SOLAR MICROWAVE PRECURSORS AND CORONAL MASS EJECTION: POSSIBLE CONNECTION

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There are a lot of results concerning the phenomena of preflare activity and Coronal Mass Ejections (CME) formation. A situation is possible when the CME is flare response or on the contrary the CME onset initiates the flare. In a number of recent papers R.A.Harrison and his coworkers have shown that CME initiation was found to be associated with weak soft X-ray emission.

We have studied a possible connection between the solar microwave precursors and CME. Following this aim, during the period of 1989, 36 hour and a half observational samples preceding solar flares were investigated. There were 8 events among them, preceding proton flares. Data have been obtained at four wavelengths (3.2 cm, 10 cm, 30 cm, 46 cm) at Zimenki Station near Nizhny Novgorod (RUSSIA). To investigate the precursors we used the classification accepted for the description of radio emission bursts in Solar Geophysical Data. So, Fig.1 illustrates examples of temporal evolution of solar radio flux and types of precursors.

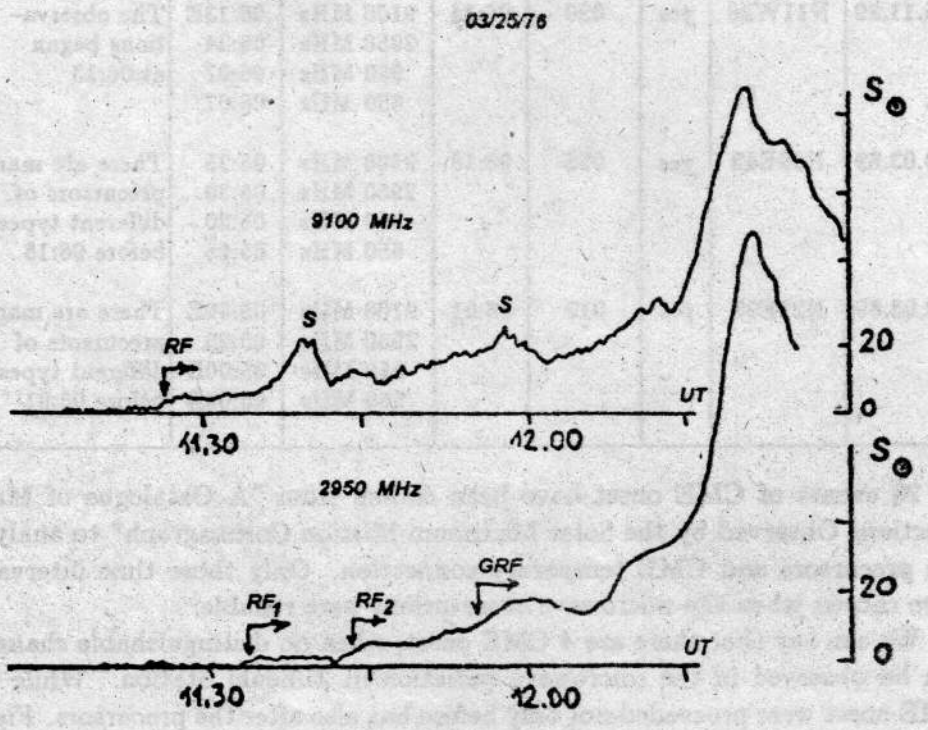

Fig 1.

The precursor is called the first if there are no any distinguishable changes before it in the solar radio flux. A possible connection between such precursors and CME is discussed.

At first, we examine proton events. It is important to separate the events have been located near the limb ($|\ell| \geq 45°$) from others. Table 1 and Table 2 demonstrate some features of CME and precursor connection:

- CMEs are formed, when there are precursors in the microwave radiation, the forestall period of time of precursors to CME are in 0 – 1 hour time interval;
- all CMEs, referenced to microwave proton precursors have the width of about 30° and loop-like shapes.

