SOLAR RADIO BURST (TYPE III)

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Abstract. This article describes the observations of a type III radio burst observed at 103 MHz simultaneously by the two radio telescopes situated at Rajkot (22.3°N, 70.7°E) and Thaltej (23°N, 72.4°E). This event occurred on September 30, 1993 at about 0430 UT and lasted for only half a minute. The event consisted of several sharp spikes in a group. The rise and fall time of these are comparable, however the peaks of individual spikes varied by a factor of four. The comparison of these observations with the data of solar radio spectrograph HiRAS indicates that this was a metric radio burst giving highest emission at about 103 MHz.

Key words: solar burst, radio emission, electron beam

1. Introduction

Type III radio bursts are a form of sporadic solar radio emission originating throughout the solar corona. The observations of these emissions from Sun have been going on for few decades and have provided a wealth of information about the magneto-hydro-dynamic processes (Fleishman et al. 1994 and references therein). The subject has evolved both theoretically as well as experimentally and it is generally believed that a stream of sub-relativistic electrons accelerated low in the corona is responsible for type III radio bursts. Using this hypothesis an attemp is made to estimate the velocity of the stream. Here we present observations and analysis of a solar radio burst of Sept. 30, 1993.

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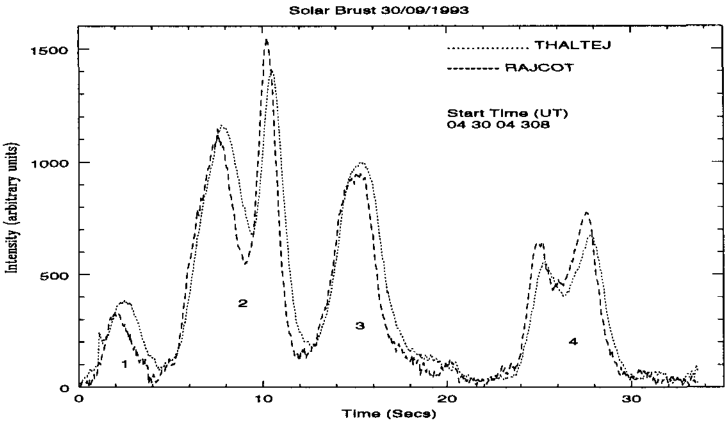
Fig. 1. Temporal profile of solar burst of Sept. 30, 1993



2. Observations and Analysis

High time resolution (48 msec) recordings of the solar radio burst of Sept. 30, 1993 by the two radio telescopes situated at Rajkot and Thaltej (near Ahmedabad) are shown in Fig. 1. Details of the observing system and procedures are described by Vats and Deshpande 1994. We divide this event in four sub-events (marked in the Fig. 1 as 1, 2, 3 & 4). Subevent 2 and 4 seem to be further split in two parts, but we have treated them as one, mainly because further analysis will use HiRAS (Hiraiso Radio Spectrograph) data whose temporal resolution is less and shows only four sub-events during this event. The New Solar Radio Spectrograph at Hiraiso and its initial observations are outlined by Kondo et al. 1994. This burst was observed only in the frequency range 25-225 MHz with peak emission around 100 MHz. The typical spectrum of this event is shown in Fig. 2.

From the temporal variation of intensity of the four sub-events we prepared frequency-time plots for the peak intensity in each case. These are shown in Fig. 3 and clearly indicate that the event usually occurred first at higher frequency and later drifted to lower frequencies with time. One obtains an average frequency drift rate ranging from 25 MHz/sec to 35 MHz/sec. The observed frequency drift rate (df)/(dt) can be used to find the velocity of the electron (more precisely its component (Vs) along the gradient of the plasma concentration in the corona). This is given (Zheleznyakov (1970) as below:

