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STUDY OF FOURTH HARMONICS OF COSMIC RAY INTENSITY ON QUIET DAYS AT MID-LATITUDE NEUTRON MONITORING STATION

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The cosmic ray (CR) intensity data recorded with Deep River and Goose Bay Neutron Monitoring Station have been investigated on quietest days (QD) for fourth harmonics of daily variation during solar cycle 21 and 22. It has been observed that in spite of the abrupt change in the amplitude and phase of quart diurnal anisotropy in CR intensity, the amplitude of third harmonic is quite significant throughout the period of investigation with larger amplitude during the year 1985. Thus, quart diurnal anisotropy clearly shows 11 year variation at mid latitude neutron monitoring station.

KEY WORDS : Cosmic Rays/Fourth Harmonics/Geo magnetially Quiet Days.

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 along with the characteristics of the first three harmonics of daily variation of extra terrestrial origin [1, 2]. However, the amplitude of the fourth harmonics is still controversial [3, 7]. Moveover, it has been observed that the amplitude and phase of quart diurnal variation of CR intensity on quiet days also vary considerably from one period to another. On the long term behaviour of the first three harmonics showed that high degree of year to year variability exists, a trend with solar activity was evident.

The higher harmonic components of daily variation which represents anisotropy produced by cosmic ray streaming flows due to local particle gradients. This is very important study for understanding the eletromagnetic environment of the interplanetary region. Thus, the studies of the higher harmonics in the daily variation of cosmic rays provide valuable information as to the nature of the cosmic ray modulation in the heliosphere.

ANALYSIS OF THE DATA

The pressure corrected hourly CR intensity data (corrected for meteorological effects) on geo magnetically five quietest days (QD) in every month for Deep River (Lat: 46.06N; cutoff rigidity: 1.02GV; Longitude 282.5°E; Altitude 145m) Goose Bay (Lat: 53.33°N; Cutoff

rigidity; 0.52 GV; Longitude; 299.58°E; Altitude; 46m) neutron monitoring station and for the period 1978-94 have been used in Fourier analysis. After applying the trend correction, such a set of data have been subjected to Harmonic analysis for each day [8]. The average values of the amplitude and phase (local time of the station) of the fourth harmonic on yearly basis have been obtained. According to solar geophysical data five quietest days are selected in a month; thus 60 quietest days are obtained in a year. These days are called international quiet days (QD). The days with extra ordinary large amplitude if any, have not been considered. Also all those days are discarded having more than three continuous hourly data missing.

Results and discussion

The yearly average amplitude and phase of the fourth harmonics of daily variation for Deep River and Goose Bay Neutron Monitoring Station have been plotted in Fig. 1 and 2 during the period 1978-94 on quiet days.

It is quite apparent from the Fig. 1 that there is no systematic change in the amplitude in the fourth harmonics of daily variation on quiet days, the amplitude during the year 1979 and 1985 has quite abruptly increased. Further the year 1987, the amplitude has small value, which is a period of minimum solar activity [9-12]. The amplitude during the years 1980 and 1991 has been observed same value, which is period of high solar activity in the solar cycle 21 and 22. Also confirm the 11 year type variation occur in the fourth harmonics of daily variation.

