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Determining a Complex Solar Radio Burst Type II on 2nd November 2014 Driven by a Hydra Solar Flare As A Blast Waves

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ABSTRACT

Recent data of a complex solar radio burst type II is analyzed and reviewed. The monitoring of solar radio burst was done by using the Compact Astronomical Low cost, Low frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO) from BLEIN 7 meter dish telescope at ETH, Zurich in frequency range of 25 until 1000 MHz. During the inspection of the X-ray spectrum, we observed that the C3-category flare was caused by a filament of magnetism, which rose up and erupted between 0400 and 0600 UT. This occurred three hours before the signature of solar radio burst type II. There are some of the material in the filament fell back to the sun, causing a flash of X-rays where it hit the Sun surface. This is a Hydra Flare which occurred without sunspots. On the basis of these results, we suggest that a single shock in the leading edge of the CME could be the source of the multiple type II bursts and support the notion that the CME nose and the CME-streamer interaction are the two main mechanisms able to generate the bursts.

Keywords: Sun; solar burst; type II; radio region; X-ray region; Hydra solar flare; active region

1. INTRODUCTION

Solar radio type II is one of the main type that discovered roughly since 1947 by Payne-Scott, Yabsley, & Bolton in 1947 [1] lasting from a few minutes to a few hours. It can be divided into two sub-type (i) Harmonic and (ii) herring bone structure. Normally, two stripes with a frequency ratio about two are observed, being interpreted as the fundamental (F) and the second harmonic (H) emissions generated via a plasma radiation mechanism at frequencies determined by the local plasma density [2]. For instance, the aforementioned F and H branches may further split into two bands causing the well-known band-splitting phenomena [3].

The factor of this burst is still controversial until now. Previous studies have shown that this burst are produced by CME-driven shock [4,5]. However, there is an evidence and it is believed that the that the metric radio bursts stem from coronal shock waves driven by flares as blast waves Cane and Reames [6]. One can deduce the propagation speed of the driving shock wave from eruption region. Thus the CME kinetic energy is the indicator of the lifetime of the type II bursts [7].

In principle, the blast waves are generated in research environments using explosive or compressed-gas driven a shock tube in an effort to replicate the environment to develop better protection against blast exposure. A blast wave is an area of pressure expanding supersonically outward from an explosive core. It has a leading shock front of compressed gases. The blast wave is followed by a blast wind of negative pressure, which sucks items back in towards the center. In the next section will highlight the solar flare and solar bursts in X-ray and radio region.

2. SOLAR BURST OBSERVATION

The monitoring of solar radio burst was done by using the Compact Astronomical Low cost, Low frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO) from BLEIN 7 meter dish telescope at ETH, Zurich in frequency range of 25 until 1000 MHz [8]. On our site, we also have constructed a log-periodic antenna is a broadband, multi-element, unidirectional, narrow-beam antenna that has impedance and radiation characteristics that are regularly repetitive as a logarithmic function of the excitation frequency [9,10,11]. This antenna covered from 45 - 870 MHz [12,13]. This spectrometer is a low-cost radio spectrometer used to monitor metric and decametric radio bursts, and which has been deployed to a number of sites space world to allow for 24 hour monitoring of solar radio activity [14,15,16,17,18]. In this case, we focused the range of 35 MHz till 80 MHz [19,20]. The selected region is the best region with minimum interference at Blein, Switzerland site [21]. We have selected the data from the 45 MHz till 900 MHz region seems this is the best range with a very minimum of Radio Frequency Interference (RFI) [22,23,24,25]. In this paper, we have focused on the intensity of flux in an X-ray and radio region to evaluate the distribution of high and low energy [12].

3. RESULTS AND ANALYSIS

An Active Region AR2203 is growing rapidly but it does not yet pose a threat for strong flares. The development of thios active region has started sice 1st November 2014. There are also a coronal holes can be detected on 2nd November 2014. Figure 1 show the position of this active region and Table 1 shows the main parameters of the Sun during that day.

