Sunspots Effect on Cosmic Rays

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ABSTRACT-The data used in this work is gotten Mexico observation centers and Spider observations for cosmic ray and sunspots respectively. These data is for the period of three months (January to March 2011). Using the data of sunspot counts with cosmic ray counts, graphs were plotted. The result shows that sunspots formation decreases when cosmic rays production increases. Hence sunspots have effect on cosmic rays production. It further revealed that both sunspot and cosmic rays do not correspond.

Index Terms- Sunspot, Cosmic rays, Particles, Sun, Atmosphere

1 INTRODUCTION

Sunspots are regions on the surface of the sun known as photosphere. They appear in pairs which are aligned in east west direction. Their magnetic field strength are thousands times stronger than that of the earth. The field is strongest at the umbra –which is the darker part of the sunspots. And the weaker field is known as penumbra [1]. Sunspots are caused by sun's magnetic field welling up to the sun's visible surface. The powerful magnetic fields around sunspots produce active regions on the sun; these usually lead to solar storms. An active region on the sun is an area with an especially strong magnetic field. Sunspots frequently form an active region [2]. The formation of sunspots could be over periods from days to weeks or even months. The average number of spots that can be seen on the surface of the sun is not always the same, but goes up and down. This rise and fall in sunspots counts is a cycle. A peak in the sunspot count is known as solar maximum while solar minimum is when there is little appearance of sunspots [3]. [4] examined the differences of sunspot figures and cosmic ray reduction and found out that there is a connection of solar events with temperatures which is likely with solar length or variation with cosmic rays. One of the possible explanations for a link between sunspots and weather is through cosmic rays.

Cosmic rays known as primary cosmic rays, enters our solar system, through the process of collision with other atmospheric constituents produce secondary particles, which spreads in different direction in the form of shower within the earth's atmosphere [5]. At certain direction, the cosmic rays particles (e.g proton) entering the atmosphere, collides with the atmospheric particles (e.g electrons), hence creating an existence between the

field strength and the distance of approach of an undeflected cosmic ray particle [6]. Most cosmic rays posses much kinetic energy. An experiment by Pirerre Auger showed that these high energy cosmic rays could come from active galactic nuclei [7]. As a result of their high kinetic energy, these cosmic rays travels with Alfven speed, and its acceleration rate is affected by atmospheric density and other parameters [8]. The energetic components of cosmic rays are in association with other classes of energetic particles with energetic event on the sun interplanetary space [9].

2 MATERIALS AND METHODS

This paper uses data from Apapity Cosmic Rays station observatory and www.ngdc.noaagov/stp/SOLAR/ftpsunspotnumber.html#hoyt for cosmic ray counts and sunspot counts respectively. This is because they are available at the net for less or no cost for researchers to use. We downloaded the data from net, though the data did not appear cumbersome. The data downloaded is for the month of January to March 2011.

3 RESULT AND DISCUSSION

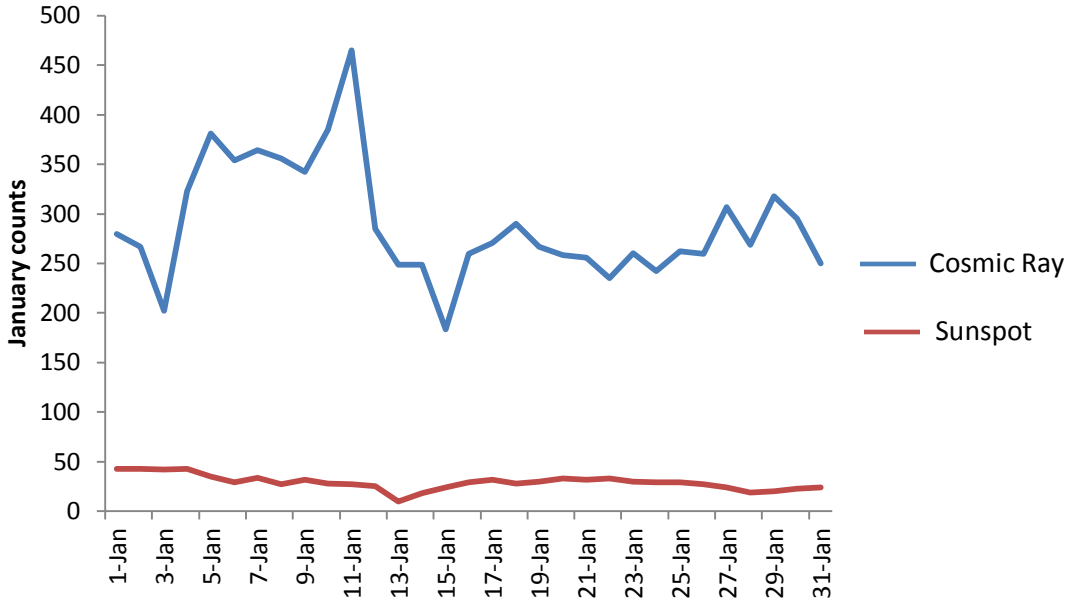

Figure1: Graph showing Cosmic Rays counts and Sunspots counts (January)

