29th International Cosmic Ray Conference Pune (2005) **2**, 171-174

Study of Third Harmonics of daily variation in cosmic ray intensity at Equatorial station

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The cosmic ray intensity (CR) data recorded with Equatorial Neutron Monitoring stations located at different latitudes has been investigated on 60 quietest days (QD) in a year for studying the variation in tri-diurnal anisotropy during the solar cycle 21 and 22. It is observed that the amplitude of third harmonics of daily variation on QD is larger by a factor of two during the period 1983 to 1986.i.e., the declining phase of solar cycle-21 as it is observed 11-years ago. i.e., the declining phase of solar cycle-20, at Equatorial stations. Thus 11 year variation in the tri-diurnal anisotropy of cosmic ray intensity is clearly observed at the Equatorial Neutron Monitoring stations.

1. Introduction

Anisotropies of galactic cosmic rays and there characteristics are studied through the diurnal and semidiurnal components mainly and the level of the isotropic intensity collectively provides the finger prints for identifying the modulation process and electromagnetic state of the interplanetary space in the neighbourhood of the Earth. Many workers have attempted to drive relationship between the main daily variation and the level of solar and geomagnetic activity. The spatial anisotropy of the galactic cosmic ray intensity in the interplanetary space manifests itself a daily variation with a period of 24 hours (and its higher harmonics) due to the rotation of the earth in course of a day. The power spectrum analysis as well as the fourier analysis of a long term data of 24-hour values of cosmic ray (CR) intensity observed by earth based detectors have provided confirmatory existence alongwith the characteristics of the first three harmonic of daily variation of extra terrestrial origin. However, the amplitude of the fourth harmonics is still controversial [1-3]. Moreover it has been observed that the amplitude and the phase of the tridiurnal variation of CR intensity on quiet days also vary considerably from one period to another.

2. Analysis of Data

The CR intensity data (corrected from meterological effects), on geomagnetically five quietest days (QD), for Tokyo and Mount Nourikura Neutron monitoring stations during the period 1980-90, have been used in this analysis .The justification for the selection of the geomagnetically Quiet days for the analysis purpose has been discussed else where [4]. The long term effect have been removed by applying trend corrections [5]. Such a set of data has been subjected to harmonic analysis for each day. The average values of the amplitude (%) and phase (hrs) in local time of station for the third harmonics (tri-diurnal) have been obtained. The days with abrupt changes in CR intensity have been considered in deriving the average harmonics.

3. Result and discussion

The amplitude (%) and phase (hrs) in local time of the tridiurnal anisotropy of CR intensity on QD for Tokyo (35.75 N, 11.5GV) and Mount Nourikura (36.12 N, 11.39 GV) neutron monitoring station during the period of 1980-90 has been investigated.

The yearly average amplitude and the phase of the third harmonics of daily variation for Tokyo and Mount Nourikura Neutron Monitoring Station during the period 1980-90 have been plotted in fig. 1 on QD. It is quite apparent from fig. 1, that there is no systematic change in the amplitude of third harmonics on QDs. Nevertheless, the amplitude of the third harmonics on QD remains relatively large during the declining phase of solar cycle 21 as compared with the declining phase of the earlier solar cycle 20 at equatorial stations [6] .The enhancement explicity point out the 11 year periodicity [7]. Further the amplitude of the third harmonics of daily variation on QD is observed to be significantly low during the year 1981, which coincides with phase reversals of the solar poloidal magnetic field. Furthermore amplitude of the third harmonics on QD has low values during minimum solar activity period [8].

It is also observed from fig. 1, that there is no systematic change in the phase of third harmonic of daily variation on QD. However , a significant change is observed , when the solar magnetic field reversed its polarity during 1980 and 1990. In the year 1980, the phase on QD shifted to later hours , when the polarity of solar magnetic field in southern hemisphere has changed from negative to positive. Further in the year 1990, the phase on QD shifted to later hours which indicates significant reverse process occurred in comparison to 1980 , when the polarity of solar magnetic field in northern hemisphere has changed from negative to positive at Tokyo station [10 and 11].

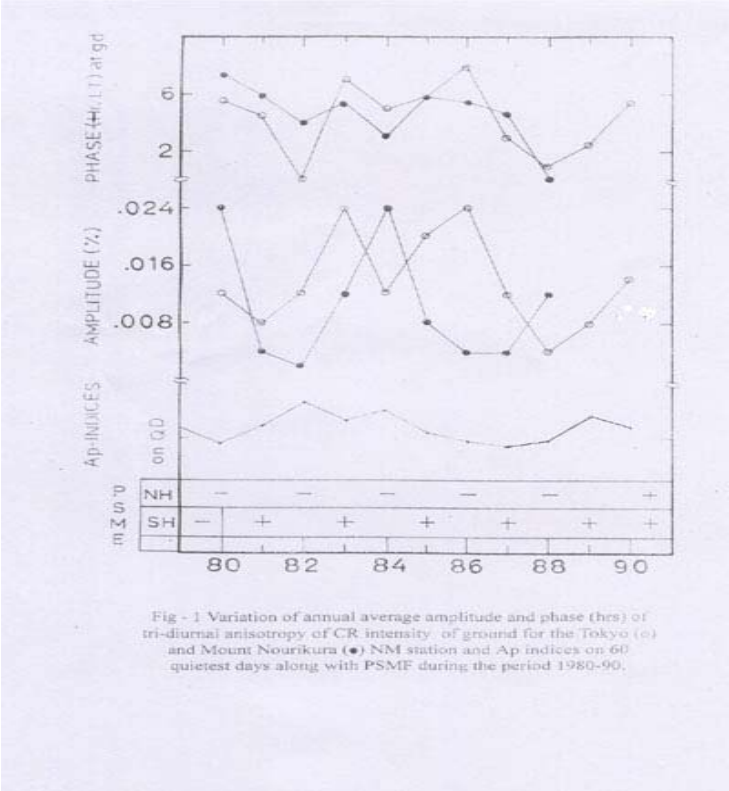

Fig - 1 Variation of annual average amplitude and phase (hrs) of tri-diurnal anisotropy of CR intensity of ground for the Tokyo (o) and Mount Nourikura (●) NM station and Ap indices on 60 quietest days along with PSMF during the period 1980-90.

4. Acknowledgments

The author are indebted to various experimental groups in particulars Profs. M.Bercovitch , K. Nagashima and Miss Aoi Inoue for providing Neutron Monitoring Data . This research is a part of minor research project financially supported by UGC, Regional office Bhopal.

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