URSI GASS 2020, Rome, Italy, 29 August - 5 September 2020

Solar Activity Observatory early stages: Analysis of the diurnal variations in the amplitude strength at 20.1MHz

Escobedo – Galván, C.R.[1], Castro Nieto, C.P.[1], and Pérez-Martínez, M.I.[2]
[1] CECyT18 Zacatecas, México
[2] Universidad Autónoma de Zacatecas

Abstract

We present the results of the early stages of a Solar Activity Observatory: the continuous monitoring of 20.1MHz signal strength in order to study the solar activity. Since the project is quite young, as to say, we have 3 months of observations, in this sense, we were able to observe diurnal changes. The difference between the day and night amplitude strength, the time it takes the amplitude to increase and decrease from day to night, and some special features such as a B class solar flare during May 6.

Introduction

During the day, the Earth atmosphere is ionized by solar radiation, increasing the total electron content, and giving place to the D layer, characterized by the strong absorption of radio frequencies. At night, the D layer disappears as a consequence of electron recombination, decreasing the electron content. This change might appear as a drastic feature due to the electron density differences.

The Solar Activity Observatory is an educational and scientific project meant to bring radio astronomy to students, and from the continuous monitoring of solar activity try to correlate it to changes in weather parameters.

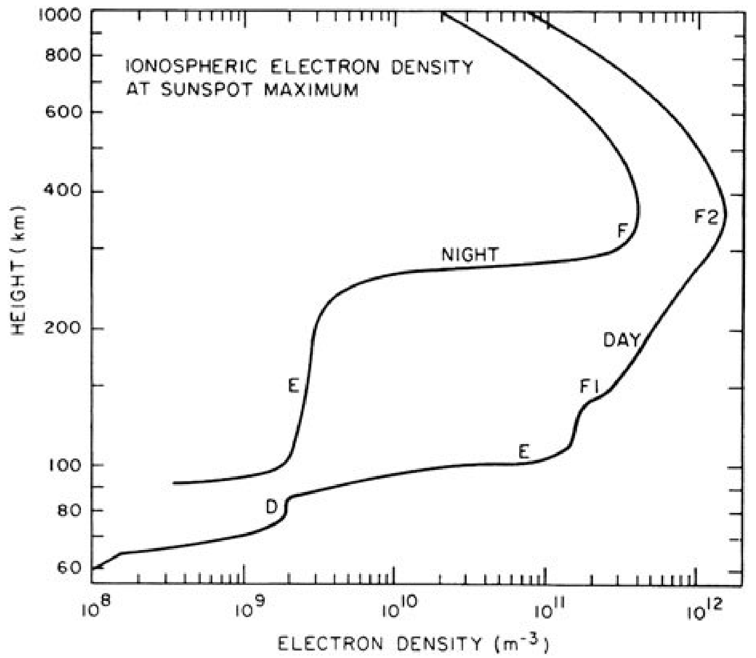
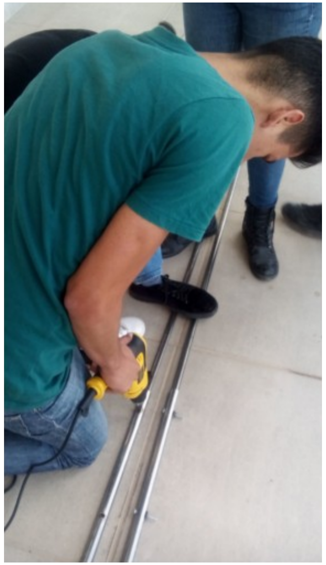


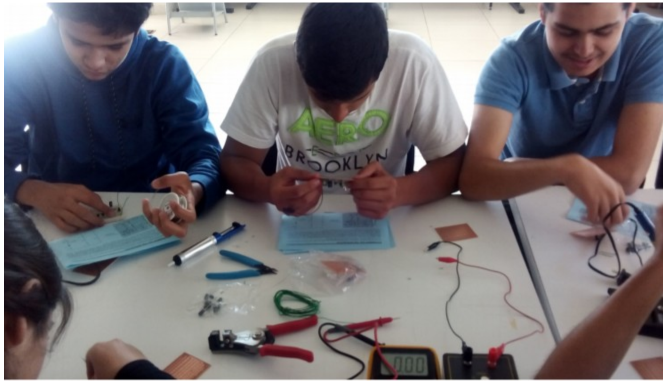
Figure 1. Idealized electron density distribution according to height. [1]

Instrumentation and location

The 20.1MHz dipole antenna, is located at the CECyT18 in Zacatecas of the Instituto Politécnico Nacional, since 2018.

