PROCEEDINGS OF SCIENCE

EFFECT OF SOLAR POLOIDAL MAGNETIC FIELD REVERSAL ON TRIDIURNAL ANISOTROPY OF COSMIC RAY INTENSITY ON QUIET DAYS AT DIFFERENT LATITUDE NEUTRON MONITORING STATIONS

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The Cosmic Ray Intensity Data recorded with the Worldwide Network of Neutron Monitoring Stations located at different latitude on sixty geo magnetically quiet days in year for studying the effect of solar poloidal magnetic field reversal in tridiurnal anisotropy of cosmic ray intensity. It has been observed that in spite of abrupt variation in the amplitude and phase of tridiurnal of cosmic ray intensity. The phase shift of tridiurnal anisotropy on quiet days during the positive/negative polarity of solar magnetic field towards early/later house has been attributed to the drift effect. It is clearly establish that exist eleven years variation tridiurnal anisotropy of cosmic ray intensity on quiet days due to the variation of solar activity.

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1. Introduction

The Cosmic Ray Intensity Data recorded with the worldwide network of Neutron Monitoring Stations located at different latitude on sixty Geo-magnetically quiet days in year for studying the effect of solar poloidal magnetic field reversal in tri-diurnal anisotropy of cosmic ray intensity. It has been observed that in spite of abrupt variation in the amplitude and phase of tridiurnal anisotropy of cosmic ray intensity. The phase shift of tri-diurnal anisotropy on quiet days during the positive/negative polarity of solar magnetic field towards early/later hours has been attributed to the drift effect. It is clearly establish that there exist eleven years variation in ter-diurnal anisotropy of cosmic ray intensity on quiet days due to the variation of solar activity.

2. ANALYSIS OF THE DATA

Solar daily variation has been studied in terms of helio-magnetic activity. A new concept of data analysis has been introduced for studying the long/short term daily variation in CR intensity recorded with world wide network of neutron monitors. Fourier technique has been applied on different types of group of days chosen according to their different geomagnetic condition.

1. All days: This means all the 365/366 days in year. Thus, these days are termed as AD. Of course ignoring the days with abrupt changes.

Quiet days: Those days on which the transient magnetic variation are regular and smooth are said to be magnetically quiet or Q days. The criteria is based upon Ap and Kp values. There are two types of days.

2. 60 Quiet days: According to solar geophysical data (SGD) lowest mean order number are the five quietest days in a month. Thus, 60 Q days in a year; termed as 60 QD.

3. 120 Quiet days: First ten quiet days in a month. Thus, 120 Q Days in a year; termed as 120 Quiet days.

The pressure corrected hourly CR intensity data (corrected for meteorological effects) on geomagnetically five quietest days (QD) in every month for worldwide network of neutron monitoring stations for the period 1978-94, have been used in Fourier analysis given below:

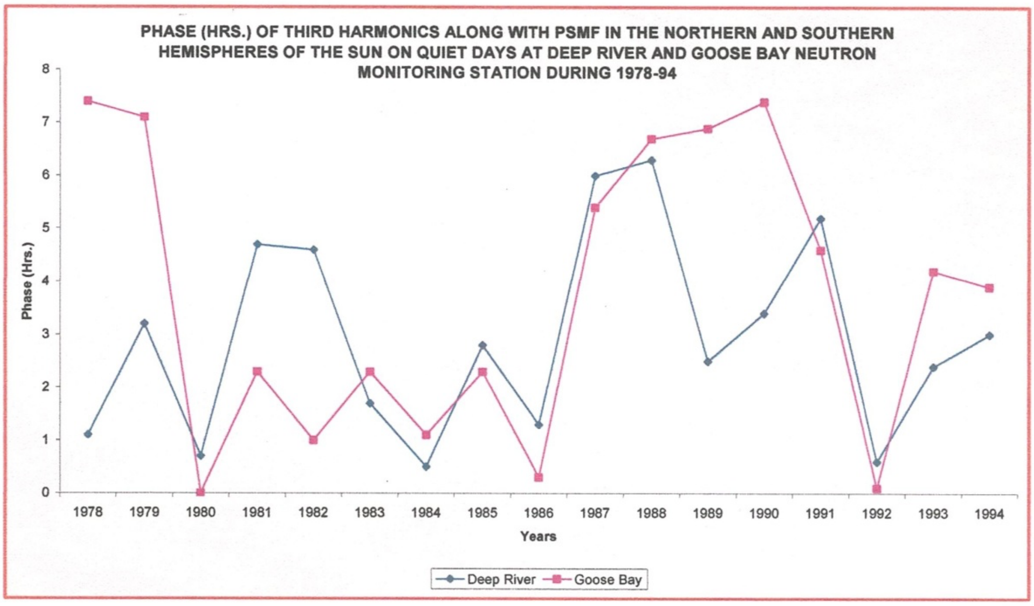
Name of Neutron Monitoring Station	Latitude	Longitude	Cut-off rigidity	Altitude
Deep River	46.06°N	282.5° E	1.02 GV	145m
Goose Bay	53.33°N	229.58° E	0.52 GV	46m
Tokyo	35.75°N	139.72° E	11.61 GV	20m
Mount Nourikura	36.12°N	137.56° E	11.39 GV	27.7m
Inuvik	68.35°N	226.27° E	0.18 GV	21 m