Table 1

Observ. data	Lat CMD	CME	Width [degrees]	Observation time [UT]			Comments
				CME	PRE		
05.05.89	N30E04	no					
15.11.89	N11W26	yes	020	06:14	9100 MHz 2950 MHz 950 MHz 650 MHz	06:13E 06:24 06:07 06:07	The observations began at 06:13
09.03.89	N29E42	yes	025	06:18	9100 MHz 2950 MHz 950 MHz 650 MHz	05:25 05:30 05:20 05:15	There are many precursors of different types before 06:18
12.03.89	N20E05	yes	019	06:01	9100 MHz 2950 MHz 950 MHz 650 MHz	05:00E 05:25 05:00E 05:00E	There are many precursors of different types before 06:01

28 events of CME onset have been chosen from "A Catalogue of Mass Ejections Observed by the Solar Maximum Mission Coronagraph" to analyse the precursors and CME temporary connection. Only those time intervals, were chosen when the microwave observations were reliable.

We can say that there are 4 CME onset, when no distinguishable changes can be observed in the microwave radiation in Zimenki Station. While 24 CME onset were proceeded not only before but also after the precursors. Fig.2 demonstrates the distribution of time offsets between the time when the CME was the first observed in the coronagraph field of view (t_{1CME}) and the time

of the first precursor (t_{pre}). A positive (negative) offset means the precursors lag (lead) the CME's observation. As we can see:

- the most typical time interval between the first precursor and the first CME observation is 20-60 min;
- on the whole, the precursors are of GRF-type and they have been seen most frequently in 9100 MHz, 2950 MHz and 950 MHz frequency range;
- one can compare the GRF-type precursors with front- and fuzzy- CME in the 20-30 min time interval and with loop-with-cavity CME in the 50-60 min time interval;
- the S and SF types of precursors are observed mainly at the 9100 MHz and 2950 MHz frequencies, time intervals they have been observed and types of CME are different.

Table 2

Observ. data	Lat CMD	CME	Width [degrees]	Observation time [UT]			Comments
				CME	PRE		
08.03.89	N34E55	yes	025	08:31	9100 MHz 2950 MHz 950 MHz 650 MHz	07:32 07:20 07:55 07:55	The CME's observat.time coincides with the beginning of flare impulsive phase
25.07.89	N26W85	yes	031	08:15	9100 MHz 2950 MHz 950 MHz 650 MHz	07:45 – – –	
29.09.89	over limb	yes	018	07:08	9100 MHz 2950 MHz 950 MHz 650 MHz	07:57 07:26 07:26 07:26	There are no precursors of different types before 07:26
29.09.89	over limb	yes	077	11:27			There is the beginning of flare impulsive phase
28.10.89	over limb	yes	043	08:48	9100 MHz 2950 MHz 950 MHz 650 MHz	08:48 08:22 – –	

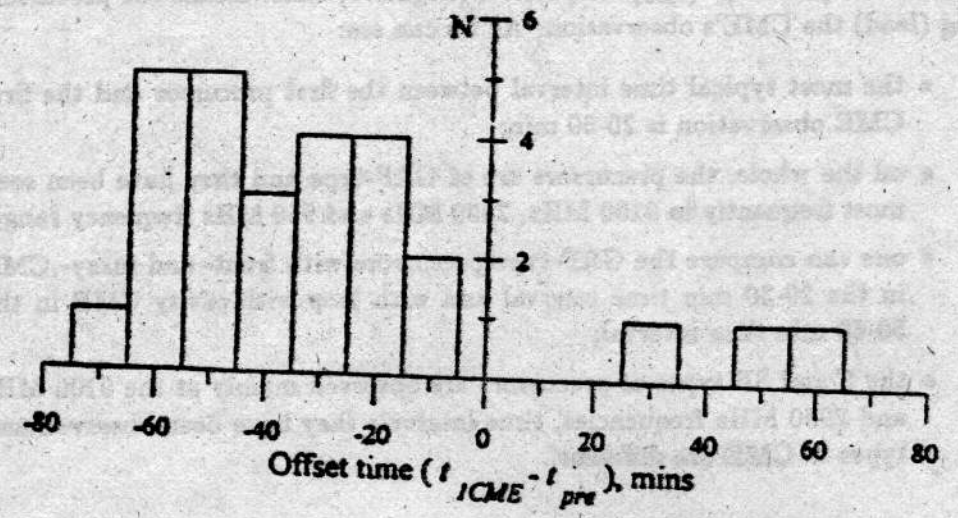

Fig.2.

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