In 2018, **the project began as a student research activity,** it involved not only the construction of the antenna, but also the assembly of the 20.1MHz receptor, as well as arduino based weather stations.





Observations and early results

The Solar Activity Observatory is located in a public institution, the receptor is working non stop, in the sense that we are continuously receiving signal during day and night.

This allows us to observe significant differences between the received intensity during day and night time.

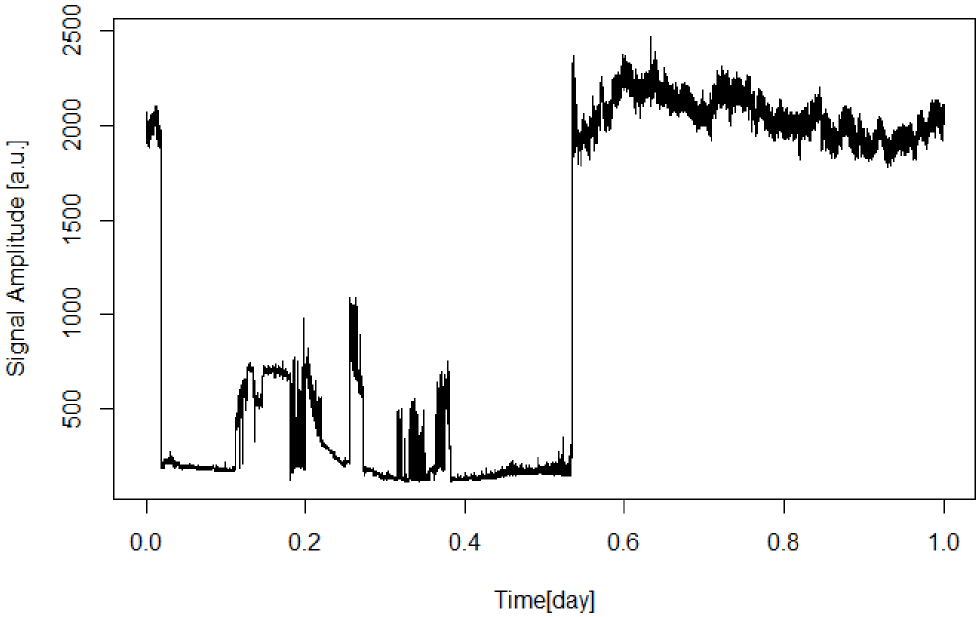
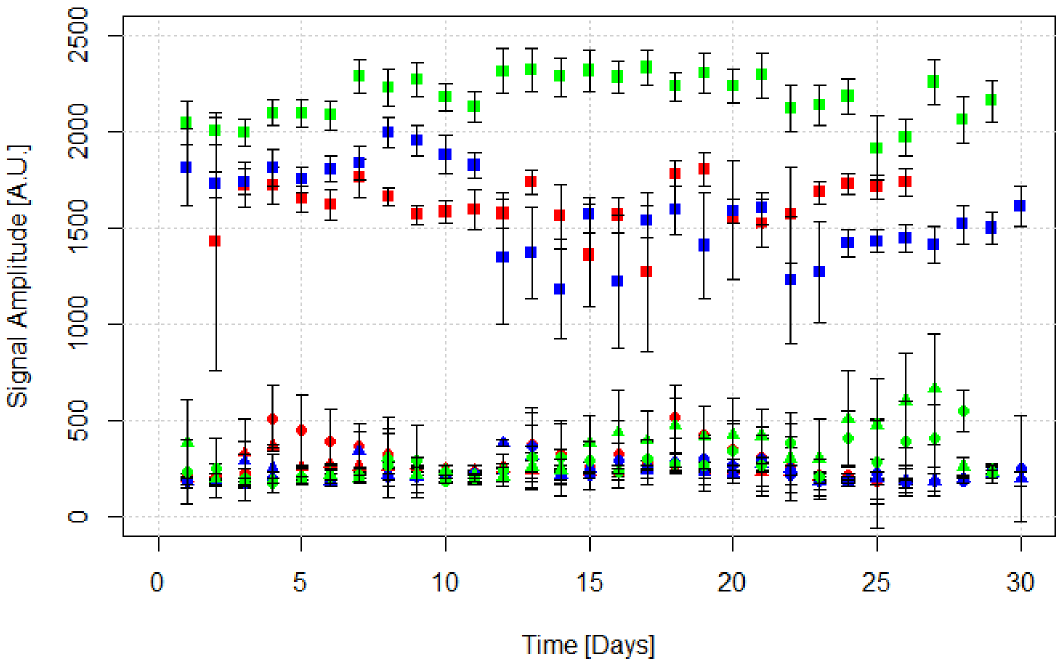