$$V_s = \frac{2\,L_n}{f} \left|\frac{df}{dt}\right| \qquad (1)$$

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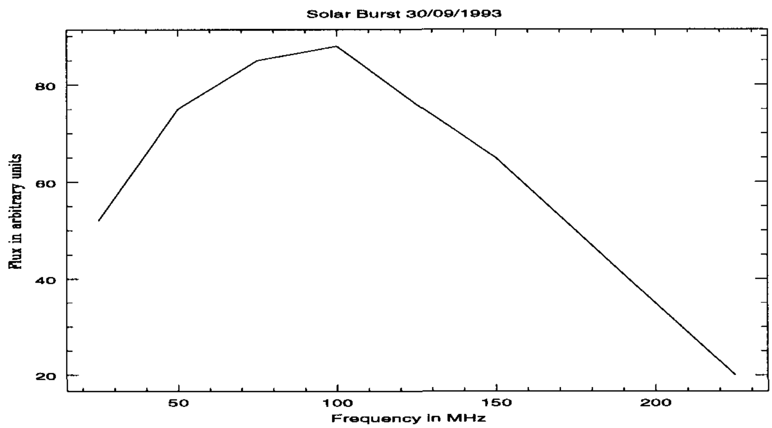
Fig. 2. Typical radio spectrum of the solar emission during the burst on Sep. 30, 1993.



where

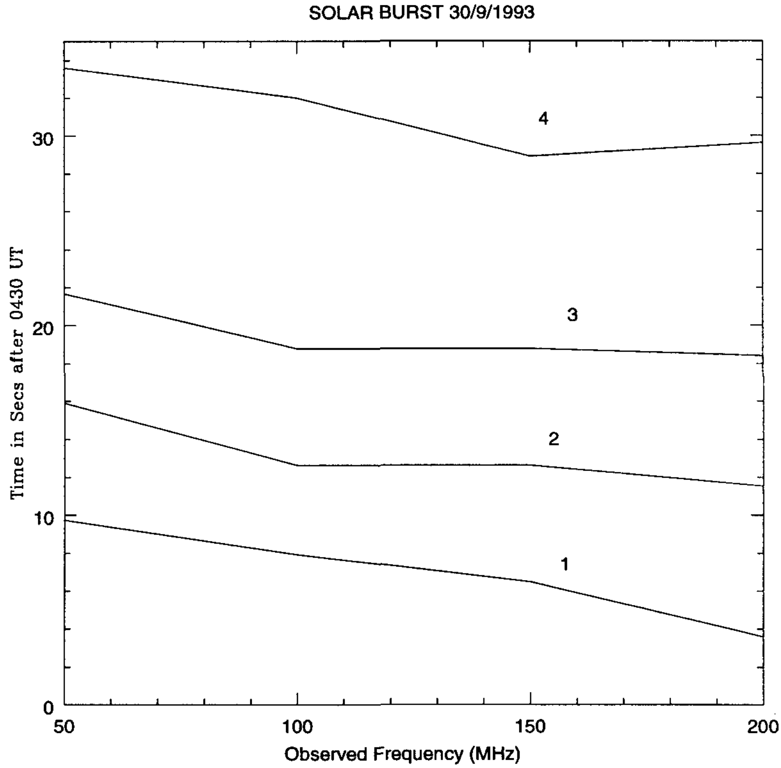
$$L_n = \frac{N}{|\nabla N|} \tag{2}$$

f and N are the plasma frequency and density at the source region. This gives the velocity of a source causing radio emission in the range of 0.1 to 0.3 c. Here standard model (Baumbach-Allen Model) for coronal plasma density and its gradient was used.

3. Conclusions

The study of this solar burst reveals that it consists of a group of sub-events having time period of 2 to 10 secs. If this sporadic emission is due to fast moving energetic particles in the solar corona, their speeds would range from 0.1-0.3c which compare with the recent observations of Fleishman et al. 1994. A very critical examination of Fig. 3 reveals that at times (1) df/dt is large which will give velocity of the source greater than the velocity of light (c) and (2) positive df/dt meaning the event is seen first at the low frequency and later at high frequency. These situations are rather difficult to understand. It will also be useful to look for the associations of such events with coronal mass ejections and the observations of energetic particles in the heliosphere.

Fig. 3. Frequency-time plot of the peak radio emission for four sub-event on Sep. 30, 1993.



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