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# EFFECT OF SOLAR WIND SPEED ON COSMIC RAY INTENSITY

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## ABSTRACT

*Observations were made for 30 days (1st - 30th June 2013). This was done by using cosmic ray intensity counts and average real-time bulk parameters of the solar wind speed data. These data was simplified by partitioning the values recorded into equal range of day's intervals for easy interpretations. The total of 57,473,339 counts of cosmic ray and a corresponding solar wind speed of 165,423 was recorded. Statistically, the angles of both events were well calculated and recorded. These were clearly shown on the graphs displayed. From the results, between 22nd – 24thof June, the eak solar win seed of 90.840 corresponded with that of cosmic ray intensity of 36.240. Also, between 10th –12th June, minimum solar wind speed of 9.780 corresponded with the cosmic ray intensity of 35.640. Though, most of the range of days did not follow any trend at all. This could be due to the anomalous behavior of geomagnetic effect at that period of time.*

**Keywords :** Solar wind, Cosmic ray, Intensity, Modulation, Particles.

## INTRODUCTION

Charges have been observed by many authors to exist in the air atmosphere. There charges are believed to be ionized by cosmic rays. And these cosmic rays are being affected by solar wind. This fact attracts serious attention. Solar wins is a stream of energized, charged particles, primarily electrons and protons, flowing outward from the sun, through the solar system at speeds as high as 900km/s, and this can be detected by ground based techniques (Feldman, et al, 2005). This detection is done by hemisphere ion traps by directly observing and measuring its strength. The instruments such as Ultraviolet Coronal Spectrometer (UVCS) on board the spacecraft do observe the acceleration region of the fast solar wind emanating from the poles of the sun (Christopher, 2009).

Based on their origin, solar wind plasma has been classified into two; coronal hole and solar flare associated streams. Observed heliospheric plasma and field parameters of these streams such as speed, field strength and its variance has been utilized in a systematic manner in order to see their effects in cosmic ray modulation (Badruddin, 1997). The flow rate of cosmic rays incident on the earth's upper atmosphere is modulated by two processes; the sun's solar wind and the Earth's magnetic field. The solar wind, being an expanding magnetized plasma generated by the sun, has an effect on the incoming particles, as well as some of the particles with energies below 1Gev (Coballero Lopez and Moraal, 2004).

For Earth's magnetic field, the cosmic ray deflected by the fact that the intensity of cosmic radiation is dependent on latitude and longitude. The cosmic ray varies from eastern and western region direction due to polarity of Earth's geomagnetic field and positive charge dominance in primary cosmic rays. This can be understood by the fact that charged particles tends to move in the direction of the field along and not across them (Ngobeni, 2006). This results in the modulation of their total flux and differential energy spectrum as measured in the vicinity of periods of high solar activity. This does not allow a direct application of the force field method to study of the atmosphere transport of cosmic rays (Gleeson, et al, 1968).

## MATERIALS AND METHOD

Observations made for 30 days (from 1st to 30th june, 2013); using cosmic ray intensity counts and averaged real-time bulk parameters of the solar wind speed data was simplified by partitioning the values recorded into equal range of days/class intervals, for easy interpretations. The data sources are the Mexico City Observatory and the Space Weather Prediction Center respectively. The total of each event was recorded within the stipulated range of days thus, 1st-3rd, 4th-6th, 7th-9th, 10th-12th, 13th-15th, 16th-18th, 19th-21th, 22nd-24th, 25th-27th, 28th-30th. The nature and behavior of the two events (cosmic ray intensity and solar wind speed) within the atmosphere was observed, using a statistical tool.

Statistically, the relation used to get the amount of angle in degree registered by both events is:

$$Registered\ Angle = \frac{Event\ occured\ in\ each\ range\ of\ days}{Total\ of\ the\ Event} \times 360^0$$

Line graph will be used to show vividly how the recurrent enhancements of solar wind velocity were associated with cosmic ray intensity.

## RESULT AND DISCUSSION

The figures below gives a breakdown of the results obtained and observations made during the course of this experimental work.