After applying the trend corrections, 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 third (tri diurnal) harmonics 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. Further, the variation in the tri-diurnal anisotropy with the reversal of polarity of solar magnetic field (PSMF) on 60 QD has been also investigated. Also all those days are discarded having more than three continuous hourly data missing.

3. RESULTS AN DISCUSSION

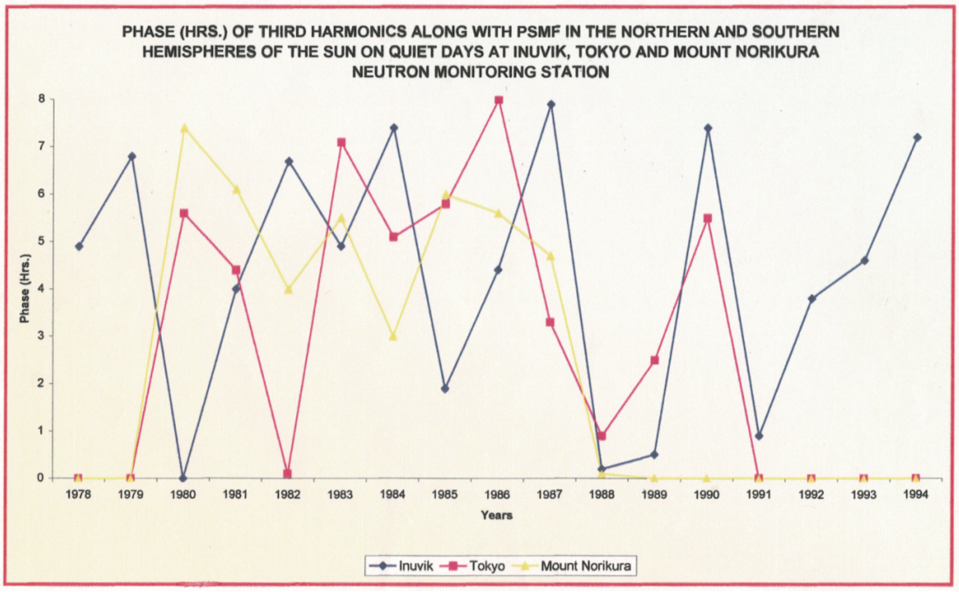
The yearly phase of the third harmonics of daily variation along with polarity of solar magnetic field in the Northern and Northern hemisphere of the Sun for Deep River, Goose Bay, Neutron Monitoring Stations have been plotted in Fig. 1 during the period 1978-94 on QD. It is quite apparent from Fig. 1 at Deep River Neutron Monitoring Station.

Fig.1



It is observed from Fig. 1 at mid latitude neutron monitoring station that there is no systematic change in the phase of third harmonics of daily variation in cosmic ray intensity on QD. However, a slight change in the tri-diurnal phase is observed, when the polarity of solar magnetic field reversed its polarity during the periods 1979-80 and 1990-91 [8]. 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 [9]. It is clear that there exist a 11 year type of variation in third harmonics of CR intensity on QD due to the variation of solar activity [10]. The polarity dependence of the phase shift change has been interpreted as a result due to the change of CR density distribution in space caused by the difference of CR drift motion in the positive and negative polarity state [11-14]. The existence of polarity dependence in the tri-diurnal variation may be defined as the state is positive, when the magnetic field is away from the sun at the north pole and toward the Sun at the south pole, while it is called negative, when the polar magnetic field are reversed [15¬-17] .

