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Study of diurnal anisotropy of cosmic ray intensity during interplanetary magnetic clouds

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ABSTRACT. Cosmic ray intensity have been observed during the consecutive days having abnormally high diurnal amplitude and unusually low diurnal amplitude, for the period 1981 – 97. In all 32 High Amplitude Events (HAE) and 27 Low Amplitude Events (LAE) have been selected. During the periods of HAE and LAE number of Interplanetary Magnetic Clouds have been identified using IMF and SWP data for each event. It has been found that the amplitude of the diurnal anisotropy increases on the day of the magnetic cloud as compared to the earlier days of the period of event and it decreases as the cloud passes the Earth. The majority of HAE and LAE have occurred when the solar wind velocity being average or moderate, which indicates that these events are not caused during the periods of occurrence of High Speed Solar Wind Streams.

1. INTRODUCTION

The solar diurnal variation of cosmic ray intensity shows a large day to day variability. This variation is a reflection of the continuously changing conditions in the interplanetary space. The interplanetary magnetic clouds are defined as a region with a radial dimension ~ 0.25 AU (at 1 AU) in which the magnetic field strength is high and the magnetic field direction changes appreciably by means of rotation of one component of B nearly parallel to the plane as per Kline et al (1982). Three classes of clouds are identified, corresponding to the association of a cloud with a shock (SAC), a stream interface (SI) or a cold magnetic enhancements (CME). It has been observed that the amplitude of the diurnal anisotropy is significantly larger during all the three types of clouds in comparison to the amplitude observed on geo-magnetically quiet days as per Yadav et al (1987).

The occurrence of trains of consecutive days having abnormally high or low diurnal amplitude have been reported earlier by many workers such as Rao et al (1972) and Mavromichalaki (1980). We have studied the nature of the diurnal anisotropy of High Amplitude Events (HAE) and Low Amplitudes Events (LEA) during the interplanetary magnetic clouds.

2. DATA ANALYSIS

The anisotropic events are identified from the hourly plots of cosmic ray neutron monitor data, after applying trend correction is subjected to Fourier analysis to obtain the amplitude and phase of the diurnal anisotropy for 32 HAE and 27 LAE observed during 1981-97. The IMF and SWP parameters have been studied to identify the magnetic clouds during the periods of HAE and LAE.

3. RESULTS AND DISCUSSION

It has been found that the amplitude of the diurnal anisotropy for HAE is significantly larger than the quite day annual average amplitude throughout the period of investigation and phase of the diurnal anisotropy has shifted to later hours for majority of the events as compared to the annual

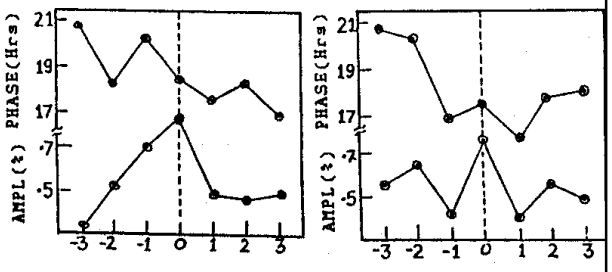

Fig. 1. (a) Amplitude and Phase of the diurnal anisotropy for the HAE during the Cloud and preceding and following 3 days.

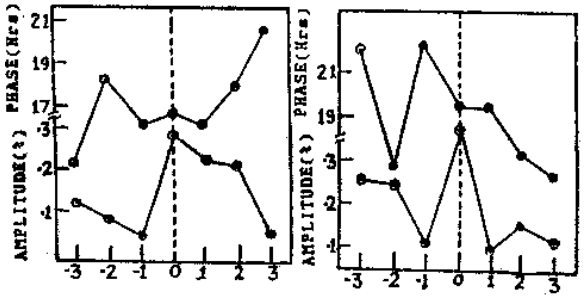

Fig. 1(b). Amplitude and phase of the diurnal anisotropy for LAE during the cloud and preceding and following 3 days

average values. The diurnal amplitude for LAE is significantly lower than the quiet day annual average amplitude and the diurnal time of maximum has shifted to earlier hours for majority of the events.

During the study of HAE and LAE, interplanetary magnetic clouds have been identified using the IMF and SWP parameters for each event. In Fig.1(a) and 1(b) the amplitude and phase of the diurnal anisotropy for some of the HAE and LAE have been plotted during the cloud and preceding and following three days.It is quite apparent from these plots that the amplitude of the diurnal anisotropy increases on the day of the cloud as compared to the earlier days of the period of events and it decreases as the cloud passes the Earth [2]. It is also observed that the phase of the diurnal anisotropy remains statistically in the corotational direction on the day of the cloud in comparison to other days of the event.

The frequency histograms of solar wind velocity for HAE

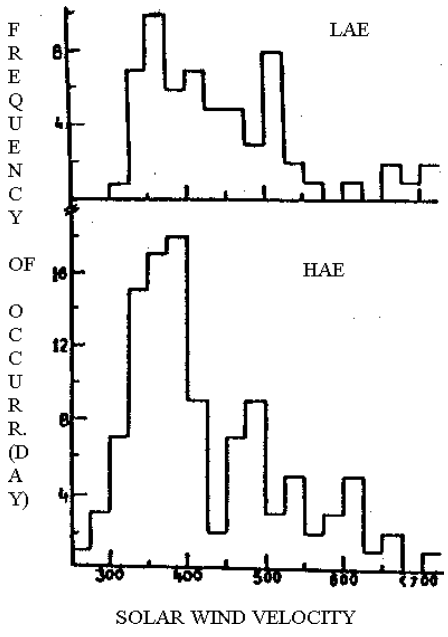

Fig. 2. Frequency Histogram of solar wind velocity.

and LAE (Fig. 2) shows that majority of the events have occurred when the solar wind velocity being average or moderate i.e. from 300 – 500 km./sec. Usually the velocity of high-speed solar wind streams (HSSWS) is 600-700 km/sec. This shows that HAE and LAE are not caused during the periods of occurrence of HSSWS as per Munakata et al (1987).

4. CONCLUSIONS

The amplitude of the diurnal anisotropy increases on the day of the cloud as compared to the earlier days of the period of HAE and LAE and it decreases as the cloud passes the Earth. The phase of the diurnal anisotropy remains statistically in the corotational direction on the day of the cloud in comparison to other days of the event.

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REFERENCES

Kline L.W. and Burlaga L.F., J. Geophys. Res., 87 (1982) 613.

Yadav R.S.;Yadav N.R. and Badruddin,Proc. 20th ICRC, Mosco, 4 (1987) 83.
Rao U.R.; Ananth A.G. and Agrawal S.P., Planet. Space Sci, 20 (1972) 1799.
Mavromichalaki H., Astrophy. and Space Sci., 71 (1980) 101.
Munakata Y, Mori S, Ryu J Y, Agrawal S P and Venkatesan D, 20th ICRC, Moscow, 4 (1987)39.