATORIES

(Report from Solar Institute)

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Abstract. Since 1969, several instruments have been designed and built at Nançay to perform research on solar and planetary radioemissions in the range of decameter wavelengths. Emphasis has been set upon the high resolution spectrography of the radiobursts, both in time and frequency.

The present note describes the instruments which were operational at the end of 1973, and gives a brief survey of the main topics which have been studied up to now.

1. The Instruments

1.1. The antennas

Two broadband antennas have been built. Each of them consists of an array of 4 log-periodic dipoles, vertically polarized, on the top of a tower 10 m high. The mounting is alt-azimuthal, and the antennas can track a source in the whole sky through a very simple coordinate transformer, driven by paper punch tapes.

The antennas can be used in the range 20 to 80 MHz, with a nearly constant gain of 10 to 12 dB. One antenna is movable on an EW railtrack 1500 m long, the other is in a fixed position. This allows interferometry with a variable baseline, but this facility has not yet been used. For the moment, the two antennas are placed 1300 m apart, on an EW baseline, to perform simple interferometry.

1.2. Total power spectrographs

Two swept-frequency spectrographs cover normally the ranges 20 to 40 MHz and 40 to 80 MHz, with bandwidths of 20 kHz and 100 kHz respectively.

They are both driven by sweep-generators which allow to change the high and low frequency limits of the range swept, as well as the sweeping rate (between 1 Hz and 500 Hz). It is then possible to obtain higher time definition spectra in a range as small as 1 MHz.

The outputs of the receivers are connected to two amplitude modulated oscilloscopes in front of a 35 mm movie-camera. They can also be recorded on a high performance analogic magnetic tape for subsequent analysis and ıecopy on film at different speeds and different sensitivities.

1.3. Swept-frequency interferometers

The two receivers have actually two channels. One corresponds to the above total power spectrograph, the other to swept frequency correlation interferometers. To do

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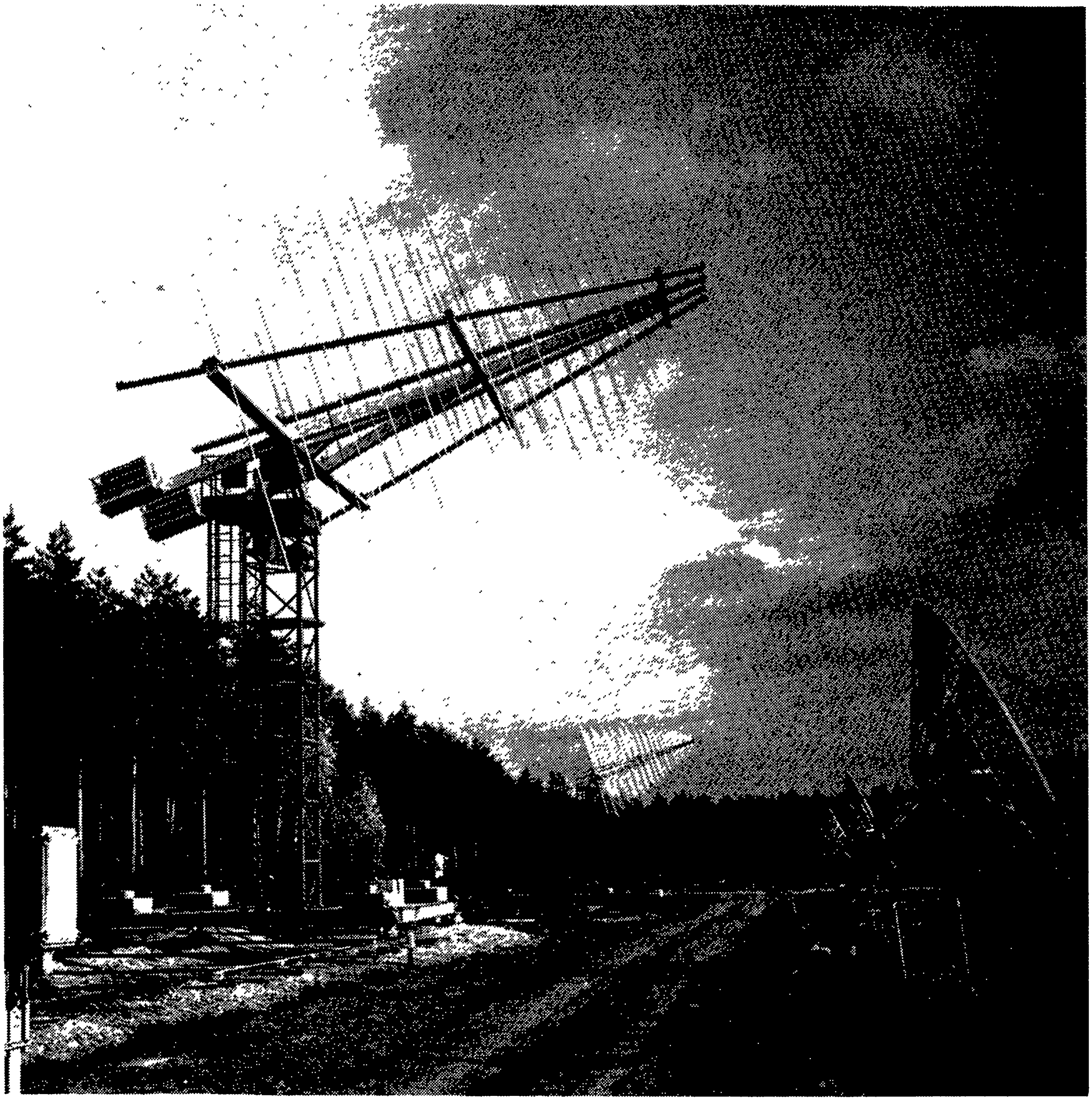

