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Analysis of the flare stars radio bursts parameters at the decameter wavelengths

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Abstract

Detection of decameter sporadic radio emission from flare stars AD Leonis and EV Lacertae were carried out with UTR-2 radio telescope in the range of 16.5-33 MHz during 2011 observational campaign. Criterion to discriminate particular events from stars and continuous sources in the main beam (ON) and two diverted beams (OFF), where true events should not appear, are discussed.

1. Introduction

Observations of radio emission from flare stars, especially at low frequencies, is an important topic in modern radio astronomy [1]. The flare stars observations were carried out with the world largest radio telescope UTR-2 [2] and were based on signals correlation from the North-South (Fig.1) and the West antennas of UTR-2 using either direct correlation mode ("pencil" beam) or so called sum-difference mode. A set of measurements were taken to discriminate between potential true events from the stars and false ones from ionosphere propagation effects.

Figure 1: The North – South arm of the UTR-2.

2. Instrumentations and methods

Dynamic cross-spectra have been obtained in full correlation mode for signals from the two antennas using three DSP-Z [5] spectral correlators with spectral resolution of 4 kHz. The observations were performed in the range of 16.5-33.0 MHz. The output data include 4 real-valued dynamic spectra with frequency resolution of 4 kHz and time resolution of 0.1 sec. Events that potentially originate from the stars was performed due to visual inspection of the dynamic spectra [4]. The events resembling solar type III bursts [6] were considered as potentially true ones if they satisfied some additional criteria, e.g. the requirement of constant cross-phase within the frequency range. This phase criterion [3] makes it possible to filter out false events emitted from wrong direction through side-lobes of the antennas.

3. Observations and results

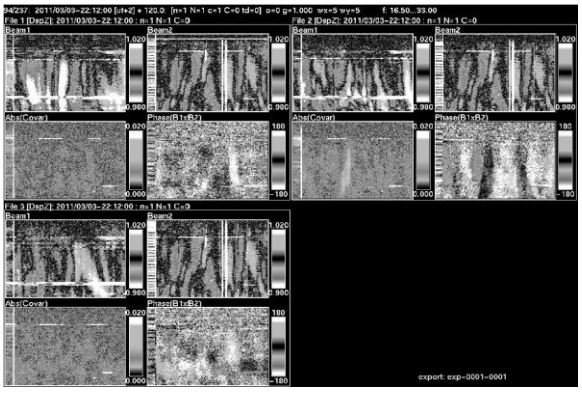

Figure 2: A burst from AD Leonis.

Each figure represents 12 dynamic spectra within the frequency range 16.5-33.0 MHz and time interval 2

min. An event, observed in March 2011, is shown on Fig.2. It is clearly seen (Fig.2) at the cross-power for channel ON, corresponds to the main beam directed to the star (the panel on the right), and is not seen in both diverted beams, i.e. OFF channels (two panels on the left). Fig.3 corresponds to a time interval at which no events were observed. A burst like event caused by anomalous ionospheric scintillation of reference source 3C144 is presented on Fig.4. Example of distributions of duration and frequency drift rates are shown on Fig.5.

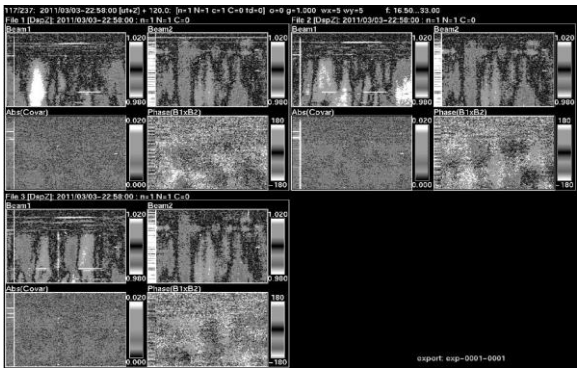

Figure 3: AD Leonis: no events.

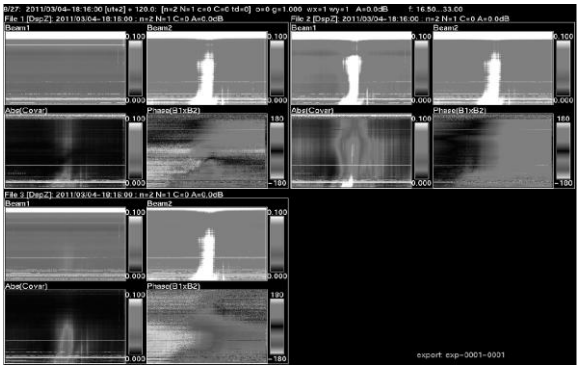

Figure 4: Anomalous burst-like ionospheric scintillation event from 3C144.

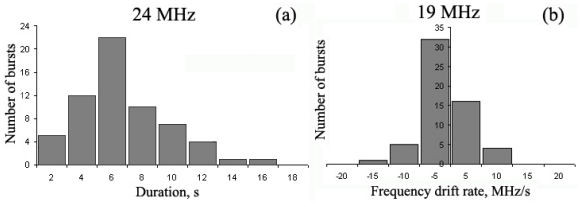

Figure 5: AD Leonis event distribution on duration (a) and frequency drift rate (b).

4. Conclusions

Hundreds of burst-like events were detected during observations of flaring stars AD Leonis and EV Lacertae in 2011. These events were filtered out on the basis of their visual appearance at dynamic spectra and non-meeting other criteria, like constancy of phase spectra, absence of counterparts in both OFF channels, presence in both antennas, etc. So, they may be preliminary classified as events originated from the stars themselves. Parameters of each event (temporal width, frequency drift, profile asymmetry, relative strength, etc.) were measured.

Acknowledgements

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