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Long term behaviour of tridiurnal variations of cosmic ray intensity on quiet days

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ABSTRACT. The cosmic ray (CR) intensity data recorded with Deep River Neutron Monitoring Station have been investigated on 60 quietest days (QD) in a year for studying the variation in tridiurnal anisotropy during solar cycle 21 and 22. It has been observed that inspite of the abrupt change in the amplitude and phase of tridiurnal anisotropy in CR intensity, the amplitude is quite significant throughout the period of investigation with larger amplitude during the year 1980 and 1985. The tridiurnal anisotropy of CR intensity shows clearly long term variation. i.e., 11 year variation at mid latitude station.

1. INTRODUCTION

The spatial anisotropy of the galactic cosmic ray intensity in the interplanetary space manifests itself as daily variation with a period of 24 hours (and its higher harmonics) due to the rotation of the Earth in the course of a day. The Power Spectrum analysis as well as the Fourier analysis of the long term data of the 24-hour values of cosmic ray (CR) intensity observed by Earth based detectors have provided confirmatory existence alongwith the characteristics of the first three harmonics of daily variation of extra terrestrial origin. However, the amplitude of the fourth harmonics is still controversial (Pomerantz and Duggal, 1971; Rao,1972; Venkatesan and Badruddin, 1990; Ahluwalia and Singh, 1973; Agrawal, 1981). Moreover, it has been observed that the amplitude and phase of tridiurnal variation of CR intensity on quiet days also vary considerably from one period to another.

The higher harmonic components which represents anisotropy produced by cosmic ray streaming flows due to local particle gradients. This is very important study for understanding the electromagnetic environment of the interplanetary region.

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2. Analysis of the Data

The CR intensity data (corrected for meteorological effects) on geomagnetically five quietest days (QD) for Deep River (46.06N, 1.02GV) neutron monitoring station and for the period 1978-94, have been used in this analysis. The long term effects have been removed by applying the trend corrections (Yadav and Naqvi,1973). Such a set of data have been subjected to Harmonic analysis for each day. The average values of the amplitude and phase (local time of the station) of the third (tridiurnal) harmonics on yearly basis have been obtained. The days with abrupt variation, if any, have not been considered.

3. RESULTS AND DISCUSSION

The yearly average amplitude and phase of the third harmonics of daily variation for Deep River Neutron Monitoring Station have been plotted in Fig. 1 and 2 during the period 1978-94 on quiet days. It is quite apparent from Fig. 1 that the amplitude of third harmonies of daily variation has quite abruptly increased during the years 1980 and 1985. The likely cause for such type of variation could be the changing of geomagnetic threshold cut off rigidly from 1.02 GV to 1.15 and 1.12 in 1980 and 1985 respectively (Smart and Shea,1987; Shea and Smart, 1983) as it has been discussed in the case of change of diurnal anisotropy of cosmic ray intensity on QD (Kumar *et al.*, 1993).

The amplitude of tri-diurnal anisotropy on QD has shown an exceptionally small value during 1987,

which is a period of minimum solar activity (Kumar *et al,* 1995). These type of variation in the amplitude of the tri- diurnal anisotropy on QD may be attributed to the change in the rigidity spectrum. The amplitude of third harmonics of daily variation on QD is observed to be significantly low during 1981 as well as in 1990, which coincides with phase reversal of the solar poloidal field (Pathak *et al,* 1983; Kumar *et al* 1998).

It is observed from Fig.2 that there is no systematic change in the phase of third harmonies of daily variation of cosmic ray intensity on quiet days. However, a slight change in the value of tri-diurnal phase is observed, when the solar polar magnetic field reversed its polarity during the periods 1979-80 and 1990-91 (Kumar *et al.,* 1998). It shows that the phase of tri-diurnal anisotropy on quiet days has nearly the same value at both sides of reversal period. Whereas in both the cases during the succeeding years, i.e., 1980-81 and 1991-92, the change in the phase of tri-diurnal anisotropy of CR intensity has been found quite significant (El Borie *et al.,* 1995). This supports 11 year variation in tri-diurnal anisotropy of CR intensity on quiet days (Richharia *et al,* 1999; Richhaira *et al,* 2000).

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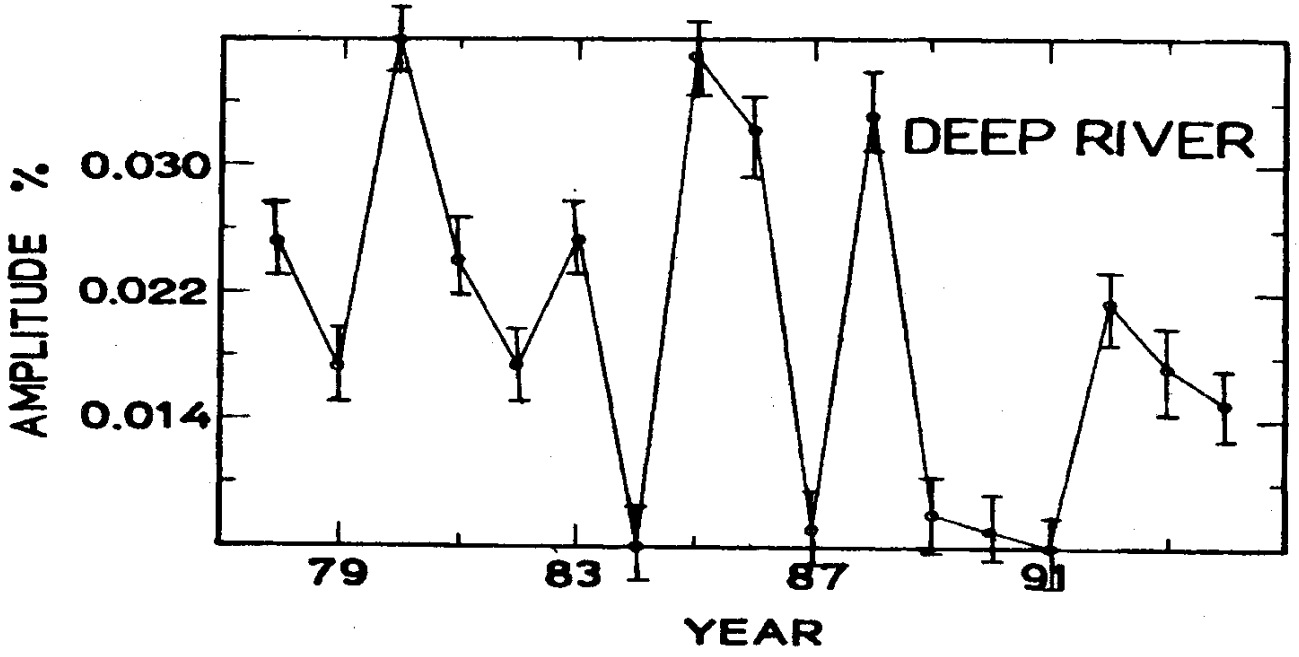

