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DETERMINATION OF PARAMETERS OF SOLAR BURST TYPE III USING DATA FROM THE NETWORK E-CALLISTO

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ABSTRACT

This work focuses on the calculation of the parameters of one solar burst, type III recorded in the frequency bands metric and decimetric (170MHz—870 MHz), in the Bleien observatory in Switzerland belonging to e-Callisto network. The Radio Solar Bursts were selected between 2010 and 2011 and then we classify. We have inferred the plasma parameters: a) the duration time of radio burst that was approximately 1s, b) the negative drift rates of these bursts are standard values for type III bursts and c) the relationship between drift rate and frequency comply with a power law; in the region where the beams of electrons accelerate and generate the emission radio type III.

INTRODUCCION

The Radio Solar bursts type III are intense radio emissions produced by energetic electrons streaming along open magnetic field lines from the low corona to distances that can reach several AU. These solar bursts have many features or parameters that we can calculate analyzing the dynamic spectrum of the event. The solar burst type III (See Fig. 1) can occur singularly, in groups or storm and Can be accompanied by a second harmonic. The duration, for single burst: 1-3s; for burst in Group: 1 -5 min and for burst as storm: minutes-hours. The frequency range: is 0.01 to 1000 MHz. The associated phenomena are active regions and flares. The solar burst type III are most common type and have sweep or drift rates in the HF range 1-10 MHz per second and in VHF range of 75-700MHz per second. The local plasma frequency is: f = 9x10-3ne½ MHz. we show in Figure 1 a solar burst type III.

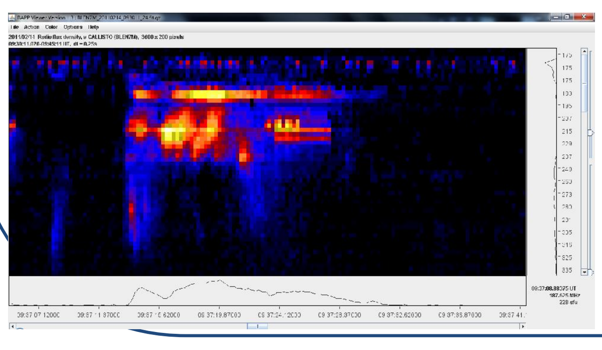

Fig 1. Solar burst type III. Data extracted from, Bleien observatory, Switzerland, plotted with program Java for solar burst in fits format

PARAMETERS OF SOLAR BURST TYPE III AND DATA ANALYSIS

We have analysed 13 bursts type III selected of spectrometer Callisto of Bleien Observatory in Switzerland, which cover range of 170—870MHz. By using digital data we have fitted a Gaussian profile at a given frequency and we analysed: peak flux and time. The drift rate was determined from a linear regression of the peak flux in the frequency– time plane as shown in Figure 2. Also, the dynamic spectra were amplified enough to make the measurements of starting (initial) and maximum frequencies (fi , ff), corresponding to the edges of the frequency band of the emission where peak flux at those frequencies.

