

CORRELATIVE ANALYSIS OF LONG TERM COSMIC RAY VARIATION IN RELATION WITH INTERPLANETARY MAGNETIC FIELD

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Abstract: In this paper we will study the relationship between Cosmic ray intensity (CRI) and Interplanetary Magnetic field (B) for the period 1986 to 2010. For this we have taken the data of Cosmic ray intensity (CRI) from various neutron monitor stations, which are well maintained stations and provide reliable cosmic ray data for variation study. Here we have taken the annual mean value of cosmic ray intensity (CRI) from the Moscow (2.42GV), Russia Neutron Monitor Station. It has been found that Interplanetary Magnetic field (B) shows anti-phase with Cosmic ray intensity (CRI). It is found that IMF shows decreasing trend with CRI and also shows negative correlation.

Keywords: Cosmic ray intensity (CRI), Interplanetary Magnetic Field (IMF), Solar cycle.

1. INTRODUCTION

Many research groups have tried to express this long-term modulation of the Cosmic ray intensity through means of various solar indices and geophysical parameters. The modulation of galactic cosmic rays in the heliosphere using theoretical as well as empirical approaches is successful and advanced rapidly [1]. The solar activity, being numerically expressed with relative sunspots numbers, varies with time for a period of about eleven years. Although this period defines the solar activity cycle, it is shorter than 11 years for some cycles, but longer than 11 years for other cycles. Furthermore, the solar activity is usually higher for the cycles with the period shorter than 11 years as compared with the one with the period longer than 11 years. So, the degree of the solar activity is causally dependent on the length of the solar activity cycle [2,3]. The 11 year variation in Cosmic ray Intensity observed on the earth is anti-correlated with sunspot number [4]. The cosmic ray intensity varies inversely with sunspot numbers, showing maximum intensity at time when solar activity is the minimum in the 11- year sunspot cycle (Forbush 1954, 1958).

The Cosmic ray Intensity curve follow a 22 year cycle with alternate maxima being flat topped and peaked as predicted by models of Cosmic ray modulation based on the observed

reversal of the sun's magnetic field polarity after every 11 year and curvature and gradient drifts in the large scale magnetic field of the heliosphere [5-8]. Solar output in terms of solar plasma & interplanetary magnetic field ejected out into interplanetary medium consequently create the perturbation in the interplanetary magnetic field. The 11-year solar cycle is the best known variability in the sun so we have investigated association of interplanetary magnetic field with cosmic ray intensity on long-term basis [9]. Joselyn & Mc Intosh (1981) have shown that the solar disappearing filaments have also been linked with large geomagnetic activities & interplanetary magnetic field [10].

Method of Analysis

In this paper we will find the correlation between Cosmic ray intensity and interplanetary magnetic field (B) for the period 1986 to 2010. Also we will see the relation between CRI and B.V (product of IMF and plasma speed). For present investigation, we have taken the data of interplanetary magnetic field (B) and plasma speed (V) for the period 1986 to 2010 from Omni Web Data Centre. The pressure corrected monthly mean value of cosmic ray data of Moscow, Russia (Cutoff Rigidity = 2.42GV) neutron monitor station have been taken for analysis.

Results and Discussion

The sun & its outputs in form of various interplanetary features such as solar plasma, Interplanetary Magnetic Field & solar wind stream velocity are related to the disturbances in earth magnetic field. Figure 1 shows the linear plot between yearly values of cosmic ray intensity (CRI) Of Moscow Neutron monitor stations with Interplanetary Magnetic field (IMF) for the period 1986 to 2010. From the analysis it is clear that cosmic ray intensity (CRI) and IMF(B) are anti-phase. It is clear from fig.2 that CRI shows anti-correlation with IMF(B) and correlation coefficient is found to be $R = -0.87214$ for the period 1986 to 2010. Similarly from fig. 3 and fig. 4 it is clear that cosmic ray intensity (CRI) shows anti-phase with plasma speed V and correlation coefficient between these two parameters is found to be $R = -0.46503$. Fig 5. Shows linear plot between cosmic ray intensity (CRI) and product of Interplanetary Magnetic field (IMF) with plasma speed BV. From figure 5, it is clear that CRI also shows anti-correlation with BV and correlation coefficient is found to be $R = -0.82129$.

