

Dissertation
on
STUDIES IN COSMIC RAYS

"The Study of the Daily Variation
of Locally Produced Neutrons"

and

"An all Copper Metal System for Purification
of Noxious and Inflammable Gases"

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STATEMENT

1. The daily variation and the daily mean intensity of local neutron measured with a neutron monitor (N_k) at the equatorial mountain station of Kodaikanal ($\lambda_m = 1^\circ$, altitude 7688 ft.) during the period November 1956 to September 1957, has been studied by the author. The daily variation and the daily mean intensity were also studied in relation to the geomagnetic disturbance, as indicated by C_p . The variance has been taken as an index of the variability of intensity during successive bihourly intervals of 12 bihours, and has been used for defining days with high and low anisotropy. The amplitude and phase of the diurnal and the semidiurnal components of the daily variation for local neutrons are also compared with those of the daily variation of the meson component measured with telescopes (M_k) having a semiangle of opening 22° in the E-W plane and 37° in W-S plane.

2. The study indicates the following :

a. From the study of the histogram of days grouped according to the magnitude and sign of the percent deviations,

ΔI of the daily mean intensity from the mean intensity of the whole period, it can be concluded that decreases of daily mean intensity are much larger in amplitude than increases.

b. A study of the histogram of days grouped according to the magnitude of variance \sum^2 of each individual day reveals that there are a large number of days which show a variance much larger than can be expected from Poisson's distribution.

c. From the study of occurrence of significant bihourly deviations at different bihours and the study of the mean daily variation for days on which a significant bihourly deviation at a particular bihour occurs, it is found that there is a region of broad maximum at 10, 12, 14 hours and a region of sharp maximum at 0 hour. There are two regions of minima, one at 6 hour (a sharp minimum) and the other at 18, 20, 22 hours (a broad minimum). The maximum at 12 and 14 hours and the minimum at 18 and 20 hours are the most prominent features of the daily variation.

d. The study of the mean daily variation I and the histogram of days grouped according to the times of maxima of the diurnal and the semidiurnal components reveal that with decrease of intensity the time of maximum of the diurnal component shifts to earlier hours whereas the second harmonic is not significantly affected.

Such a study for groups according to the value of C_p reveal that while for high and low C_p groups the daily variation has individual characteristics, the intermediate C_p group has no definite type of daily variation associated with it. The study of subgroups of C_p and I confirm the above conclusions.

e. The amplitudes r_1 and r_2 of diurnal and the semidiurnal component respectively are significant in all cases. r_1/r_2 ratio is important for differentiation of type only for high C_p days where $r_1/r_2 \leq 1$ is related to I^+ and $r_1/r_2 \geq 1$ is related to I^- .

f. High Σ^2 days represent days of high anisotropy. I^+ days are associated with negative deviations at 6 hour in the mean daily variation curve and I^- days with a negative deviation at 22 hour. This suggests that both increases as well as decreases of cosmic ray intensity can occur.

g. From a comparison of the diurnal and the semidiurnal component of the daily variation of neutrons N_k and mesons M_k , it is observed that the diurnal and the semidiurnal components at Kodaikanal are equally important.

3. The method of superposed epochs involving what is known as Chree analysis has been used to study the nature of sequential changes of a parameter on days preceeding, during and following the occurrence of any particular event. High C_p , low C_p , high I and low I events are selected to study the sequential changes. The study of I and C_p for high anisotropy days as indicated by high Σ^2 is also carried out. The following are the main results of the study.

a. The decreases of intensity are, in general, connected, to a large extent, with the effect of the beam not explicitly connected with the electric field. However, if the electric effect is also present, high anisotropy occurs.

b. An examination of the time series of C_p for high I and low I indicates the presence of a component of the frozen magnetic field in the direction of the solar dipole field. However, during the period of observation under study the solar dipole field and the sunspot field were in the same direction. Therefore the results obtained cannot be

considered either to confirm or refute the hypothesis of the beams carrying the sunspot fields with them.

c. It is also observed that the decreases in cosmic ray intensity have a larger amplitude than increases. This is explained by the fact that while decrease can be due to both the electric and magnetic effects of the beam, the increases can be only due to the electric effect.

4. With the guidance of Professor H.V.Nehru the author has developed an all metal copper system for the purification to a high degree of BF_3 and $\text{B}(\text{CH}_3)_3$ gases. The method of purification of BF_3 and the method of preparation of BF_3 counters are described in the second chapter.

5. The present dissertation describes in Chapter III the apparatus and in Chapter IV the method of analysis of the investigation made with local neutrons. The principle conclusions of the investigations are discussed in Chapter VI. The author has included at the end of his thesis a list of references to original papers.

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