Figure 2. An example of a single day signal strength. In which, can be observed the difference in amplitude strength between day and night.

Observations and early results

Diurnal variations

In order to visualize the difference between the day and night emission, the average amplitude was obtained, before, during and after nighttime. All the averages for each day of the three months, are represented in the next figure, in which the green character represent May of 2019, the red ones represent June and the blue ones July. The squares denote the night average, the triangles and the dots are for the after and before the night, respectively.



Observations and early results

Time delay

One of the things that caught our attention, is the time interval in which the signal emission goes from minimum to maximum, and vice versa. Since it is linked to the nature of the ionosphere, it might be related to the time it takes to the solar radiation to ionize the upper atmosphere, and on the other hand, the time it takes to recombine.

In order to determine the time interval in which this change happens, the time interval was measured, from day to night and from night to day,

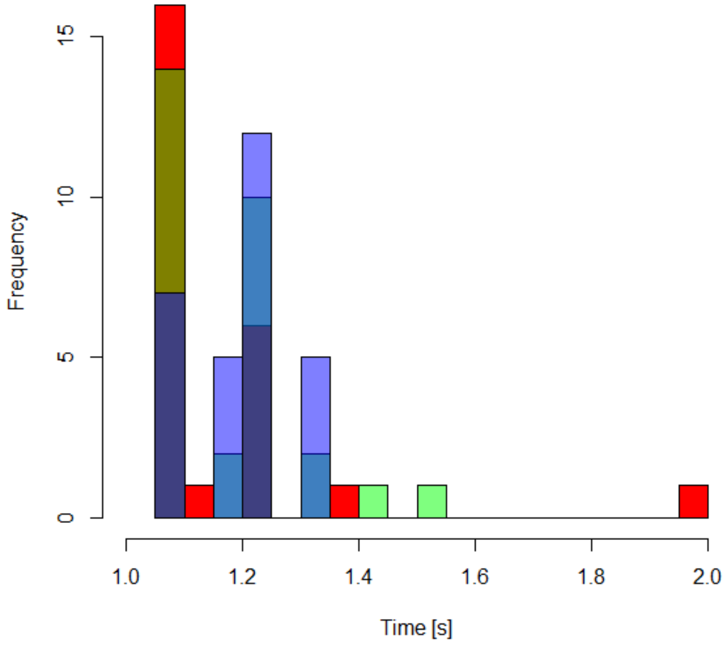


Figure 4. Histograms of the measured time lapse, **from day to night**

Observations and early results

Time delay

One of the things that caught our attention, is the time interval in which the signal emission goes from minimum to maximum, and vice versa. Since it is linked to the nature of the ionosphere, it might be related to the time it takes to the solar radiation to ionize the upper atmosphere, and on the other hand, the time it takes to recombine.