Fig. 1. The two antennas used for the observation of the Sun and Jupiter on decameter wavelengths at Nançay. In front the antenna is on a carriage and movable on an 1500 m long EW tail track. The second antenna, in rear, is in a fixed position.

this each receiver have two inputs were the two antennas are connected separately. The interferometers use the same sweep-generators and the same oscilloscope-camera device as the spectrograph.

1.4. Multichannel spectrograph

To increase the time resolution of the spectrographs, without lost in sensitivity, a multichannel receiver has been built. It has 50 adjacent channels of 20 kHz bandwidth, and so cover a total range of 1 MHz.

The multichannel spectrograph can be used anywhere in the meter and decameter ranges, thanks to a change in frequency which is made in the receiver itself. Thus,

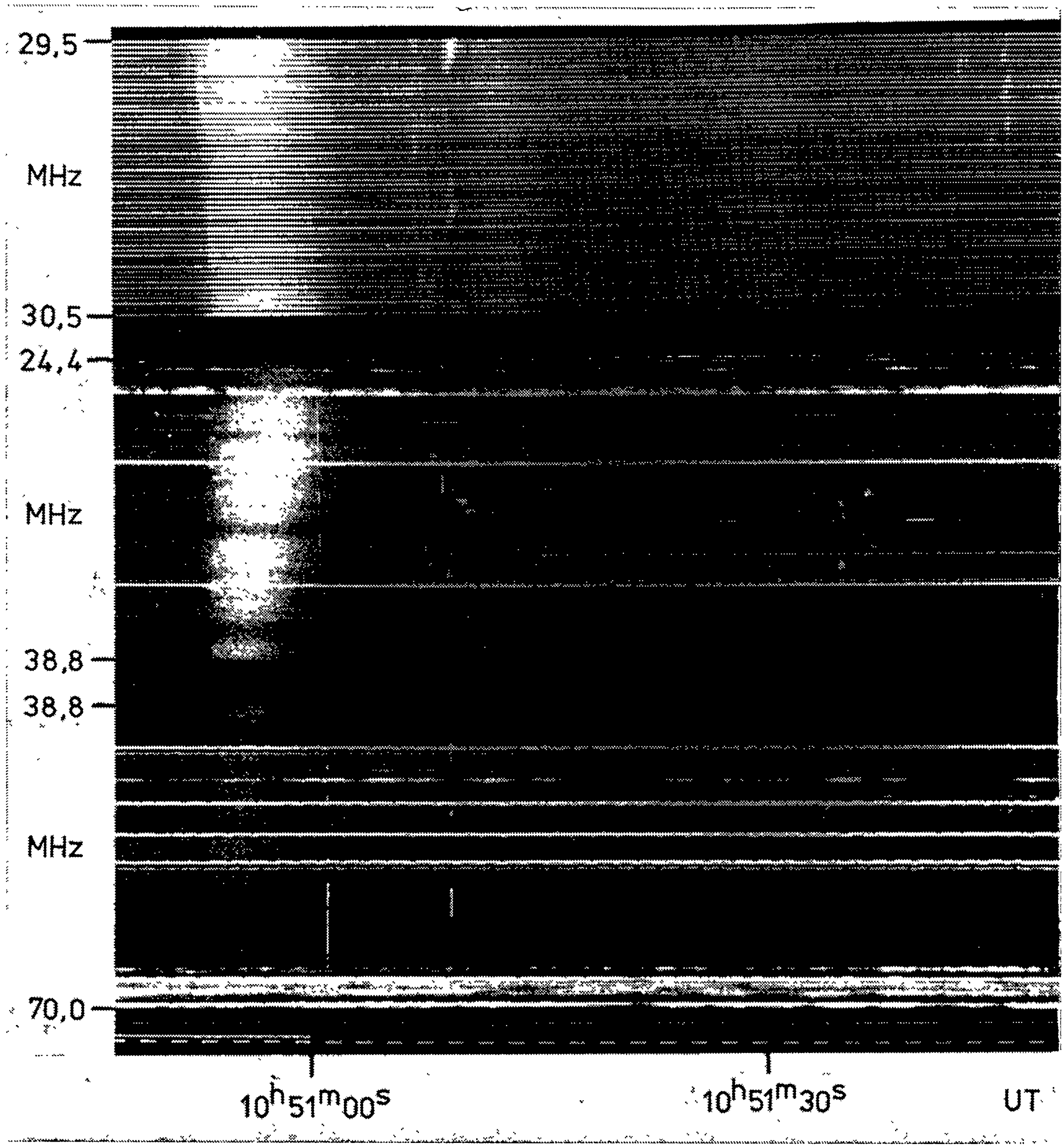

Fig. 2. Example of solar bursts observed with the two swept-frequency spectrographs and the multi-channel receiver. Horizontal white lines are interferences and frequency markers. The three dark horizontal fringes on the 20–40 MHz spectrum are due to ground effects. They are observed only when the Sun is low above the horizon. The two vertical lines at $10^h51^m00^s$ and $10^h51^m08^s$ are emissions by lightnings. (Nancay, December, 21, 1973).

high definition spectra of radiobursts can be obtained in very different part of the radiospectrum, provided an antenna is available.

The outputs of the 50 channels are connected to 50 photoelectric diodes, the intensity variations of which are recorded on a second 35 mm camera.

1.5. Fixed frequency receivers

To perform much easier intensity calibration of the spectrographs, and also to study