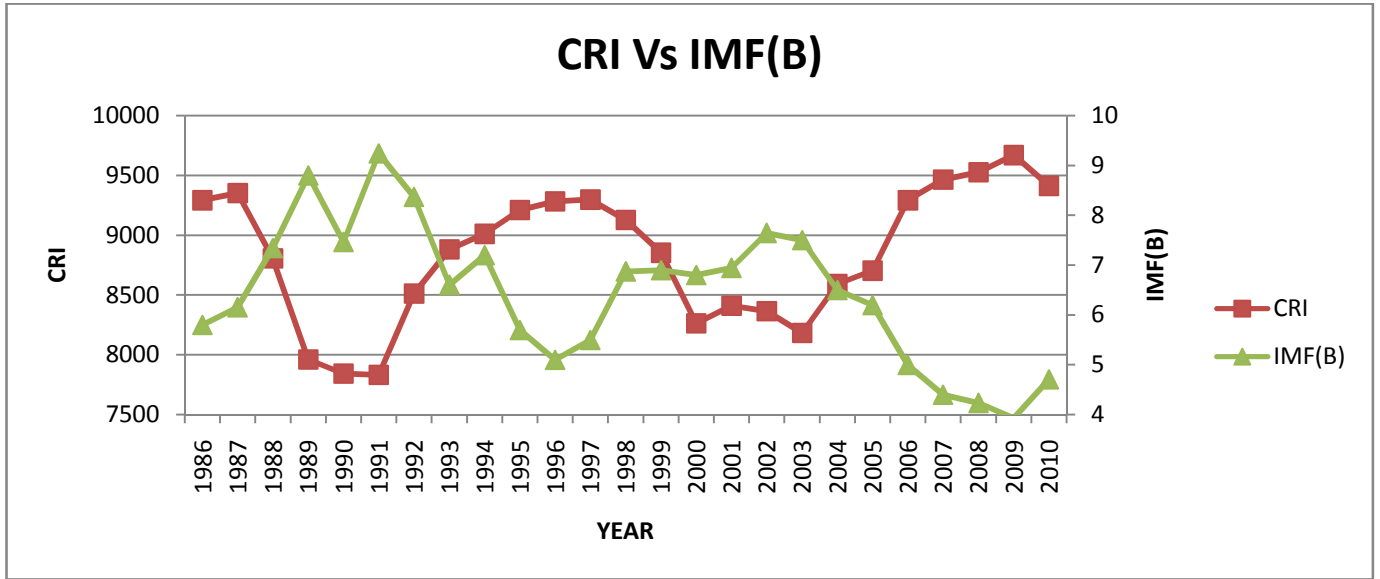


Fig: 1 Linear plot between Cosmic ray intensity (CRI) of Moscow Neutron monitor station and IMF(B)

For the period 1986 to 2010

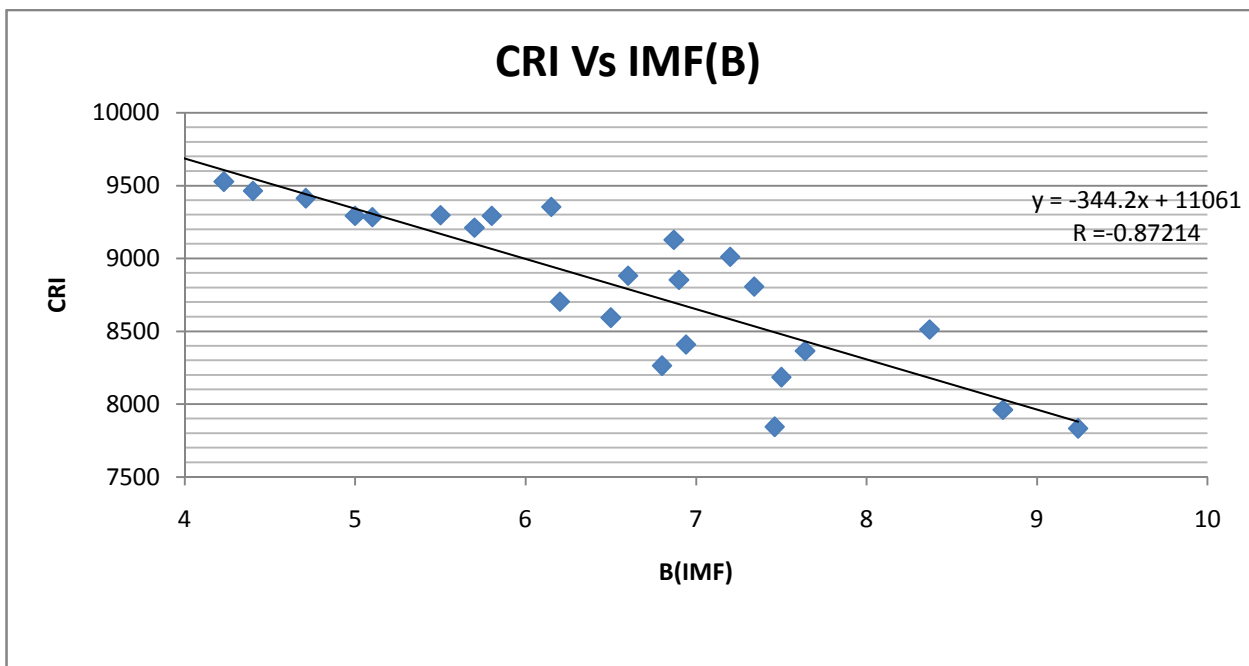


Fig: 2 Shows correlation between Cosmic ray intensity (CRI) of Moscow Neutron Monitor station and IMF(B) for the period 1986 to 2010.

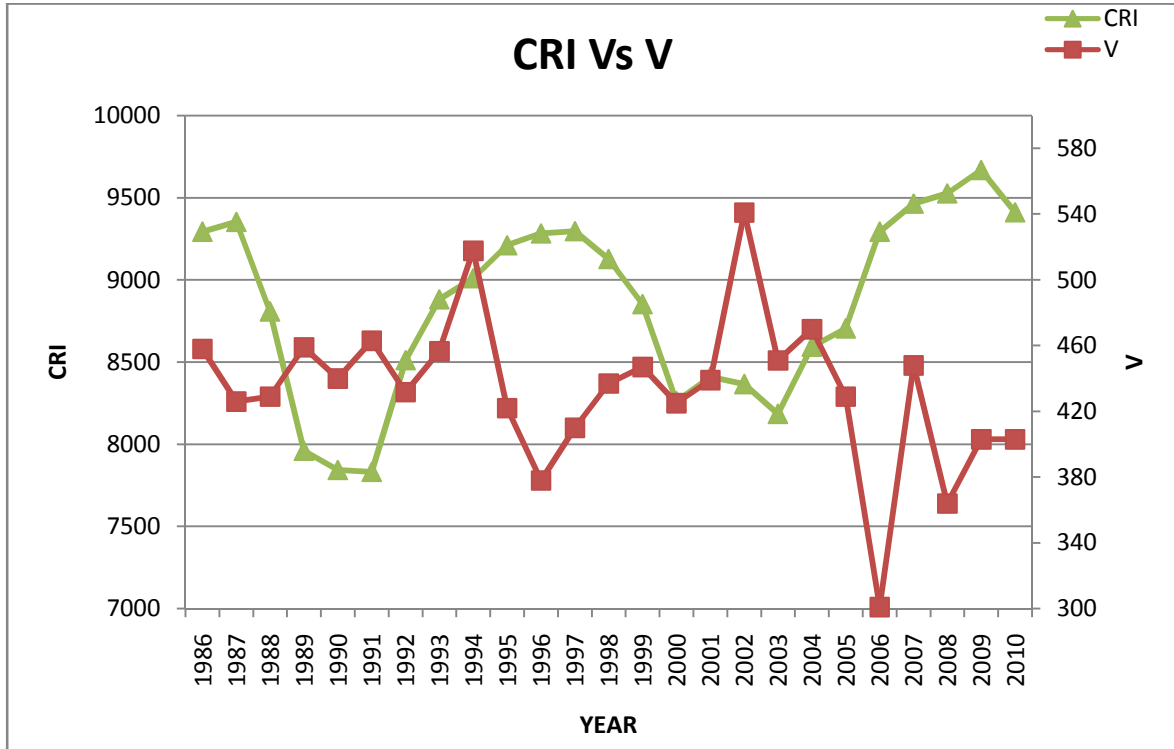


Fig: 3 Shows Linear plot between Cosmic ray intensity (CRI) of Moscow Neutron monitor station and plasma speed (V) for the period 1986 to 2010.

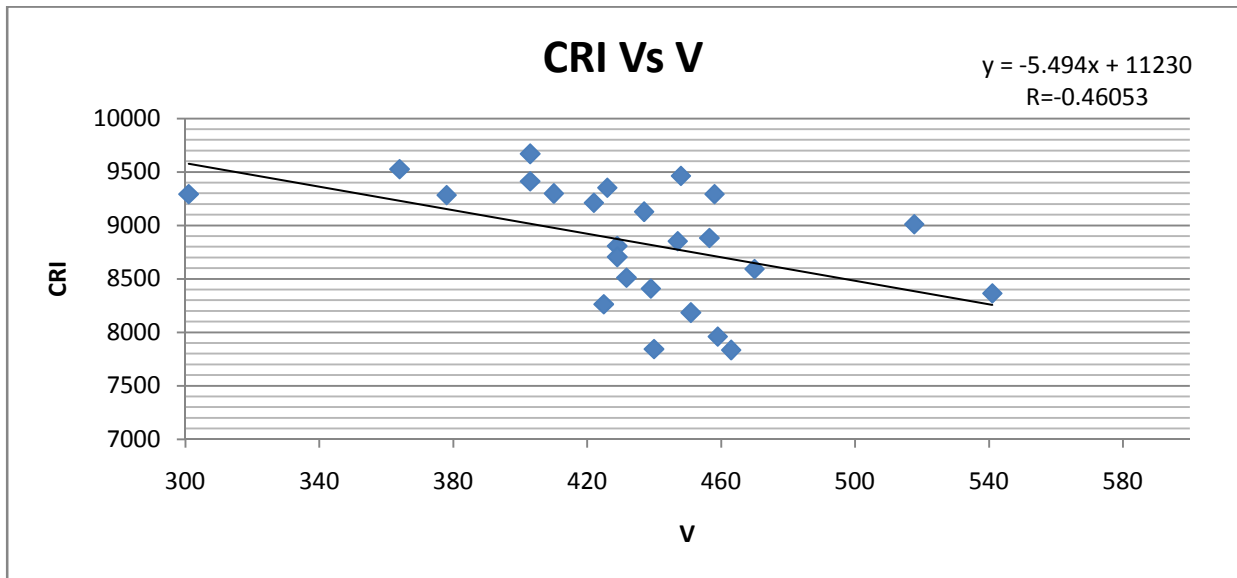


Fig: 4 Shows correlation between Cosmic ray intensity(CRI) of Moscow Neutron Monitor station and Plasma speed(V) for the period 1986 to 2010

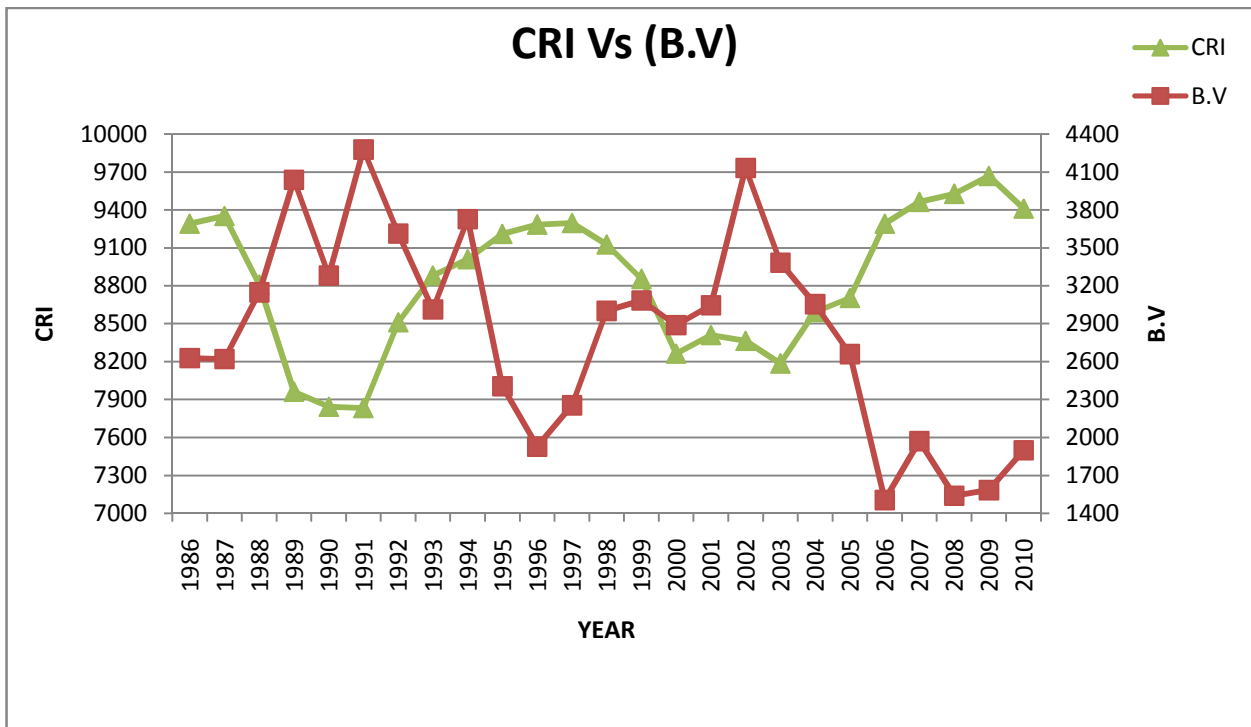


Fig: 5 Shows linear plot between Cosmic ray intensity (CRI) of Moscow Neutron monitor station and product of IMF and plasma speed i.e. B.V for the period 1986 to 2010.

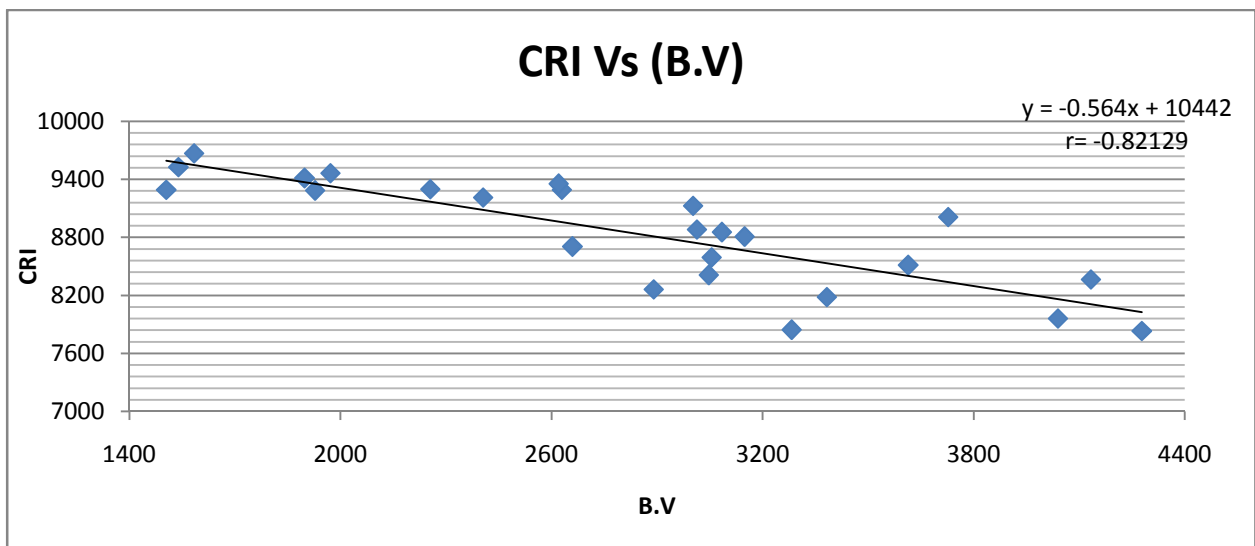


Fig: 6 Shows correlation between Cosmic ray intensity (CRI) of Moscow Neutron monitor station and product of IMF and plasma speed i.e. B.V for the period 1986 to 2010.

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