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High Time Resolution Observation of Solar Radio of A Group Type III And U Burst Associated of Solar Flares Event

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Abstract

The results of high time resolution of solar flare type III and U burst at National Space Centre, Sg Lang, Selangor, Malaysia have been reported. We selected data in the meter - wave region solar radio spectral observations of the 2012 March 9th flare. During that period, a strong M 7.9 solar flare was recorded from solar Active Region 1429. It is clearly seen an inverted type occurs between 310 MHz till 384 MHz within 1 second. The group of type III burst also occurred before type U. During this period, M6 solar flare occurred in the active region AR 1429 starting at 03:32 UT and ending at 05:00 UT, with the peak at 04:12 UT. There is also a halo of Coronal Mass Ejections (CMEs) produced shortly after, and is expected to deliver a glancing blow to the earth's magnetic field sometime March 16th. In conclusion, we believed that the behavior of type III should be critically understood in order to predict the formation of type U burst. This also approve that the CALLISTO system possible to detect a radio burst signal at a precise time.

Keywords – Solar burst, U burst, III burst, CALLISTO, solar flare.

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1. INTRODUCTION

Discovery of solar bursts from the Sun opened a whole new vista on solar activity. Solar radio bursts are a radio Demission of solar flares that emphasizes its brief energetic and explosive characteristic. It is widely known that a common practice to characterize solar radio burst signals is to record the dynamical radio burst profile. The classification of bursts is based on bandwidth, frequency drift rate and duration of the emission. There are five (5) main types of solar burst (I, II, III, IV and V). It is believed that these bursts are generated by beams of fast electrons at levels of the local plasma frequency or its second harmonic (plasma hypotheses).In radio astronomy, bursts are considered to be a significant characteristic of solar activity because they are generally attributed to a sudden acceleration of particles from the Sun [1,2]. One of the main reason detecting solar burst is because this is the important tool for specifying magnetic, thermal and density structures at the time. Solar radio burst at low-frequency lies in the fact that they originate in the same layers of the solar atmosphere in which geo-effective disturbance probably originate. This is where the solar flares and Coronal Mass Ejections (CMEs) are believed to be launched. Solar flares, a sudden large energy release (10^{29} erg in 10^{2-3} s) in the magnetic active region are the most active manifestation of solar activity. It might define as a rapid brightening in H alpha, but simultaneously can have manifestations right across the electromagnetic spectrum and might eject the high energy particles and blobs plasma into the solar wind. In addition, most solar emission contains the plasma emission which is also related to Langmuir waves. Plasma emission is remarkably prevalent in the solar atmosphere, appearing in some form quite a large fraction of flares [3]. High sensitivity and high time and frequency resolution studies of so-called decametric continuum revealed that the continuum is composed of several kinds of bursts. Type III burst generally occurs in groups of overlapping burst are due to upward- and downward directed beams of nonthermal electrons, presumed to originate in the energy release site. It's considered as one of the best indicators of release of electron beams near the Sun along open magnetic field lines.

At low frequencies, where the radiation lasts for some ten of minutes, single burst are not common except during quiet times. Although isolated single bursts occur rarely, it is generally assumed that complex events can be described as a combination of individual bursts. One interesting fact about type III is it results from energetic particles escaping along open magnetic field lines. This burst is a short-lived (a few seconds), broadband (≈100 MHz) burst in which the frequency of maximum intensity drifts rapidly towards the lower frequencies due to solar flare event. The first observation of inverted type U burst has been reported by Maxwell and Swarup in 1958 [4]. Among the various impulsive of solar burst, type U is a unique and interesting to study in detail in terms of association with solar flares. Based on previous studies, it occurs during the large flare, but still much more rarely and basically generated to invert of J burst [5]. There is evidently the most regions this type happens is between 20 to 200 MHz in asymmetrical form [6,7]. Until now, the mechanism of generation of type U bursts is still a matter of ongoing study. It was observed that in some cases it will form in fundamental or harmonic structure but the configuration is very rare. Theoretically, there is an interpretation suggested the electron beams propagating in closed coronal loops requires (i) a high ambient temperature in the relevant coronal loops which approximately $T \geq 7 \times 10^6$K and (ii) the magnetic strengths should be higher compared with those implied by potential explorations [8]. Normally, the ratio closed to open magnetic field structures increase with lower altitude. Present paper shall review the observation of an inverted type III and U solar burst observed on 9th March 2012 detected by CALLISTO system.