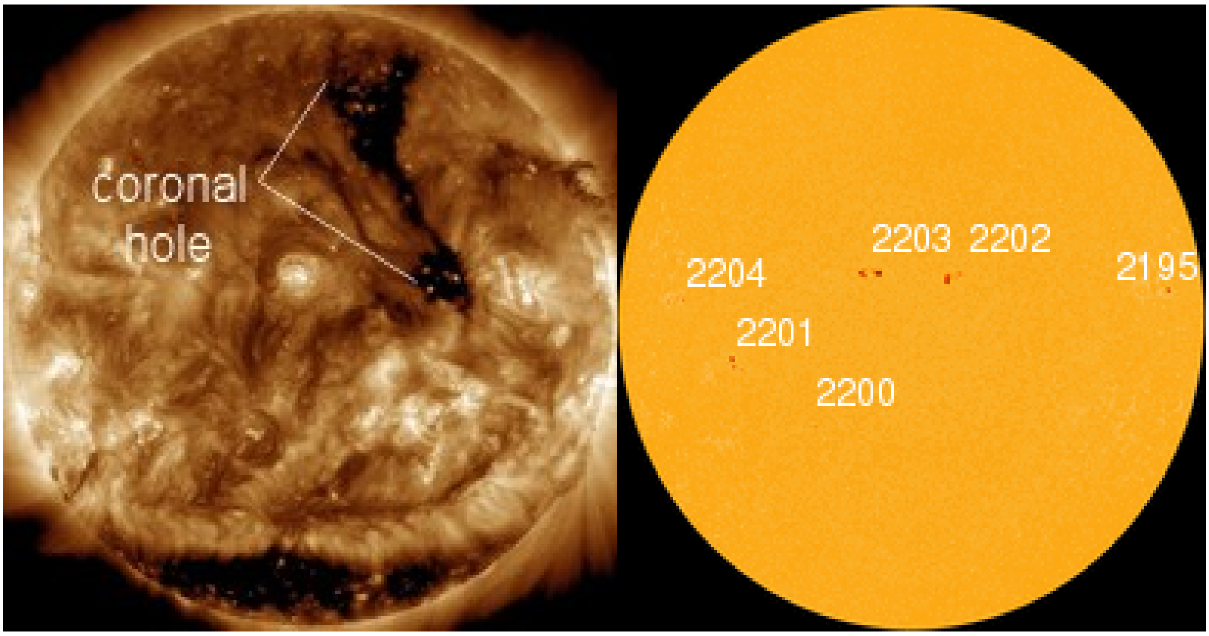

Figure 1. The Active regions during 2nd November 2014 and the image of the Sun by X-ray from Space Weather Website (Credited to: NOAA/ SWPC).

Table 1. Main parameters of the Sun.

Parameter	Value
Solar wind speed	451.7 km/sec
Solar wind density	6.3 protons/cm^3
X-ray Solar Flares 6-hr max	C9
X-ray Solar Flares 24-hr max	C9
Sunspot number	82

During the inspection of the X-ray spectrum, we observed that the C3-category flare was caused by a filament of magnetism, which rose up and erupted between 0400 and 0600 UT. This occurred three hours before the signature of solar radio burst type II. There are some of the material in the filament fell back to the sun, causing a flash of X-rays where it hit the Sun surface. This is a Hydra Flare which occurred without sunspots. The rest of the filament flew out into space, forming the core of a massive CME. After a few hours a data from the Solar and Heliospheric Observatory shows the CME billowing away from the Sun. However, it will not hit the Earth.

