STUDY OF ELECTROMAGNETIC PHENOMENA OBSERVED IN THE EARTH'S IONOSPHERE

By

Fayrouz Ahmed Mohammed Hussein

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy in Science

In

Theoretical Physics

Department of Physics-Faculty of Science

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Egypt

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ABSTRACT

The periodically solar masses released into space which is termed as solar wind causes short-term alteration in the Earth's magnetic field when it impinges the earth's magnetosphere. During solar activity, the amount of solar masses released into space is extremely larger that significantly perturbs the Earth's magnetic field in comparison with regular variations. Subsequently, huge quantities of energy and momentum associated to the perturbed solar wind are ejected into the Earth's ionosphere-thermosphere at auroral latitudes. This abrupt variations in the Earth's magnetosphere is known as geomagnetic disturbances/storm, but when is observed locally over the auroral region is termed as geomagnetic substorm.

One of the most distinguished phenomena in the equatorial ionosphere that is strongly correlated to geomagnetic disturbances is the Equatorial Plasma Bubble (EPB). EPB known as abrupt depletion in the equatorial ionospheric plasma density. It is generally observed by satellite data within nighttime period. The ionospheric irregularities in the electron density associated with the development of EPBs can seriously disrupt the diffusion of trans-ionospheric radio wave path by impacting both phase and amplitude of the radio signal. Therefore, studying this phenomenon and their impacts on the ionosphere are the scope of our thesis due to its academic and industrial applications. Thesis is divided into five chapters,

Chapter 1 introduce the basics about the Sun, solar activity and its impact on the Earth's atmosphere. In addition, it presents some knowledge about the structure of the magnetosphere and its magnetic and current system.

Chapter 2 introduce basic information about the ionosphere and the F, E regions dynamo processes that control it. Moreover, we present various

ionospheric anomalies, such as Equatorial Ionization Anomaly and Equatorial Spread F, and their morphology.

Chapter 3 presents an investigation about the impact of the total solar eclipse (21 August 2017) on different ionospheric parameters using data from recorded by the Swarm mission during its pass over United States. These parameters are the electron density, slant total electron content (STEC) and electron temperature. We use calibrated measurements of plasma density and electron temperature.

Chapter 4 presents the general features of the EPB during different types of geomagnetic storms. Based on the observations of Ionospheric Bubble Index (IBI) data derived from the Swarm mission. The characteristics of plasma bubbles are investigated during different types of geomagnetic storms recorded from 2014 to 2020. The geometrical constellation of the Swarm mission enabled us to investigate the altitudinal profile of the IBIs during different activity levels in a statistical mean.

Chapter 5 depicts the features of the Equatorial Ionospheric Anomaly (EIA) single crest. This work makes use of eight years of electron density data observed by the Swarm constellation to study its features of equatorial ionospheric single crests recorded at different altitudes.