1.1 E-CALLISTO NETWORK

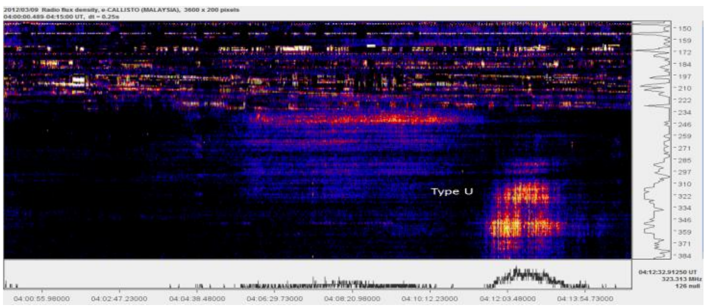
The e-CALLISTO system has already proven to be a most outstanding new tool for monitoring solar activity and for space weather research. The Compact Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO) has been described in detail by Benz et al. (2005) [9]. This experimental setup designed to observe solar flares in 24hours monitoring which have been distributed to 30 countries so far. On principle E-Callisto receiver uses a microprocessor controlled television tuner, logarithmic detector and other integrated circuit components. The receiver has provisions for controlling a 'focal plane unit' located at the antenna that can include a low noise amplifier, antenna polarization switching, noise calibration source and associated coaxial switches. This spectrometer observes automatically and their data are collected every day via the internet and stored in a central database. A public web interface exists through which data can be browsed and retrieved.

2 METHODOLOGY

The observations of a radio emission of the Sun have been monitored on 9th March 2012 at National Space Centre Malaysia. During this time the weather seems to be a hot day with a range of temperature varied from 28-31˚ Celcius. Solar observations in radio region have been carrying out the observations by Callisto spectrometer 45 - 870 MHz. However, due to interference, we focus on 150 MHz to 400 MHz.CALLISTO system provides a (wealth of data at high spectral, temporal, and spatial resolutions with the specification of the 0.25 second time resolution. All data are stored with a scale factor and an offset applied so that the measured ADC digits range fits into the byte data range (0 - 255). The antenna has a boom length 5.45 meters with gain 7dBi. Low Noise Preamplifier is connected to amplify a gain more than 10 dB. Within this range, it could be possible to detect solar activities specifically solar flare and Coronal Mass Ejections (CMEs).

3 RESULTS AND DISCUSSION

Observing time is as long as 12 hours routinely and the detected of bursts occurred on 9th March 2012. The flux density of the radio emission of the Sun is being shown in a light curve and spectral profile as shown in Figure.



During that event, a strong M 7.9 solar flare was recorded from solar Active Region 1429. This Sunspot has remained active since three (3) days ago. Due to the analysis, the group of type also remains exploded for a few hours. It is clearly seen an inverted type occurs between 310 MHz till 384 MHz within 1 second. The group of type III burst also occurred before type U. During this period, M6 solar flare occurred in the active region AR 1429 starting at 03:32 UT and ending at 05:00 UT, with the peak at 04:12 UT. There is also a halo of Coronal Mass Ejections (CMEs) produced shortly after, and is expected to deliver a glancing blow to the earth's magnetic field sometime March 16th.

4 CONCLUSION

Because the combine observation of III and U type is the first report from our site, it is of interest to understand the chronology of this event. Our understanding of solar burst phenomena is still very limited and here we shall discuss the possible ways in which the emission could be generated. In order to understand the possible mechanism of dynamical structure of the burst, we have investigated relationships and time integrations of the bursts with sunspot active region 1429. In conclusion ,the behavior of type III should be critically understood in order to predict the formation of type U burst. This also approve that the CALLISTO system possible to detect a radio burst signal at a precise time.

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Biographies And Photographs

Zety Sharizat Hamidi (Z.S.Hamidi) is currently a PhD candidate and study in Solar Astrophysics specifically in radio astrophysics at the University of Malaya. Involve a project under the International Space Weather Initiative (ISWI) and also a lecturer in School of Physics and Material Science, at MARA University of Technology, Shah Alam Selangor.