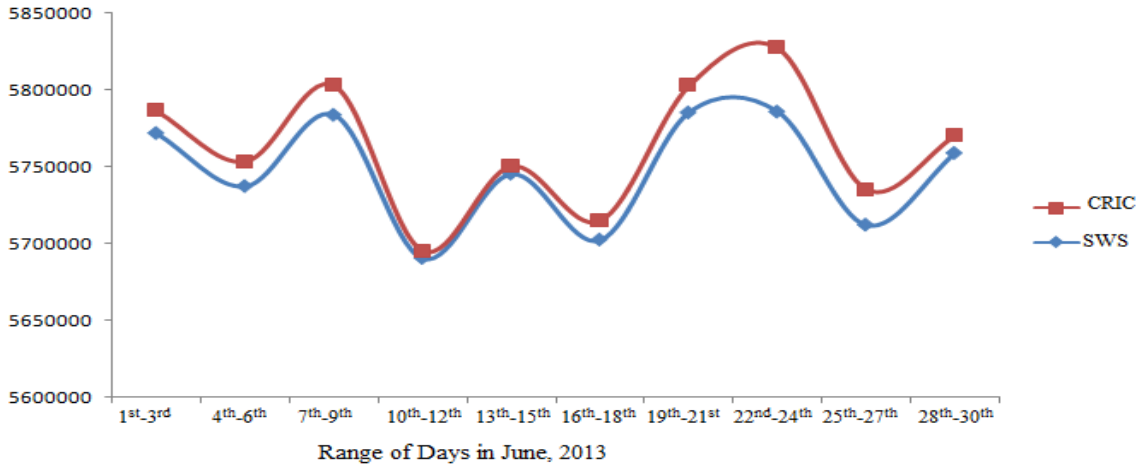


**Figure 1:** Cosmic Ray Intensity Counts (CRIC) versus Solar Wind Speed (SWS) within the Range of days in June, 2013.

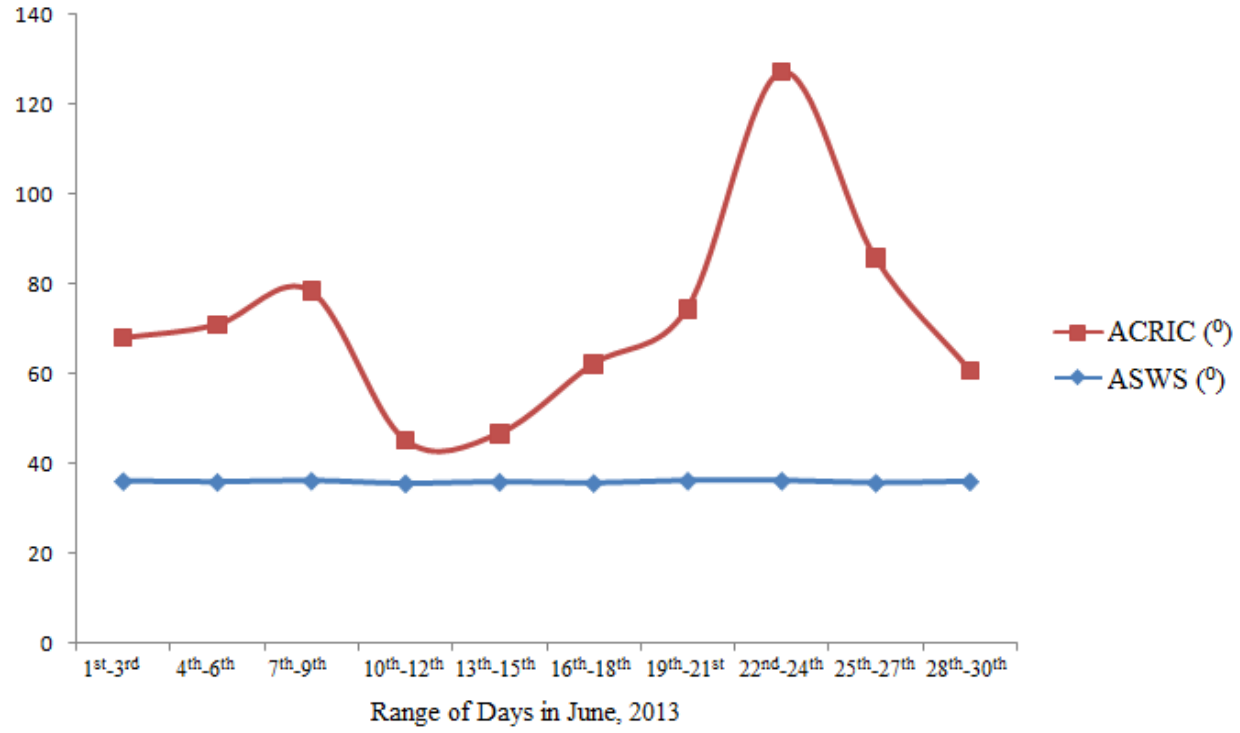


**Figure 2:** Angle described by Cosmic Ray Intensity Counts, ACRIC ($^0$) versus Solar Wind Speed SWSR ($^0$) within the Range of days in June 2013

Variation of the intensity for cosmic rays and solar wind speed has been investigated using the recorded data from 1$^{st}$-30$^{th}$ June, 2013. From the observation, total of 57,473,339 counts of cosmic rays activity was recorded, while total of 165,423.4 solar wind speed was also recorded. It was found between 22$^{nd}$-24$^{th}$ of June, 2013 that the peak solar wind speed of 90.84$^0$ corresponded with the high energy cosmic ray intensity of 32.24$^0$. On the other hand, between 10$^{th}$-12$^{th}$ June, 2013 minimum solar wind speed of 9.78$^0$ corresponding with the cosmic ray intensity of 35.64$^0$ whereas, most of the remaining range of days did not follow any trend at all. The clear pictures were shown using line graph where the whole values were displayed (Figure 1 and 2). In particular, the variation of the solar wind speed is directly proportion to the high energy cosmic ray intensity within some range of days.

Those ranges of days that cosmic rays did not vary proportionally, tarry or follow any trend with solar wind may be due to the anomalous behavior of geomagnetic effect within that period of time; and it supports the work of Gordon and Lennard (2012): "…there is no evidence for change in the gradient with either the level of solar activity or the overall modulation of cosmic ray flux within a given solar cycle"

## CONCLUSION

From this research work, it is well clear that solar wind speed is closely associated with cosmic ray intensities apart from some days which did not follow a trend, which is due to the behavior of geomagnetic effect within that particular period of time. Hence solar wind has strong effect on cosmic rays

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