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Preliminary Analysis on the Solar Burst Type III and the Effect of the Magnetic Reconnection

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ABSTRACT. From the data from a BLEIN Callisto site, we aim to provide a comprehensive description of the synopsis formation and dynamics of a a single solar burst type III and magnetic reconnection effect. The data above is the solar radio burst type iii occurred on 10th September 2005 between 05:44 UT till 06:00 UT.This eruption has started since 5:55 UT with a formation of type III solar burst. The wave emission process of solar radio burst type III from magnetic reconnection region in a solar flare were investigated by using a two-dimensional, that are electromagnetic and relativistic particle-in-cell code. The solar radio burst type III initially impose into two plasma populations : background dense plasma and hot electrons that can be generated by the magnetic reconnection process in a solar flare. The conversion of the energy stored in the magnetic field by a process called the magnetic reconnection released the energy in the solar flares and related phenomena. By the launching the e-CALLISTO network, its prove the existence of the magnetic reconnection on the surface of the sun in radio region.

1. INTRODUCTION

The Sun is the nearest star in our galaxy. The distance this star from our Earth is 149,600,000 km. However the biggest star from the Earth take about 5000 light years from our Earth. The structure of the Sun consists of prominence, granulation, sunspot, corona , chromospheres, photosphere, convective zone, radiative zone, and core. Corona is the most active region and beyond has a temperature millions of degrees which is still considered as mysteries properties. Usually the solar radio burst occurs at the surface of the corona. Under certain circumstances, solar burst type III plays an important rule to understand of solar accelerated electron beams. It is a propagating beams of nonthermal electrons in the solar atmosphere and the solar system [1,2,3]. Electrons are regularly accelerated to near-relativistic energies by unstable magnetic field of solar atmosphere [4]. The frequency of drift rate is the change of frequency in time. The starting frequency of type III burst varies dramatically from burst to burst. During large solar flare type iii burst can starts at frequency in GHz. Typically type III bursts will start at 10s or 100s of MHz and can start at even lower frequencies [5]. Some type III burst will only exist at high frequencies above 100MHz [6]. These solar type III radio emissions is dominant a few days before solar flare and Coronal Mass Ejections explosion [7,8,9].

Type III bursts trace electron streams as they propagate along open field lines from flaring regions near the Sun into the interplanetary medium.In general, solar radio burst type III solar burst is the most the most common type [10] with range of frequency from 500 − 10 MHz [11,12,13]. This emission is probably from a part of the electron population that remains trapped in closed magnetic loops [14]. Usually, a fast drift (type III) solar radio bursts are synchronized in time with solar flares [15]. A previous study has shown that the type III are generated in a weak-field region comes from the absence or low degree of circular polarization of the bursts [16]. Langmuir waves active region radio emissions is believed to be a main subject that relevant with a type III burst [17,18,19,20,21]. These forces drive the plasma to a state unstable to the growth the beam-plasma interactions, is believed to generating these waves [22,23]. This type is very synonymous at the meter and decimeter wavelengths [24,25]. Early stage of solar flares may indicate that open field lines are an essential part of models for energy release by magnetic fields [26,27].

The conversion of the energy stored in the magnetic field by a process called the magnetic reconnection released the energy in the solar flares and related phenomena. Commonly the solar radio burst type III will also produce solar radio burst type II. This solar radio burst occurs due to magnetic reconnection. Magnetic reconnection is the primary energy that release the heats plasma and accelerates particles. It is the key link in the process of flare triggering. It is also the process by which magnetic lines of force break and re-join in a lower-energy configuration, which magnetic energy converted into plasma kinetic energy. The corona is a good conductive medium. Therefore, it still has a finite resistivity. The magnetic energy can also be released in the diffusion process. Magnetic reconnection has been established to play an important role in these processes. The magnetic reconnection changes the topology of the field surrounding the flux rope and assist reduce the magnetic tension force that bind the flux rope to the solar surface, hence enhance acceleration of the expulsion. Detailed analysis of the Sun in radio and x-ray region to understand the distribution of high and low energy [28,29,30,31]. We will highlight the solar flare and solar bursts in both electromagnetic radiation.

2. SOLAR FLARE OBSERVATION

In this section will discuss about the network used to obtain the data about the solar radio burst type III. There are a lot networks that can be used to obtain the data of solar flares such as e CALLISTO and NOAA. During a major space weather event which includes a burst of solar [32,33,34]. Compact Astronomical Low cost, Low frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO) from BLEIN with the 7 meter dish telescope at ETH, Zurich is being used to monitor the solar burst. [35,36]. 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 [34,37,38,39,40]. The Log Periodic Dipole Antenna has been constructed from 45 - 870 MHz [41,42,43,44]. The CALLISTO spectrometer is a low-cost radio spectrometer used to monitor metric and decametric radio bursts [45,46,47,48,49]. We select the range of 150 MHz till 900 MHz for this data [50,51,52]. This range has a very minimum interference at Blein, Switzerland site [53,54]. Selected the data from the 150 MHz till 900 MHz region seems this is the best range with a very minimum of Radio Frequency Interference (RFI) [54,55,56,57,58]. The next section will highlight the detailed analysis of solar flares in an X-ray and radio region to evaluate the distribution of high and low energy [41]. The instrumental parameters used in CALLISTO were stated in the table below.

