Moderate Radio Flux Density of Single and Group III Bursts from AR2887 Active Region on 26th October 2021

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Abstract. The radio flux density is one of the most important parameters for predicting solar activity, such as solar flares and Coronal Mass Ejections. Compared to other burst types, solar burst type III (SRBT III) occurs most frequently due to solar flare phenomena. In the meter and decimetre wavelength range, gyro synchrotrons dominate, as do localized disturbances in the plasma frequencies caused by SRBT III. In this paper, we examine the most recent solar event that took place on 26th October 2021 in this gradual phase of the 25th solar cycle and can be detected from our site. In order to compare our results to other regions of the electromagnetic spectrum, we also used the data from the Solar Monitor and Space Weather Live website, where the data from NOAA and SDO/AIA were made publicly available. A wavelength of 10.7 cm corresponds to 101 solar flux units. Approximately 4.7 nT of interplanetary magnetic field exists and 1.7 nT in the northward direction. In the past 6 hours and 24 hours, flares of class C2 and M1 have been detected due to active region AR2887 generated by a 'beta-gamma' magnetic field.

1. Introduction

One of the most important parameters for determining solar activity, such as solar flares or Coronal Mass Ejections, is the radio flux density. The flux density is usually measured in Jansky or Decibel units according to the system and the antenna gain. As a result of the structure of the Sun, the solar bursts indicate the Sun is active. Depending on the factors involved, solar bursts can be classified into five types, from type I to type V [1]. Compared to other bursts, solar burst type III is the most common, mostly caused by solar flares. Solar radio burst type III is fascinating because it explains how particles ejected during massive solar activity are emitted [2]. There are three types of solar bursts: single bursts, group bursts, and complex bursts. By studying their correlation, we can improve our understanding of the magnetic reconnection process on the Sun's surface that leads to solar flares and CMEs.

The generation mechanisms in SRBT III mainly consist of two types: nonlinear wave-wave coupling and direct emission mode conversion: the result of density inhomogeneity [3]. The nonlinear wave-wave coupling is the coexistence of two Langmuir waves [4]. SRBT III's localized disturbances in plasma frequencies dominate at meters and decimetre wavelengths, along with gyro synchrotrons. [5]. These are associated with the primary energy-releasing sites in flares. Type III bursts of the Sun are characterized by the very fast movement of disturbance through the solar corona that could exceed 3 x
$10^4$ to $10^5$ km/s. That velocity corresponds to one-third of the velocity of light. These electrons are accelerated to energies between $10^4$ and $10^5$ eV [6]. Sunspot groups are usually associated with active regions on the Sun. An earth-sized sunspot is similar in size to a moderate-sized sunspot. Sunspots form and disappear over a period of days or weeks when magnetic fields emerge through the solar surface and allow cooling [7]. Penumbra usually develops around the central area or the umbra as the flux accumulates beyond the pores. As the magnetic field rises, it loops back towards the photosphere (North polarity). Sunspot groups with complex magnetic fields are often the source of solar flares. From an astronomical point of view, we can understand and describe the weather and climate conditions of Earth's lower atmosphere by analyzing the magnetic structure of Mount Wilson. [8].

2. Methodology and observation
Activated regions were compiled from the Solar Monitor and Space Weather Live website, which provides publicly available data from NOAA and SDO/AIA. Additionally, we compared the sun's activity with e-Callisto data, which monitors the sun's activity around the world via radio waves. [9]. Solar activity at Earth's surface can be detected by radio telescopes and ground-based antennas [2]. Observations were conducted with the LPDA, low noise amplifier (LNA), CALLISTO spectrometer, and Windows computer. A GPS clock controls the sampling time of the spectrometer in order to standardize the time. An antenna tracking controller controls the direction of the antenna. We will observe from 7 am to 7 pm, 12 hours a day. The CALLISTO network monitors the Sun 24 hours per day within the UNBSSI/IHY and ISWI instrument deployment program [10]. Figure 1 shows the Log Periodic Dipole Antenna that has been installed at National Space Centre, Banting, Malaysia.

![Log Periodic Dipole Antenna](image_url)
3. Result and discussion

A single and a group of moderate-intensity radio bursts appear in Figure 2, both exploding within less than 14 dB of each other. SRBT III properties have been attributed to a variety of mechanisms. Solar flares of type III are the subject of intense research during the solar cycle’s maximum especially. There is usually one flare or flare-like event that propagates electrons through the lower corona emitted incoherently as l-waves (electron plasma waves).

![Figure 2. Single and a group solar burst type III at Banting, Malaysia station](image)

Within three hours, the radio flux density reaches a moderate level (Figure 3). The energy release site is believed to be the source of upward- and downward-directed beams of non-thermal electrons that cause the SRBT III. Single bursts at low frequencies lasting a few minutes are quite rare. While isolated single bursts are rare, complex events are usually described as a combination of multiple individual bursts.

![Figure 3. A moderate radio flux density is continuous within few hours on 26th Oct 2021](image)
As shown in Figure 4, the M-class solar flares associated with growing sunspot AR2887 are being generated by a "beta-gamma" magnetic field. Other active regions are AR2886, AR2888, and AR2889, but they are considered less active than AR2887. Due to the stronger magnetic field in active regions with sunspots, solar flares are more likely to occur. At the dividing line between areas of oppositely directed magnetic fields, the magnetic energy in the solar atmosphere is typically released.

Solar magnetic fields are complex and powerful. On this day, 81 sunspots are visible. It has a density of 4.9 protons per cubic centimeter, and it can travel at speeds of up to 378 km/s. During the past 6 hours and 24 hours, flares of class C2 and M1 have been detected. Temperatures could exceed $49.4 \times 10^{10}$ W in the thermosphere. At a wavelength of 10.7 cm, the flux number shows 101 solar flux units. In the north direction, there is a magnetic field of approximately 1.7 nT and 4.7 nT. Due to magnetic reconnection on the Sun, magnetic energy has been released from the loop top of the reconnection site.

4. Conclusion

Groups of $\beta$-$\gamma$ sunspots that are bipolar, but are sufficiently complex that no continuous line can be drawn between spots of opposite polarity. This is a complex character that results from the larger sunspot. The most intense major solar flares usually originate from the delta configuration active region since its umbras have mixed magnetic polarity, which originates from AR2887.

5. References

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