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MAGNETIC PROPERTIES OF ACTIVE REGIONS (ARS) AND ITS CONTRIBUTION TO SOLAR RADIO BURST TYPE II AND SOLAR RADIO BURST TYPE III

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ABSTRACT

Solar activity of the Sun is becoming a growing concern as it may influence activity on Earth. The Sun's gases, moving in a plasma state, constantly create tangles, stretches, and twists in its magnetic fields. The Sun surface tends to be active and quiet depends on stages of the solar cycle. Magnetic field and Type II bursts are associated with solar flares and CMEs, which can potentially release solar energetic particles. The productivity of flares is connected to the magnitudes of flares and magnetic complexity. However, it has limitation in direct observations of magnetic properties of Active Regions (ARs). The main objectives are to determine the maximum counts of the magnetic classifications of sunspots in early stages of the Solar Cycle 25 and to evaluate the probability magnetic classification of the sunspot triggering Type II burst and Type III burst and its correlation. Next, to investigate the effect of magnetic properties of AR towards structure and characteristics of Type II burst and Type III burst. Descriptive statistical, R-value Pearson Correlation and ANOVA using Statistical Packages for Social Sciences (SPSS) and Linear Regression Analysis are method used in this research. From findings, it concluded that α sunspot, 33.24%, βγ sunspot ,28.49% and β sunspot, 25.14% has the highest magnetic classification of sunspot occurred in 3 years. The relationship between sunspot number and solar radio flux in all sunspots showed positive correlation and has slightly differences in variance. It statistically proved solar radio flux is directly proportional to sunspot number, however, unreliable to predict magnetic field. Next findings are the highest possibility to trigger Type II burst and Type III burst are originated from β sunspot followed by other sunspots. β sunspot has highest tendency to trigger Type III burst (37 events) and followed by Type II burst (17 events). β sunspot has range intensity of flares from $1.0\,x\,10^{-5}Wm^{-2}$ to $1.9\,x\,10^{-5}Wm^{-2}$. The greater the intensity of flares released from the sunspot affects the area and complexity of sunspot. It displayed that X-class of flares released greater number of magnetic properties of ARs (7 SHARP parameters) such as USFLUX, TOTUSJH, TOTUSJZ, TOTPOT, MEANPOT, AREA_ACR and SHRGT45 compared to M-class of flares. This research is crucial in forecasting solar activity in Solar Cycle 25 and study the difference between magnetic properties of ARs with previous solar cycles. Magnetic properties of ARs are crucial and significant to provides information solar flares and CMEs which causes eruptions solar radio burst to our earth.

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CHAPTER 1
INTRODUCTION

1.1 Research Background

The black body emission is well-known for its efficiency in absorbing and emitting energy. A distinctive feature of the black body emissions is that they are natural and generate significant amounts of energy, including heat and solar energy. In terms of cosmic rays, the Sun is the nearest star. Sun consists of various types of gases, including helium, oxygen, carbon, neon, and nitrogen. This hydrogen gaseous mixture is fused into massive stars through the process of nuclear fusion. Nuclear fusion begins when two hydrogen nuclei (H) combine to form a deuterium (D) nucleus, a positron (e^+), and an electron neutrino (v_e) (Kong & Ravndal, 1999). The positron is instantly annihilated when it collides with an electron, resulting in the formation of two gamma rays (Bethe & Critchfield, 1938). Following deuterium's fusion with one neutron and the emission of another gamma ray, two helium isotopes fuse to form a helium nucleus with two neutrons and two protons. This nuclear fusion occurs in the Sun's core (Raffelt & Stodolsky, 1982). This energy is then transferred to the Sun's different layers, including the radiative zone and convective zone in the inner layers, and the outer layer of the Sun which are photosphere, chromosphere, and corona. Solar wind carries energetic particles and energy released in the core into outer space in the form of Electromagnetic Radiation (EMR).

Electromagnetic fields are primarily visible in the Sun's outer layers, such as the photosphere and corona. Solar activity is visible in the photosphere as sunspots and Active Regions (AR), while the events occur on corona is categorized by solar flares, Coronal Mass Ejections (CMEs), and solar prominences. Sunspots are referred as the coolest and the darkest region on the photosphere surface due to its lower temperature. The temperature in the region decreased because magnetic field trapped in the subsurface, thus it prevents hot plasma with conducting electrons from recharging and cooling radiatively. Heat transferred as magnetic plasma moves outward in the penumbra and then returns to the umbra from beneath the surface. Evershed flow is the technical term for this plasma flow. Not to be neglected, the umbra is the sunspot's darkest region, with the greatest potential for large flares and geomagnetic storms du

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