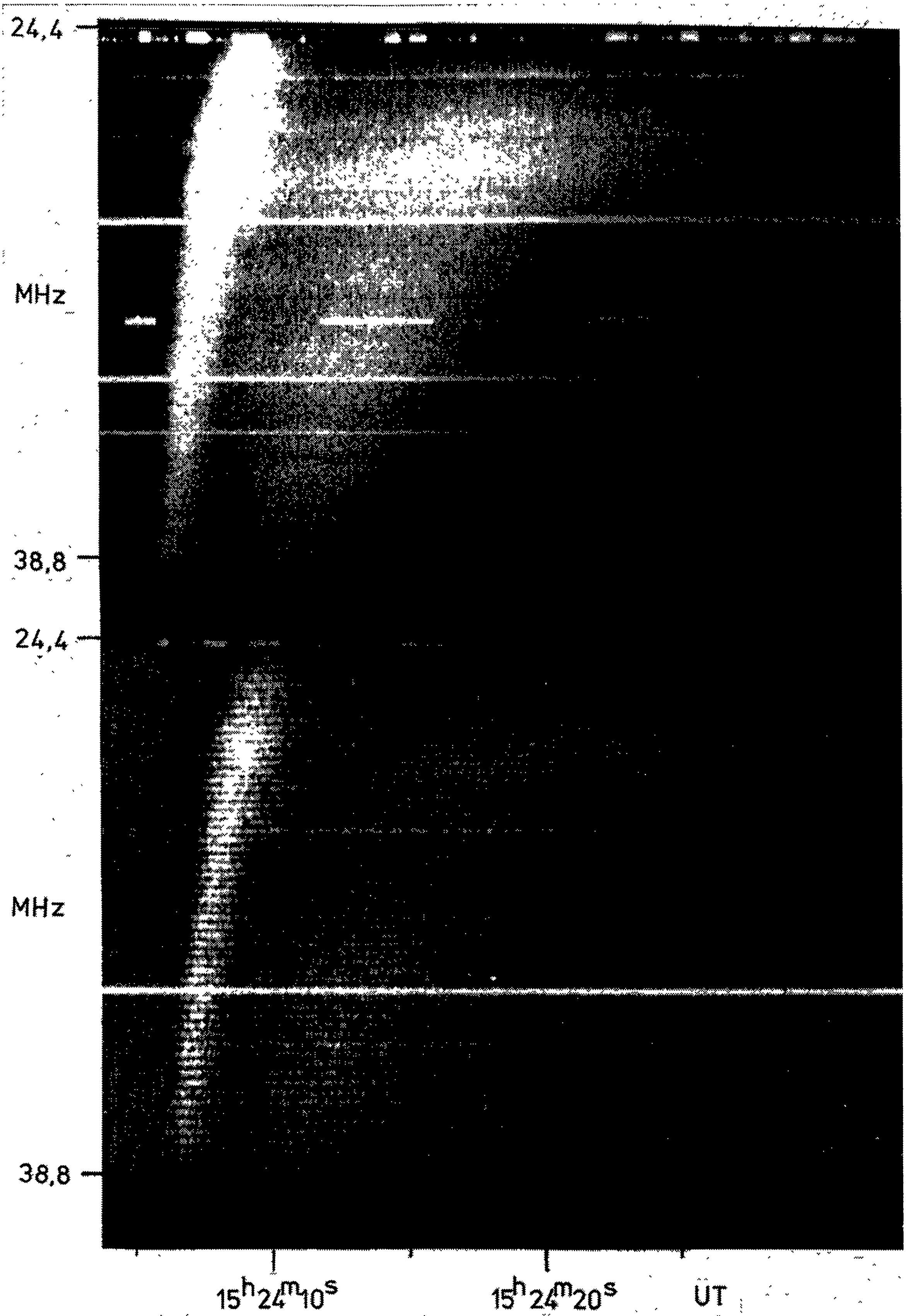

Fig. 3. Example of type III bursts observed simultaneously with the 20–40 MHz spectrograph and the 20–40 MHz swept-frequency interferometer (Nançay, September 1, 1973).

the time profile of the bursts, 4 fixed frequency receivers are used, on 30 MHz, 36 MHz, 60 MHz and 72 MHz. They are all identical, with a 250 kHz bandwidth, and their frequency can be moved a few Megahertz from their nominal values to avoid strong narrow-band man made interferences.

The log-periodic antennas are shown on Figure 1. Figure 2 presents a solar burst observed with the two swept-frequency spectrographs and the multichannel spectrograph, while Figure 3 gives an example of simultaneous observations of the 20–40 MHz total power spectrograph and the 20–40 MHz swept-frequency interferometer.

In July and August 1970, the swept-frequency spectrographs and the fixed-frequency receivers have been born to Arecibo (Porto-Rico) and used with the 1000 ft radiotelescope to get dynamic spectra of solar bursts with a much higher sensitivity.

2. Main Fields of Research

We are interested in any problem on the solar and Jovian radioemissions, both observational and theoretical, with emphasis upon the interpretation of the spectral fine structures of the bursts and the corresponding mechanisms of emission.

In particular, the following topics have been, or are presently studied.

