A STUDY OF THE PARAMETERS OF
INDIVIDUAL TYPE-I BURSTS

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Abstract. The Dwingeloo 60-channel radio spectrograph has observed at metric wavelengths for a long time. Hundreds of type-I bursts in the digitally recorded solar noise storms were studied and the results are presented in this paper. We hoped to learn more about the emission and propagation of the radiation by trying to find patterns in the dynamic spectra of individual bursts or statistical relations between some of the parameters that can be defined to describe the spectra. The bursts are reduced and represented in a standard way. Graphical representations are inspected by eye and compared qualitatively. Numerical burst parameters are studied statistically. We describe the properties of instantaneous burst spectra. The polarization properties of bursts and the relation between burst- and continuum-polarization are studied to some extent. Apart from these results we find no significant new properties, despite the high quality of the data.

1. Introduction

The 60-channel spectrograph in Dwingeloo (van Nieuwkoop, 1971) was extended in 1972 with a digital recording system (Slottje, 1973). The data of each channel can be sampled up to 200 times per second and written on magnetic tape. Because of this high time resolution the data rate is too high to record all observations without selection. As usual the spectrograph data are recorded on film and only in some cases are recorded digitally. From these digitally recorded data, parts are selected and kept for analysis afterwards.

A first major research goal formulated for this recording system was the investigation of solar noise storms. From the years 1974 to 1978 approximately 10 hr of noise storm activity are available on magnetic tape.

This article reports on the first results obtained with this material. This investigation has been devoted to the individual type-I bursts, later work will include the continuum and chains of bursts as subjects of investigation.

The aim of this investigation was to study individual type-I bursts, looking for characteristic properties and relations between their describing parameters. This was done by reducing hundreds of bursts, thereby representing and parametrizing these in a standard way. Subsequently the representations were examined thoroughly to find typical patterns or characteristics and the burst parameters were analyzed statistically to establish relations between them.

The difficulties in obtaining positive data on the type-I noise storm phenomenon are well known (Elgaroy, 1978) and perhaps it is not surprising that even this exhaustive investigation of a large sample of well recorded and well described bursts did not yield new properties or relations. However, the high sensitivity of
the spectrograph led to clear and well defined profiles of the bursts, which is of
great help in judging the correctness of hitherto surmized characteristics.
Of the continuum only the circular polarization degree has been evaluated to
some extent.

2. Method of Investigation

2.1. THE SPECTROGRAPH

The Dwingeloo spectrograph consisted at the time of observation of 40 channels
with bandwidth 0.25 MHz and 0.33 MHz center to center separation as well as 20
channels with bandwidth 0.9 MHz, 0.89 MHz apart. The narrow channels occupied
a 13 MHz band that was tunable in the range from 200 to 320 MHz, the wider
channels were always tuned from 160 to 177 MHz. Table I shows the frequency
bands used in this investigation and their designations. Frequency band A was
always used in combination with one of the bands D, G or L. In each of the 60
frequency points both the sum and the difference of the two circular polarized
flux components were sampled. The time constant of the receiver was 0.01 second,
allowing a maximum sampling rate of up to 200 Hz.

The noise in each channel was typically 1 solar unit (1 su = 10^{-22} W m^{-2} Hz^{-1}).

TABLE I

| The names and allocated frequencies of the spectrograph bands used in the investigation |
|---------------------------------|---------------------------|
| A band                          | 160.44–177.33 MHz        |
| D                               | 200.17–213.17 MHz        |
| G                               | 240.17–253.17 MHz        |
| L                               | 306.83–319.83 MHz        |

2.2. THE MATERIAL

In major noise storms the burst activity is often so intense that the bursts overlap
on a spectrograph recording. For this reason we had to select quiet parts of storms
with only occasional bursts. Apart from this the following points were considered
in the selection of storms, the dates of which are listed in Table II:
  - The sample of bursts should have a size of the order of 100 to 200.
  - A good quiet Sun background value should be available for the periods used.
  - A considerable subsample of bursts from one observing day should be available.
  - A good coverage of various frequencies must be present.
  - Possible center to limb variations should not be excluded.

2.3. SELECTION OF BURSTS

The bursts were selected by their appearance on the film which was made simultaneously with the digital recording. The following criteria were used: