INTERPLANETARY CORONAL MASS EJECTIONS AND COSMIC RAY INTENSITY VARIATION

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ABSTRACT

Interplanetary Coronal Mass Ejections (ICMEs) are the interplanetary manifestation of Coronal Mass Ejections observed by Coronagraphs near the sun. Based on the ICMEs observations for the descending phase of the solar cycle 23, we have proposed that the short-term modulation of cosmic rays is influenced by CMEs activity. In this study, 93 events of ICMEs have been used to derive their effects on cosmic ray intensity for the period of 2002 to 2007. Daily values of Kiel neutron monitor have been taken in chree analysis. Results of present analysis suggest that ICMEs can produce short-term transient decreases in cosmic ray intensity.

Key words: Interplanetary coronal mass ejection, cosmic rays

The concept of mass ejection from the sun has been known from a long time, the phenomena of coronal mass ejection first time reported in 1971, using the seventh orbiting solar observatory (OSO-7). Coronal mass ejection (CMEs) bring about large scale changes in the corona, which have fundamental implications for the evolution of the magnetic flux of the sun (Gopalswamy, 2006). Currently interplanetary manifestations of CMEs are known as Interplanetary Coronal Mass Ejections. ICMEs are associated with many characteristics including the speed of ICMEs. Almost majority of ICMEs, include abnormally low solar wind proton temperature. Solar wind ion charge state and compositional anomalies, the generation of shock upstream of fast ICMEs which may be important accelerators of energetic particles. Forbush decrease in cosmic ray intensity and generation of geomagnetic storm are caused by these anomalies. CMEs are known as the causes of interplanetary magnetic field fluctuations and many scientist suggested that the solar cycle dependent modulation of galactic cosmic rays (GCRs) can be explained by the presence of CMEs related magnetic in homogeneities in the hemisphere (Lara et al, 2005; Shrivastava, 2005). They studied the effect of Interplanetary Coronal Mass Ejections cosmic ray intensity for the period of 1997 to 2002. Recently Shrivastava and Singh, 2008 suggested that ICMEs can produce geomagnetic activity with an increase in geomagnetic Ap-index and decrease in Dst-index. In the present study, we examine the influence of ICMEs on cosmic ray intensity for the period of 2002 to 2007, which represent the descending phase of solar cycle 23.

DATA AND METHOD ANALYSIS

Observations of ICMEs are taken from LASCO/SOHO, FIT/SOHO and GOES Satellites. These data are taken from internet websites. The present study investigates by means of superposed epoch analysis the intensity of cosmic rays on a large time scale (days: 5 days before and 10 days after the ICMEs onset).

RESULTS AND DISCUSSION

Earlier it was thought that the solar flares and solar wind are the main culprits in cosmic ray modulation (Rao, 1972, Shrivastava and Shukla, 1994). After the identification of CMEs in 1971, many scientists investigated the role of CMEs and ICMEs in the cosmic ray modulation processes in short-term as well as in long-term basis (Lara et al, 2005, Shrivastava, 2007). Our aim of this study to verify the role of near earth ICME in short term modulation of cosmic ray intensity variation. To observe the average behavior of cosmic ray intensity variation during the period of ICMEs, the three analysis for days 5 to 10 days...
have been plotted in Fig.1, as a percent deviation of the data from the Kiel neutron monitor station. During each year from 2002 to 2007 we observed significant transient decreases in cosmic ray intensity for almost all the years. Year to year changes in intensity profile are noticed. It is expected due to superposition of another interplanetary factor in cosmic ray modulation processes. To observe average behavior for entire period of study, we have generated another diagram for the combined period of 2002 to 2007 as seen in Fig.2. From this figure, we can see a significant decrease in cosmic ray intensity. Maximum decrease is seen one day after the onset of ICME. Our study suggests a significant role of ICMEs in cosmic ray modulation. It is suggested that the shock disturbances in which the ICMEs driving the shock highly effective in stimulating cosmic ray decreases. When a CMI is accompanied by a shock, the compressed region between the shock and the driving CME, which is also known as shock sheath produce decreases in cosmic ray intensity.

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Figure caption:

Fig.1: The results of Chree analysis for -5 to +10 days with respect to zero epoch days. The percent deviation of daily values of cosmic ray intensity (Kiel) is derived for each year starting from 2002 to 2007. Zero days is corresponding to arrival day of ICMEs.
Fig. 1
Fig. 2: The results Chree analysis for -5 to +10 days for the combined period of 2002 to 2007

REFERENCES