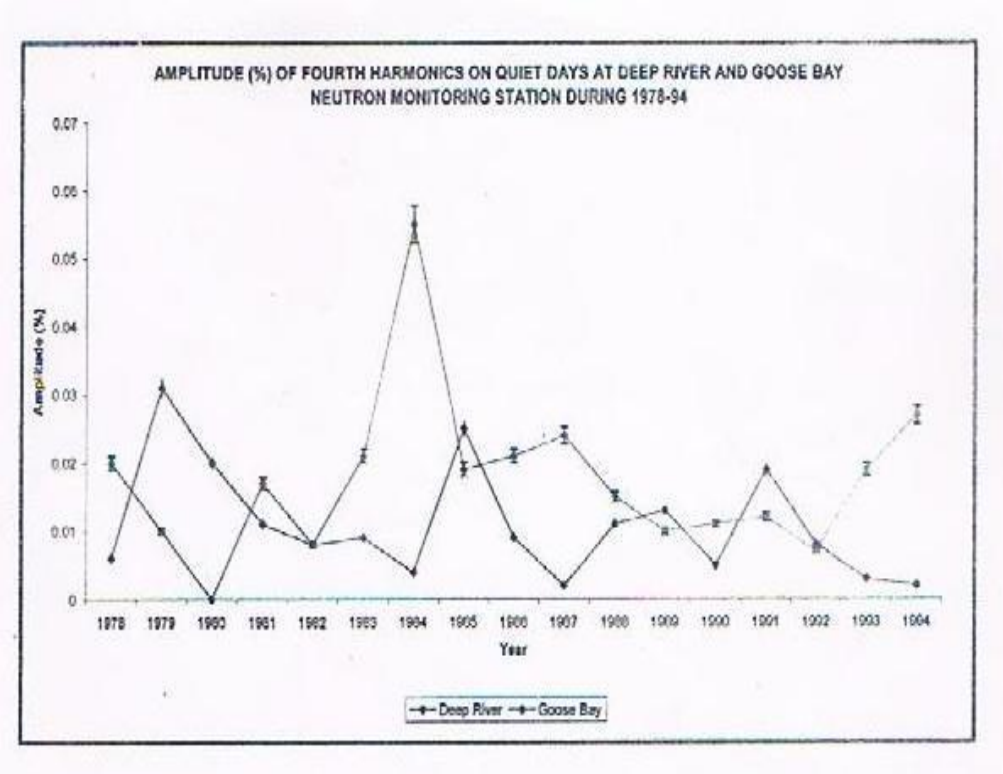

Fig. 1

It is quite apparent from Fig. 2, that there is no systematic change in the phase of fourth harmonics, the phase in the year 1981 and 1992 has occurred in the same direction, which also indicate likely eleven year variation at Deep River Neutron Monitoring Station [13]. It is quite apparent from Fig. 1 & 2 that there is no systematic variation observed in the amplitude and phase of the fourth harmonic of daily variation at Goose Bay Neutron Monitoring Station.

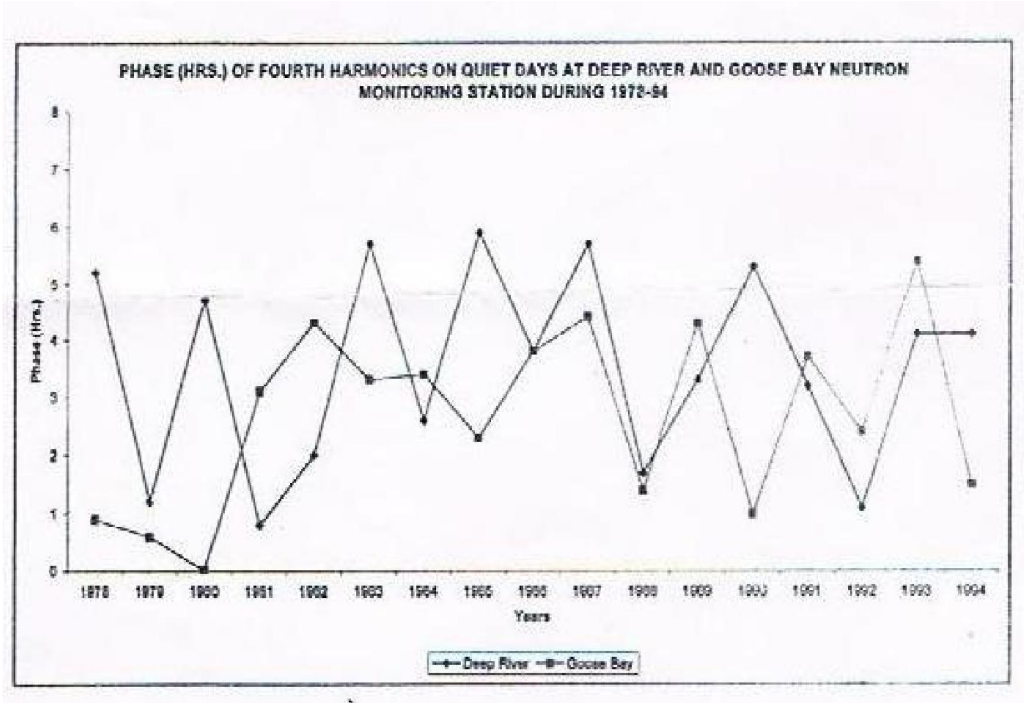

Fig. 2

Conclusion

Following conclusion may be drawn from the present investigation.

1. The amplitude of quart diurnal on quiet days having small value during the year 1987 *i.e.*, which is the period of minimum solar activity period.
2. The quart diurnal anisotropy of CR intensity on QD has shown long term variation *i.e.* 11 year variations.

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