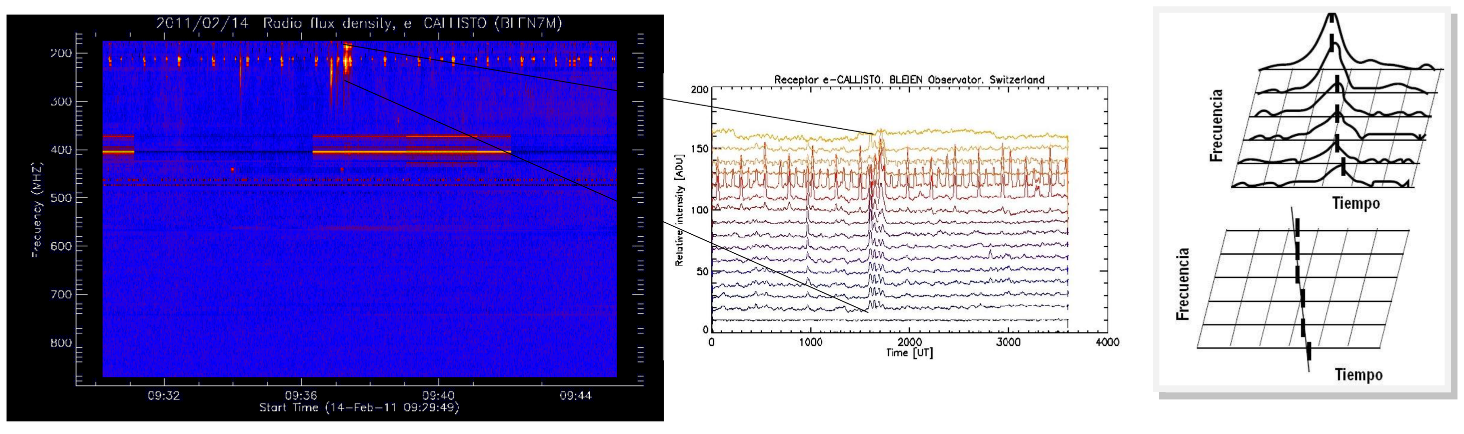

Fig 2. Method for calculate the drift Rate. Dynamic Spectrum of solar type III radio burst of Bleien Observatory 14—feb—2011.

The defining property of a type III radio burst in comparison to other solar radio bursts is their high drift rate df/dt (usually measured in MHz/s). One major survey of type III burst drift rate was done by Alvarez y Haddock (1973) who used the rise time of type III bursts between 3MHz and 50kHz and combined them with eight other studies up to 550 MHz. They reported a least squares straight line fit to the frequency drift rate over all four orders of magnitude such that

$$df/ft=-0.01f^{1.84}$$

More recently a linear dependence (df/dt f) was found for a number of powerful radio bursts ocurring during a two month period in the solar maximum of 2002. The value of the frequency drift rate was similar at 10 MHz to Alvarez y Haddock (1973) but smaller by a factor of two at 30 MHz. Going to higher frequencies, studies by Aschwanden et al. (1995) and Melendez et al. (1999) looked at radio bursts between 100 MHz and 3 GHz and found drift rates

$$df/dt=0.1f^{1.4} \quad \text{and}$$

$$df/dt=0.09f^{1.35} \quad \text{respectively.}$$

REFERENCE

[1] A. O. Benz, C. Monstein and H. Meyer CALLISTO, A New Concept for Solar Radio Spectrometers, Kluwer Academic Publishers, The Netherlands. 2004.

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[3] Whitham D. Reeve. Solar Radio Burst Catalog. 2013.

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[5] International Network of Solar Radio Spectrometers: http://www.e-callisto.org/

[6] Data e-Callisto: http://soleil.i4ds.ch/solarradio/callistoQuicklooks

INSTRUMENTATION

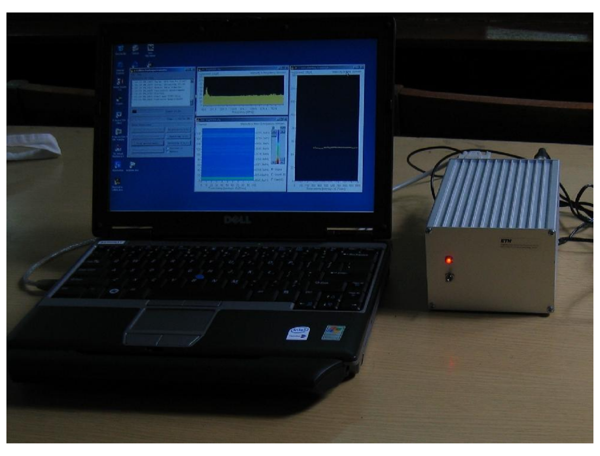

Fig. 3. Typical backend composed of Callisto and a notebook. http://e-calisto.blogspot.com

The CALLISTO (Compact Astronomical Low cost Low-frequency Instrument for Spectroscopy and Transportable Observatory) spectrometers in the entire world form the e-Callisto network developed by C. Monstein in Zürich, and installed in different parts of the world. The main applications are observation of solar radio bursts and rfi-monitoring for astronomical science, education and outreach. For this work we extracted data Bleien observatory, which is located on the network e-Callisto:
http://soleil.i4ds.ch/solarradio/callistoQuicklooks/

Fig. 4. Bleien observatory Switzerland. 7m parabolic dish tracking the sun. Feed: log-per 100 MHz - 4 GHz, currently observing 170 - 870 MHz File-ID = **BLEN7M**

RESULTS

The duration of solar burst type III were calculated with method describe and was approximate 1s for the majority of solar burst. We having fit Gaussian For the frequency 187,625 MHz the duration is a 1.5 s for the burst at 14/02/2011 to 08:32:32 (See Fig. 5).