In order to determine the time interval in which this change happens, the time interval was measured, from day to night and from night to day,

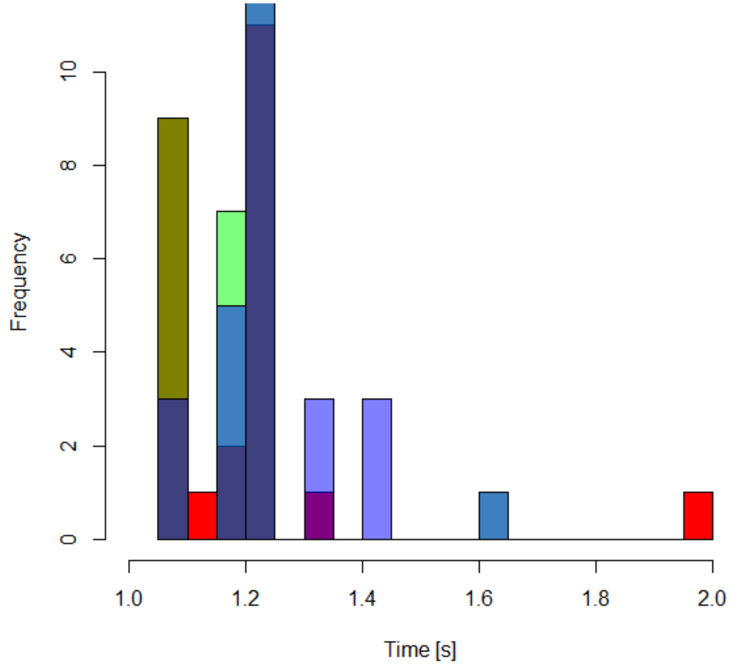


Figure 4. Histograms of the measured time lapse, **from day to night**

Observations and early results

Special features

Between May 5 and 6, the sunspot 2740 emerged, along with a solar storm, which was observed in the daily records. This solar storm was used to support our observations, since thanks to the RadioJOVE data archive, we were able to confirm our observations with other radio telescopes.

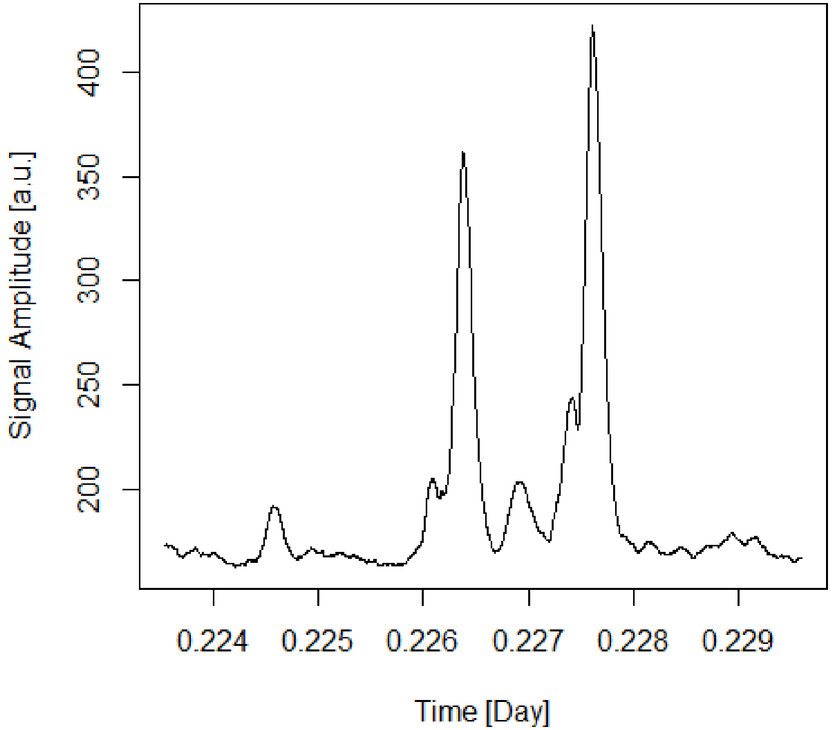


Figure 5. Solar flare observed on May 6 2019

Conclusions

We presented the first observations of the Solar Activity Observatory at Zacatecas, Mexico, an effort achieved thanks to the high school students and teachers at CECyT18. Thanks to the continuous monitoring, we were able to observe and analyze diurnal variations, such as the average strength amplitudes during day and night, and measure the time it takes the radiation to change from day to night and vice versa. Indeed, there is a lot of work left to do, as mentioned above, this are the first steps to calibrate, analyze and describe the signal variations we observe.

References

[1] A.R. Thompson, J.M. Moran, and G.W. Swenson Jr., Interferometry and Synthesis in Radio Astronomy, Astronomy and Astrophysics Library.