(1) The fine structure of decameter dynamic spectrum of solar radiobursts; study of the drift pairs (de la Noë and Møller-Pedersen, 1971), type III_b bursts and split-pairs (de la Noë and Boischot, 1972), and several other fast bursts observed in the decameter range (Lacombe and Møller-Pedersen, 1971); characteristics of the noise storms in the decameter range, and the differences between the meter and decameter storms.

(2) The time profile of type III bursts, observation and theory: origin of the decay of the bursts (Aubier and Boischot, 1972), Landau damping of the plasma waves in the corona and characteristics of the type III excitor (Harvey and Aubier, 1973; Aubier, 1974).

(3) The coronal density structures associated with regions of solar burst activity (Leblanc *et al.*, 1974).

(4) The quiet Sun emission at different wavelengths from observation at Arecibo. Influence of the scattering on the brightness temperature (Aubier *et al.*, 1971).

(5) The scattering of the radiowaves in an inhomogeneous corona: theoretical study of the propagation by the Monte-Carlo method (Steinberg *et al.*, 1971; Caroubalos *et al.*, 1972), application to the problem of the relative positions of fundamental and harmonic sources of type II and type III bursts (Leblanc, 1973; Boischot, 1974).

(6) The decameter emission of Jupiter. Apparent drifts in position of the sources in LMC and phase of Io; fine structures of the bursts, in particular the Faraday fringes and the modulation lanes.

The publication of the solar activity observed with the above instruments is not planned. However, the observations are made nearly every day, and the data can be made available for all those who are interested in.

Acknowledgements

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