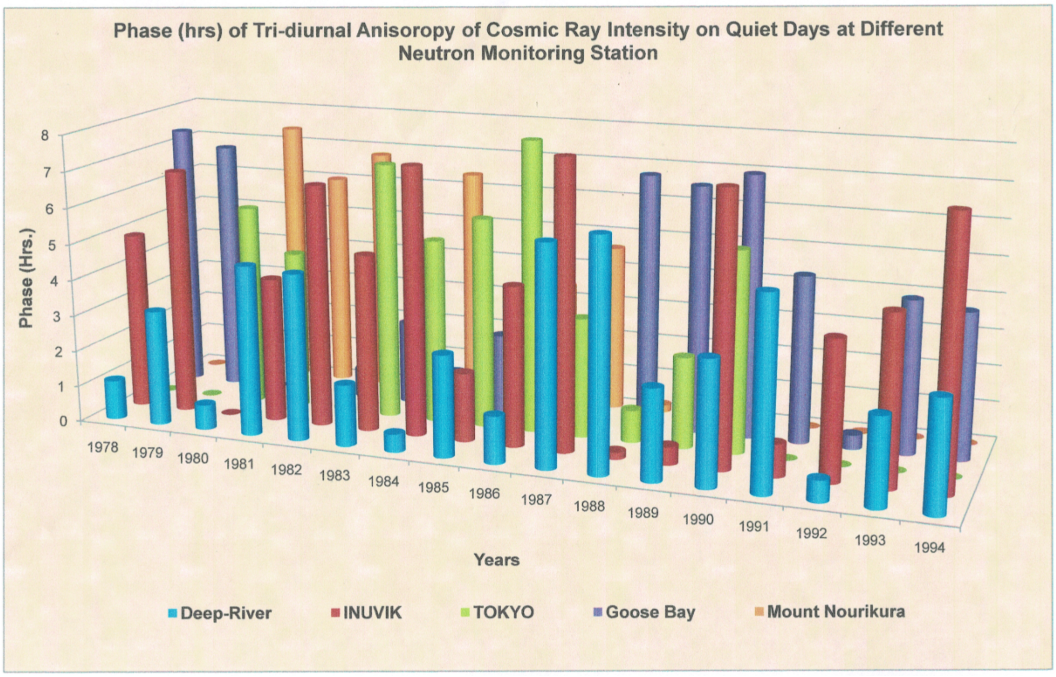
Fig. 2



It is also observed from Fig.2 that there is no systematic change in the phase of third harmonics of daily variation in cosmic ray intensity on QD. However, in the year 1990, the phase shifted to later hours, when the polarity of solar magnetic field in the northern hemisphere has change from negative to positive. The polarity dependence of the phase shift change has been interpreted as a result due to the change of CR density distribution in space caused by the difference of CR drift motion in the positive and negative polarity state at high latitude & equatorial (Tokyo) Neutron Monitoring Station (13). The significant variation in the phase of tri-diurnal anisotropy of Cosmic Ray intensity as seen from these figures :

The time of maximum ϕ_3 of tri-diurnal anisotropy reaches its maximum (08 Hr) on 1983, 1986 showing the peaks during these years and its minimum during 1982, 1988 showing dips during these years at Tokyo Station.

Fig. 3



The time of maximum ϕ_3 of tri-diurnal anisotropy reaches its maximum on 1981, 1982, 1987, 1988 and 1991 showing peaks during these years and its minimum on 1980, 1984 and 1992 showing dips during these years at Deep River Station.

The time of maximum ϕ_3 of tri-diurnal anisotropy reaches its maximum on 1978, 1979, 1988, 1990 showing peaks during these years and its minimum on 1982, 1984, 1986, 1992 showing dips during these years at Goose Bay Station.

The time of maximum ϕ_3 of tri-diurnal anisotropy reaches its maximum on 1980 to 1982, 1984 showing peaks during these years and its minimum on 1988 showing dip at Mount Nourika Station.

The time of maximum ϕ_3 of tri-diurnal anisotropy reaches its maximum on 1979, 1982, 1984, 1987, 1990, 1994 showing peaks during these years and its minimum during 1988, 1989, 1991 showing dips during these years at Inuvik Station.

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