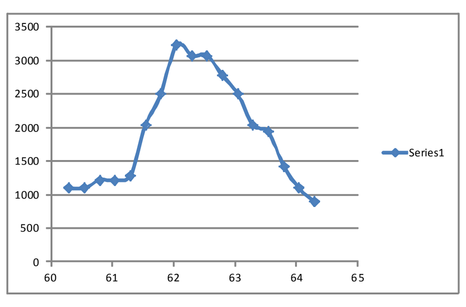

Fig. 5. Light Curve of solar burst to 187,625 MHz at 14/02/2011 to 08:32:32. Axis X: Time and axis Y:Relative Intensity

The negative drift rates of these bursts are standard values for type III bursts as mentioned in the Introduction (See Table 1).

Date	Inicial Time	Final Time	Type	Sub-type	Intensity	f_i	f_f	f_i (Spectrum)	Drift Rate	Density electron
14/03/2010	15:26:49	15:29:47	III	G	3	430	192	218,063	-35,364	$5,9x10^8$
17/10/2010	08:54:35	08:56:47	III	G	2	309	150X	181,813	-35,572	$4,1x10^8$
26/10/2010	12:33:18	12:35:18	III	G	2	417	150X	176,875	-60,654	$3,9x10^8$
14/02/2011	08:32:32	08:32:34	III	-	3	372	207	315,75	-85,774	$1,2x10^9$
14/02/2011	09:32:02	09:37:30	III	GR	3	350	175X	214,875	-73,74	$5,7x10^8$
15/02/2011	09:49:01	09:49:04	III	B	2	355	175x	304,875	75,741	$1,1x10^9$
15/02/2011	13:22:50	03:23:30	III	B	2	324	176	290,688	-35,266	$1,0x10^9$
18/02/2011	11:02:23	11:02:38	III	B	2	440	200	427,813	-130,6	$2,3x10^9$
20/02/2011	12:18:36	12:18:48	III	B	3	400	250	366,688	-75,017	$1,7x10^9$
05/03/2011	10:33:58	10:34:30	III	B	2	330	180	182,813	-57,277	$4,1x10^8$
16/03/2011	08:46:38	08:46:48	III	B	2	309	222	222,625	-25,236	$6,1x10^8$
09/08/2011	08:17:44	08:22:19	III	R	2	870X	190X	175	17,076	$3,8x10^8$
19/12/2011	14:00:14	14:12:54	III	GG	2	450	175X	236,375	46,546	$6,9x10^8$

Table 1. Data that we analyzed with features calculated of dynamic Spectrum

The relationship between drift rate and frequency comply with a power law and the indices are many near of value of Aschwanden and Melendez (See Fig. 6).

$$df/ft=-0.06f^{1.22}$$

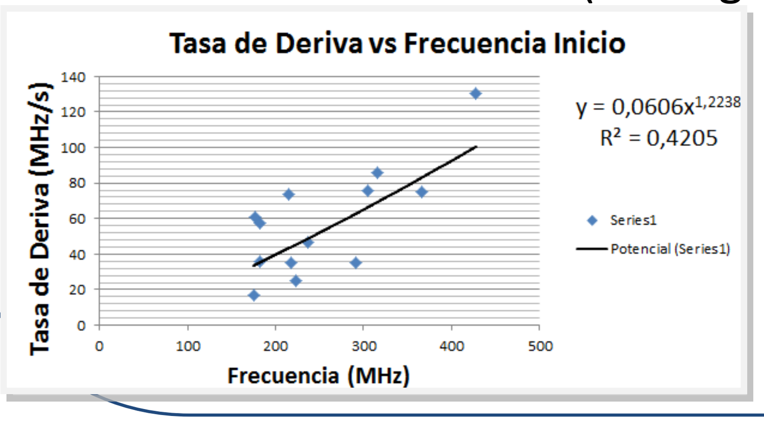

Fig. 6. Drift Rate vs. Initial Frequency, which comply

CONCLUTIONS AND FUTURE WORK

The majority of the solar burst have a negative Drift Rate and according to Reeve meet the specified values for the corresponding frequency range mentioned in the introduction.

The densities electron also are the corresponding for the frequency which we have observed.

The relation of drift rate and frequency fit a power law, and the indices are very approximate to those that shown Aschwanden and Melendez in their works.

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