Fig.1. The annual amplitude (%) of tri-diurnal anisotropy of CR intensity on quiet days during 1978-1994 at Deep River Neutron Monitoring Station.

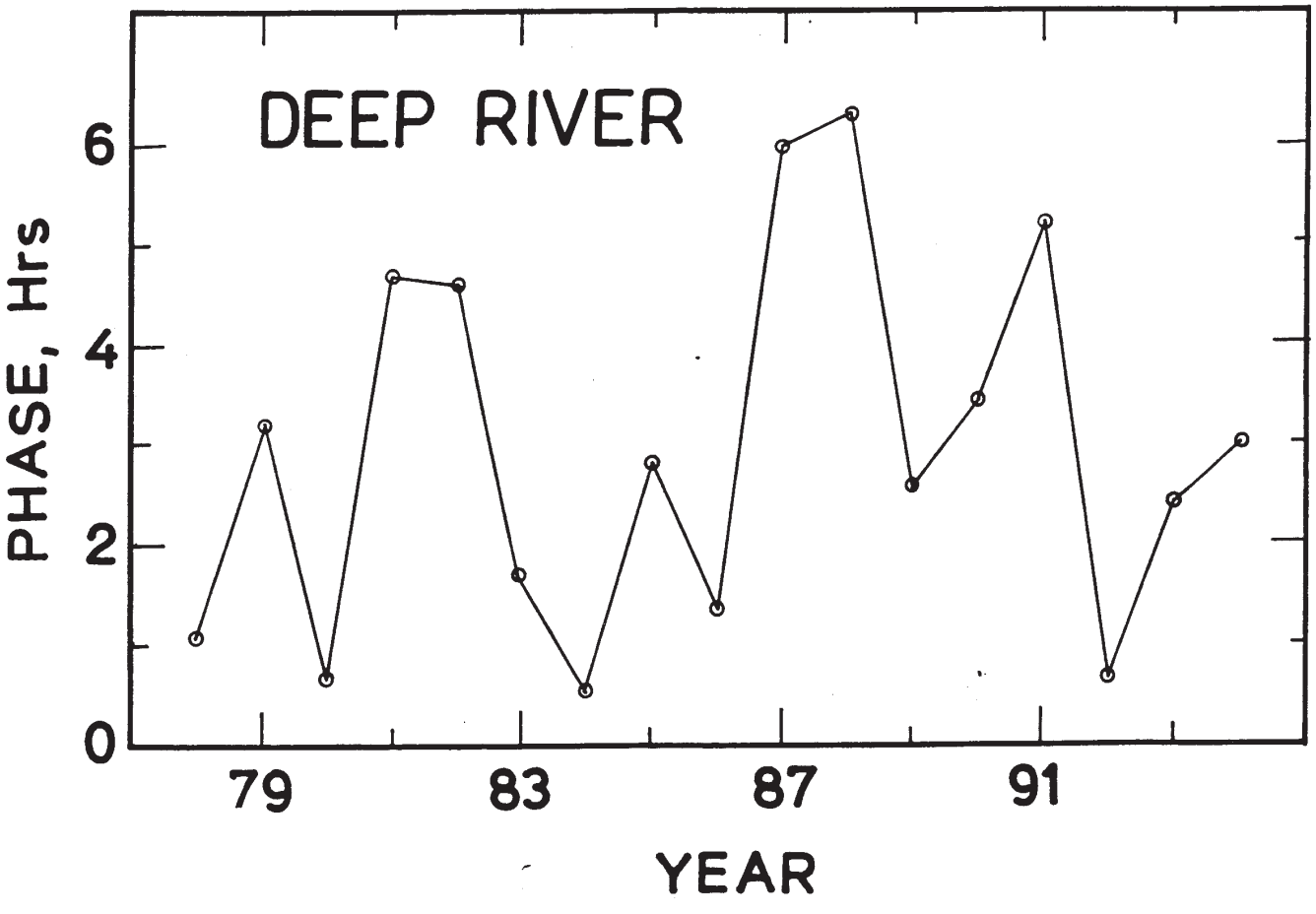

Fig.2. The annual phase (hrs) of tri-diurnal anisotropy of CR intensity on quiet days during 1978-1994 at Deep River Neutron Monitoring Station.