Table 1: The specification of CALLISTO spectrometer

Parameter	Specification
Frequency range	45.0MHz to 870MHz
Frequency resolution	62.5KHz
Radiometric bandwith	300KHz/-3Db
Dynamic range	-120dBm to -20dBm(depending on gain voltage)
Sensitivity	25Mv/Db +/-1Mv/dB
Noise figure	<10dBm
Sampling frequency	Internal clock 800 s/sec max, external clock 1000 s/sec max
Number of channels	1 to 500, nominal 200 frequency per sweep
Supply	12V +/- 2V / 225Ma
Weight	~800 grams
Dimensions	110mm x 80mm x 205mm
Material cost	<200$ (material only)
Input	3 configuration files (config, frequency, scheduler)
Output	2 files (FITS-file and logfile)

3. RESULTS AND ANALYSIS

Solar burst type III rapidly drift from high to low frequencies. It may exhibits harmonics and sometimes accompany the flash phase of large flares. The data above is the solar radio burst type iii occurred on 10th September 2005 between 05:44 UT till 06:00 UT. This data were detected by the antenna BLEN5M (Bleien 5m parabola) model QM. The peak was between 05:54 UT till 05:56 UT. The wave emission process of solar radio burst type III from magnetic reconnection region in a solar flare were investigated by using a two-dimensional, that are electromagnetic and relativistic particle-in-cell code. The solar radio burst type III initially impose into two plasma populations : background dense plasma and hot electrons that can be generated by the magnetic reconnection process in a solar flare. The hot electron plasmas lead to generation of Langmuir waves and generated Langmuir waves can be converted to electromagnetic waves (solar type III radio burst) through the direct linear made conversion process. The emission process of radio burst type III from a magnetic reconnection region in the solar flare were investigated by using two-dimensional, electromagnetic and relativistic particle-in-cell.

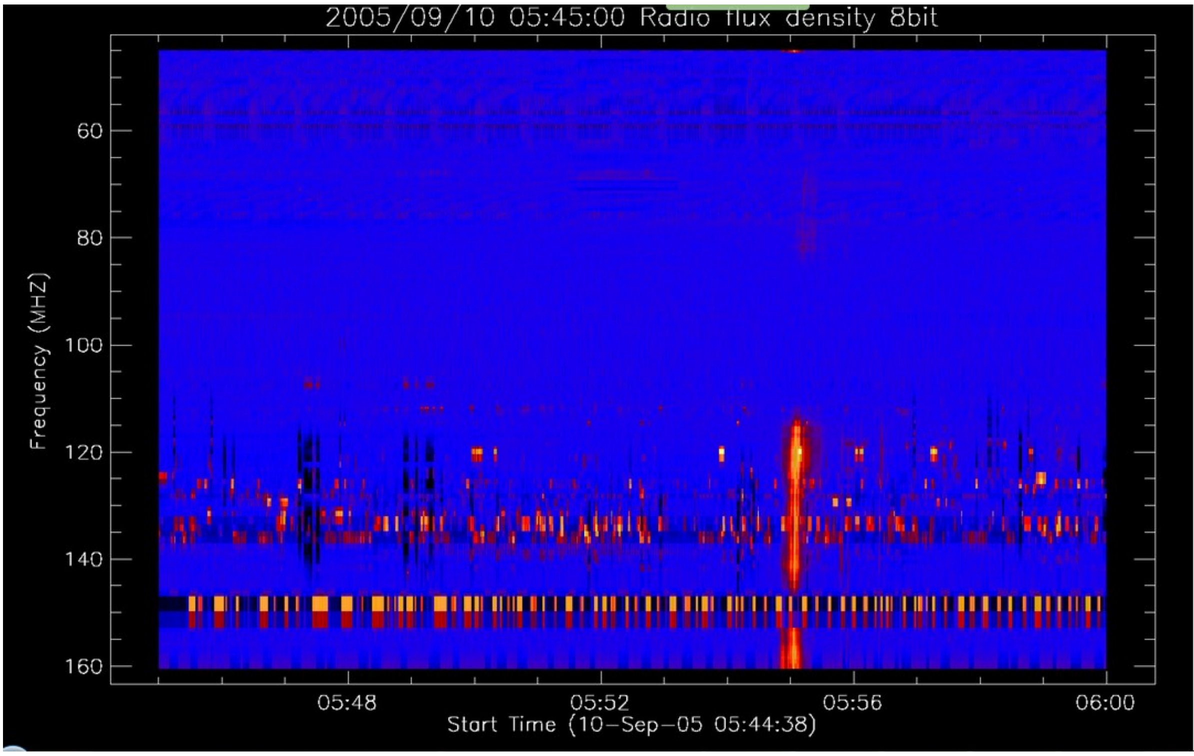

Figure 1: The single solar radio burst type III at 5:55 UT (Credited to: E-Callisto network (BLEIN7M))

Reconnection of magnetic fields on the surface of the sun drive the biggest explosions in our solar system. The magnetic reconnection that produced solar radio burst can be detected by the e CALLISTO. The reconnected magnetic fields were proved by launching the Yohkoh satellite. The scientific objective was to observe the energetic phenomena taking on the Sun, specifically solar flares in x-ray and gamma ray. There were four instruments on this satellite to detect the energetic emissions from the Sun. they are Bragg Crystal Spectrometer (BCS), Wide Band Spectrometer (WBS), Soft X-ray Telescope (SXT) and Hard X-Ray Telescpope (HXT).

4. CONCLUDING REMARKS

By the launching the e-CALLISTO network, its prove the existence of the magnetic reconnection on the surface of the sun in radio region. The solar radio burst type III rapidly drifts from high to low frequencies. The hot electron plasmas cause the Langmuir waves and generated Langmuir waves can be converted to electromagnetic waves (solar type III radio burst) through the direct linear mode conversion process.

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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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C.Monstein is a senior Engineer at Institute of Astronomy, Wolfgang-Pauli-Strasse 27, Building HIT, Floor J, CH-8093 Zurich, Switzerland and one of the researchers who initiated the CALLISTO system around the world.

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