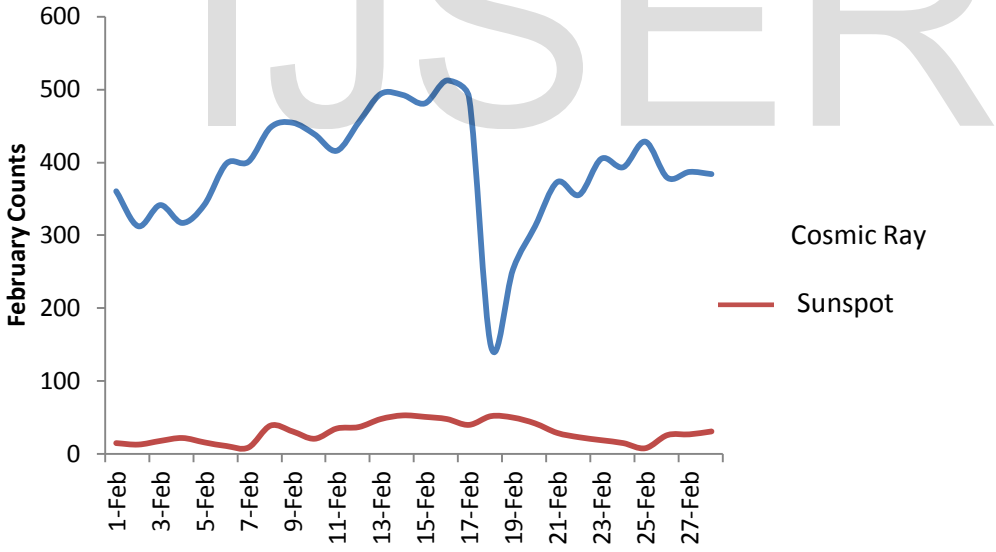

Figure 2; Graph showing Cosmic Rays counts and Sunspot Counts (February)

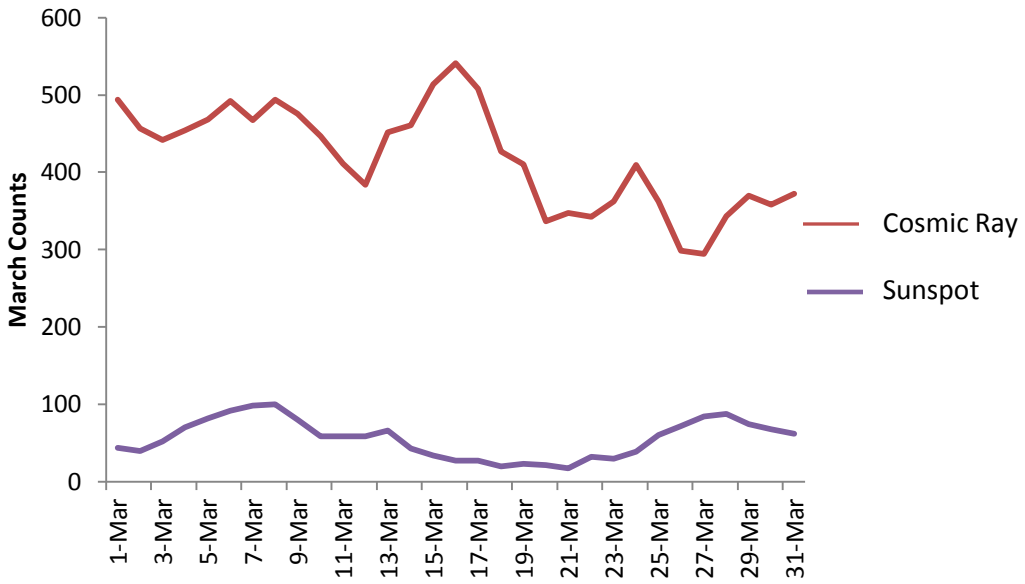

Figure 3; Graph showing Cosmic Ray counts and Sunspot counts (March)

In the month of January, as seen in figure 1, cosmic rays counts appear highest on day 11 with the value of 365 and minimum on day 15 with the value of 183.5. On the other hand, sunspots counts appear highest on day 1, 2 and 4 with the value of 43 and minimum on day 13 with the value of 10. Figure 2 is for the month of February. It shows that cosmic rays recorded its peak value of value of 512.5 on day 16 and its minimum by 147.5 on day 18, while sunspots recorded its peak by 53 on day 14 and its minimum by 9 on day 7. Also, in the of March as seen figure 3, cosmic ray has the highest value of counts by 541 on day 16 and minimum by 294.5 on day 27. Sunspot on the other hand, recorded its highest value by 100 on day 8 and its minimum by 17 on day 21.

Furthermore, there are some obvious fact about the sunspots and cosmic rays as seen in figure 1, 2 and 3. Firstly, sunspot counts numbers are generally low while that of cosmic rays are high. Secondly, their peak values increases as the months advances. And thirdly, from these counts values, it can be seen that both cosmic rays and sunspots do not correspond within the three months of observation.

In summary, it is clear from the figures presented that there is an existence of rise and fall in the number of sunspots and according to W. Nuntuyakul et al, 2014 [10], the decrease in sunspots formation brings about the increase in cosmic ray production. It also causes decrease in the solar activities such as Solar Flares and Coronal Mass Ejection. That is, if the sunspots are high there will be high solar activities, such as solar storm but from the figures, we see that cosmic ray counts are far higher than that of the sunspots, which implies that within the first three months of 2011, the solar activity has been very low. This is in line with NSF 2000 [11], that sunspot will increase if cosmic ray decreases and there will be increase in solar activity.

Conclusively, this paper has shown that there is no correspondence between cosmic ray and sunspot. And that more abundance of one implies the less abundance of the other. That is, if there are large availability of cosmic rays, sunspots formation will be small. This could lead to the cause of the variation of cosmic rays that enters the earth. This is supports the work of Henrik and Nigel 2004 [12]. It further reveals electromagnetic field and the matter emission from the sun must be low. With this, there will be more production of cosmic rays which will help in atmospheric activities. In a nut shell, the formation of sunspots certainly affects the availability of cosmic rays, this agrees with work of Rakesh, et al, 2011[12].

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