

# Quasi-Periodic Components of Solar Microwave Emission Preceding The CME Onset on 19 October, 2001

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**Abstract.** The results of solar microwave observations in the Radio Astronomical Observatory NIRFI "Zimenki" are examined. Data analysis shows the presence of periodic component, that arose prior to burst connected to CMEs onset, and its absence after burst. Obtained data are compared with the dynamics of the development of activity on the solar disk. Results can be considered as the illustration of the dynamics of wave motions in the periods of flare activity.

**Keywords.** Sun: radio radiation, oscillations, coronal mass ejections (CMEs), evolution

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## 1. Introduction

The laws governing the wave and fluctuating motions in the structures of solar atmosphere in the periods of flare activity and shaping of the coronal mass ejections are being established. We investigated the rapidly changing quasi-periodic components of solar radio emission with the use of data of the patrol observations of solar flux.

We would like to emphasize the effort in obtaining the data. The physical processes that can describe such a phenomena are not analyzed consciously. It is well known that there is a lot of research on the diagnostic possibilities of flare loops parameters, using parameters of the periodic oscillations of radio emission in the bursts.

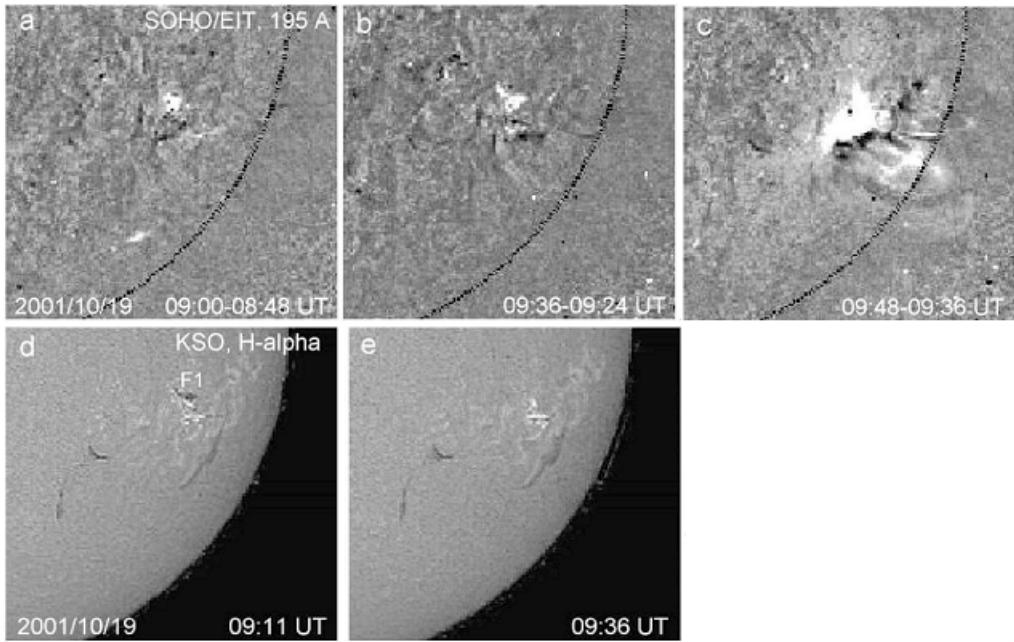
Obtained by us results can be considered as a step in direction in development of diagnostic possibilities under the conditions for the monitoring observations of solar radio flux with the increased time resolution.

## 2. Observation Data

The situation in the sun during the observation day 19.10.01. was that there were 2 active regions on the Sun. It is evident that the analyzed dynamics of radio emission can be attributed to the changes in most developed active region AR 9658 (S14 W47) and CMEs event, which relates to this period. Peculiar 1B/M5.7 flare of 09:40 UT and radio emission and CMEs are discussed.

Data of radio emission was obtained in the period of patrol observations of the general flux of solar emission carried out in the period of the high solar activity during October 2001. Observations were conducted on 4 waves of cm and dm ranges in the Radio Astronomical Observatory "Zimenki" of Radiophysical Research Institute (NIRFI).

In this project we examine observation results at wavelengths 3 and 10 cm (time resolution on the radiometers of the corresponding wavelengths was 50 and 200 milliseconds, respectively). There was relatively high discretion of the registration of signals (0.5 s).



**Figure 1.** Solar Images. 19.10.01.

For the analysis we used parts of the record both directly preceded and after the burst, when the signal level did not change substantially within the limits of record.

### 3. Results

We used for this analysis the realizations of the records, that made it possible to analyze periods in the interval of 2–30 seconds. For the spectral treatment the program of Fast Fourier Transform was used which made it possible to estimate the presence of periodic components and their relative value.

Data analysis in 3rd cm emission shows the presence of periodic component ( $\sim 14$  s), that arose approximately 15 minutes prior to burst connected to CMEs onset, and its absence after burst.

In 10 cm emission we look at 2 components: about 6 seconds and 14–17 seconds. The first one exists prior to the burst during a whole 25-minute interval, while the component of  $\sim 14$ –17 seconds becomes steady 15 minutes prior to burst. The latter result coincides with ones obtained for 3rd cm emission. 6th seconds component remains also at the stage after burst.

The event in question preceded appearance a compact (size  $\sim$  several angular minutes) UV brightening in the line  $195\text{\AA}$  in the northern environment of AR 9658 between 08:48 and 09:00 UT (Fig. 1a). As show higher sensitive difference images, at this time in the south there was observed the less intensive UV brightening, which was connected with the first weakly luminous loop, elongated westwards. The manifestation of this activity was observed as steel weak pulse dm-bursts at 900 and 600 MHz frequencies, and also the group of type III bursts (see Gnezdilov, Gorgutsa, Sobolev, *et al.* (2002)), which covered entire range of spectrograph from 270 to 25 MHz, and it was most intensive in interval of 08:55–08:58 UT. This followed the formation (or ejection) of the small transient  $H_{\alpha}$  fiber F1 (Fig. 1d), which coincided in the localization with the basic UV brightening and was

observed during 09:02–09:20 UT. To the time interval 09:36–09:38 UT we can see that UV brightening was renewed and increased in the size (Fig. 1b), and H $\alpha$  fiber F1 ceased to be visible (Fig. 1e). From the LASCO data ([http://cdaw.gsfc.nasa.gov/CME\\_list/](http://cdaw.gsfc.nasa.gov/CME_list/)) it is evident that CMEs took the form of the bright, clearly outlined, compact (angular dimensions of 15–20 deg.) ejection, which is extended in the corona with an uncommonly low speed of  $V \sim 240$  km/s. It should be noted that localization on the position angle, form and angular dimensions of this CMEs correspond well to the loop structure, which is visible into 09:48 UT on the UV difference images in the line 195 Å above the bright region of eruption (Fig. 1c).

The comparison of all data shows, that the appearance of fluctuations coincides with the appearance of dark fiber and the brightening. Fluctuations with periods (about tens of sec) disappear after the destruction of fiber, damage of the structure of flare loop.

#### 4. Conclusions

Thus, the obtained results can be considered as the illustration of the dynamics of wave motions in the periods of pre flare and pre CMEs activity. It is an important step in increasing the possibilities of the stationary monitoring observations of the general flux of solar radio emission. The increased time resolution for the analysis of the dynamics of wave and fluctuating motions and development of diagnostic ideas is also vital.

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