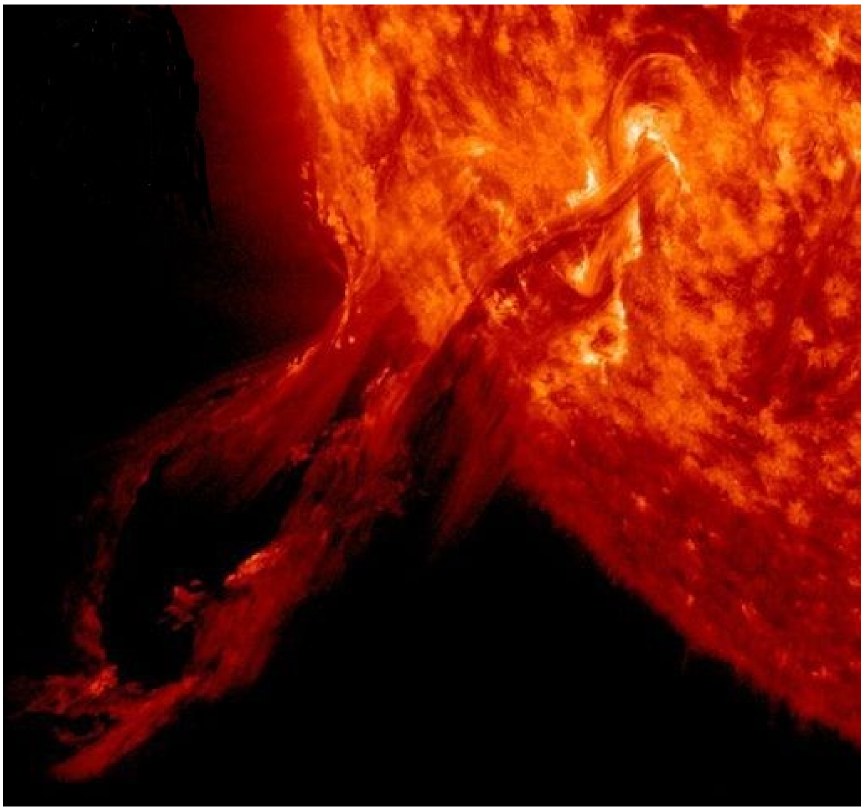

Figure 2. The plasma eruption during 2nd November 2014 and the image of the Sun by X-ray from Space Weather Website (Credited to: NOAA/ SWPC).

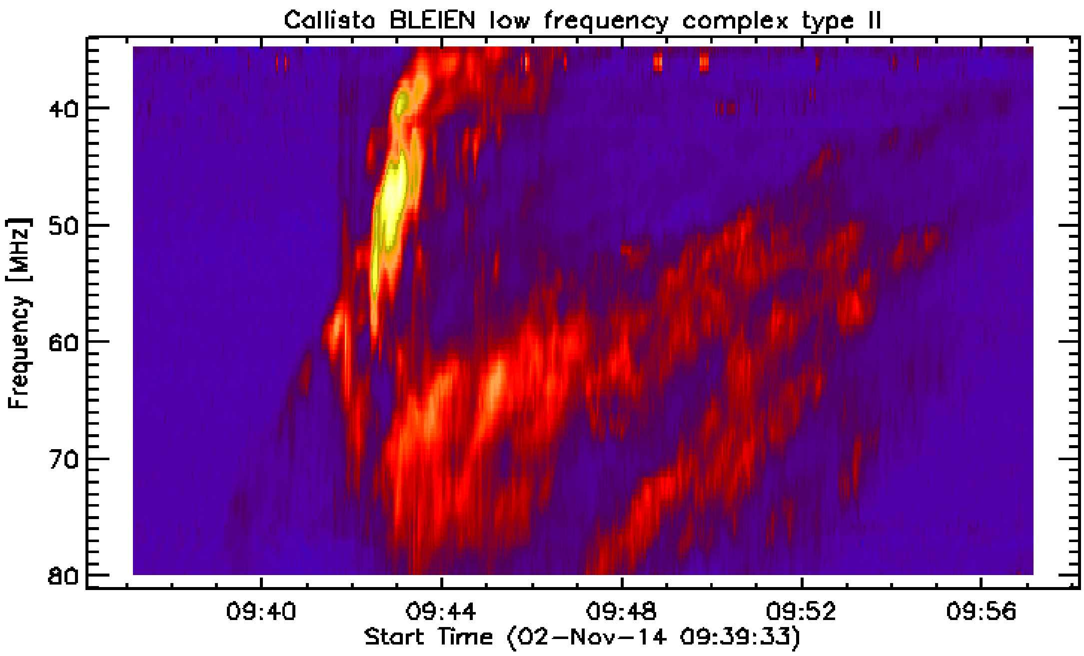

Figure 3. The continuous solar radio burst type II within 16 minutes (Credited to: E-Callisto network (BLEIN7M)).

Our main results are as follows: (1) the complex and splitting harmonic structure of type II bursts occurred successively at 16 minutes intervals and displayed various emission structures and frequency drifting rates; (2 Hydra Flare could be the source of the multiple type II bursts.; (3) this burst also can be detected at several sites of CALLISTO system such as Daro, Essen, Glassgow, Rwanda and Ooty sites.

4. CONCLUDING REMARKS

On the basis of these results, we suggest that a single shock in the leading edge of the Hydra Flare could be the source of the multiple type II bursts. During the inspection of the X-ray spectrum, we observed that the C3-category flare was caused by a filament of magnetism, which rose up and erupted between 0400 and 0600 UT. This occurred three hours before the signature of solar radio burst type II. There are some of the material in the filament fell back to the sun, causing a flash of X-rays where it hit the Sun surface. This is a Hydra Flare which occurred without sunspots.

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Biography

Dr Zety Sharizat Hamidi is currently a senior lecturer and focused in Solar Astrophysics research specifically in radio astrophysics at the School of Physics and Material Sciences, Faculty of Sciences, MARA University of Technology, 40450, Shah Alam, Selangor, Malaysia. Involve a project under the International Space Weather Initiative (ISWI) since 2010.

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