## CONTENTS

**F scatter and Cosmic Radio noise received on 25 J6/8 AT AHMEDABAD**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>64</td>
</tr>
<tr>
<td>Introduction</td>
<td>64</td>
</tr>
<tr>
<td>Diurnal variation of Cosmic noise; dependence on</td>
<td></td>
</tr>
<tr>
<td>Critical frequency of F layer</td>
<td>67</td>
</tr>
<tr>
<td>F scatter and increase in Cosmic Radio Noise</td>
<td>68</td>
</tr>
<tr>
<td>F scatter and decrease in Cosmic Radio Noise</td>
<td>69</td>
</tr>
<tr>
<td>Discussion</td>
<td>72</td>
</tr>
<tr>
<td>References</td>
<td>73</td>
</tr>
</tbody>
</table>

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III
CHAPTER III

List of Figures

3.1 Two instances of fluctuations in Cosmic Radio Noise (25 mc/s) Ahmedabad, during F scatter on September 20 and 27, 1957 (lower curves). The undisturbed records of 21 and 23 September, when there was no F scatter are shown for comparison.

3.2 Dependence of Cosmic Radio Noise power (25 mc/s) at Ahmedabad on sidereal time. All observations used for this curve relate to early morning hours when ionospheric absorption is minimum.

3.3 Cosmic Radio Noise attenuation (25 mc/s) Ahmedabad; dependence on Critical frequency of F2 layer.

3.4 Cosmic Radio Noise (25 mc/s) Ahmedabad on 24 and 26 March 1957 showing increased noise during F scatter at time of minimum galactic noise (09 hr sidereal time). No scatter on March 30.

3.5 Hourly h'f ionospheric records on 24-3-57 showing F scatter at 21-23 hrs. There was no scatter at 20 hrs.
3.6 Cosmic Radio Noise (25 mc/s) Ahmedabad, 11 and 20 August 1957 showing decrease in noise during F scatter at time of maximum galactic noise (19 hr sidereal time). No scatter on August 19.

3.7 Hourly hf ionospheric records Ahmedabad, August 11/12, 1957 showing appearance and decay of F scatter.

3.8 Cosmic Radio Noise (25 mc/s) Ahmedabad on December 13/14 and 15/16, 1957 showing decrease in noise during F scatter at time of peak in galactic noise (6 hrs sidereal time). No scatter on 19/20.
CHAPTER III

F SCATTER AND COSMIC RADIO NOISE RECEIVED ON 25 MC/S AT AHMEDABAD

Abstract

In the cosmic noise records (on 25 mc/s) which are maintained continuously at Ahmedabad, pronounced fluctuations are sometimes found associated with the occurrence of F-scatter in the ionosphere. A dependence of the fluctuations on sidereal time is also observed. Cosmic noise attenuation is increased if the F-scatter occurs at an hour of maximum galactic noise, and decreases if the scatter occurs at the time of minimum galactic noise. An explanation of the observed effects is offered in terms of the scattering of the cosmic radio waves by spatial variations in electron density.

Sporadic E is found to have negligible effect on cosmic noise absorption on 25 mc/s.

Introduction

Bhonsle & Ramanathan (1953) have reported on the results of measurements of cosmic noise on 25 mc/s at Ahmedabad (Latitude 23°01′N, Longitude 72°36′E) during the
period March 1957 to 1953. They have estimated the effects of D region absorption and F region attenuation separately. They have shown that during the first half of the night, the F-attenuation often exceeds the daytime maximum attenuation by as much as 2 db. Changes in foF2 alone were shown to be inadequate to explain this large excess of pre-midnight absorption.

In a later paper, Ramanathan and Bhonsle (1959) have suggested that F scatter might be one of the causes for the large increase in absorption. Mitra and Shain (1953) also had suggested F scatter to be a possible cause of excess attenuation. A study of individual instances with and without F-scatter has now been undertaken. The results show that F-scatter can increase as well as decrease the measured absorption under appropriate conditions.

An automatic sweep frequency ionospheric recorder is maintained at Ahmedabad and gives hourly, and at times, more frequent F1F records. The sweep is from 0.6 mc/s to 25 mc/s. After sunset, when the D layer has vanished, the absence of multiple reflections is associated with severe F-scatter (or spread F).

The presence of atmospherics appear as spikes mounted on an otherwise smooth cosmic noise record. It has been observed that the sferics activity gets enhanced
during the presence of F scatter indicating the possibility of oblique transmission, bringing in more atmospherics from over larger areas by scatter propagation. The severity of the enhancement may itself provide an index of the F scatter present at a given time. Local thunderstorms do not lift the base level of the recorded cosmic noise appreciably. Increased local sferics can therefore be ruled out as a possible cause of the fluctuations which are seen on the cosmic noise record during F scatter.

Bateman (1953) and others from their observations with 36.4 mc/s and 49.24 mc/s V.H.F. signals during IGY in the Philippines-Okinawa area have reported enhanced propagation on many occasions during the evening hours. The periods of these strengthened signals have been shown by them to correspond to periods when spread F was observed at the station Baguio in the Philippines and high values of foF2 over Okinawa.

At Ahmedabad, the effect of F-scatter is seen as a wavy pattern mounted on the usual cosmic noise record. Fig.3.1 shows two typical instances of fluctuations in cosmic radio noise associated with F scatter on the evening of September 20 and 27, 1957. Two undisturbed records of 21st and 23rd September during similar hours are reproduced for comparison. The disturbed record of the 20th clearly shows a large increase in the middle of a depression in the cosmic radio noise.
Two instances of fluctuations in Cosmic Radio Noise (25 mc/s) Ahmedabad, during F scatter on September 20 and 27, 1957 (lower curves). The undisturbed records of 21 and 23 September when there was no F scatter are shown for comparison.
radio noise level at 2115 hours 75° S.M.T. There appears to be a subsidiary lifting at 2230 hours as also at 0030 hours on the following morning. The hourly ionograms, not shown in the diagram, taken during the same night showed F scatter from 21 hours onwards, no scatter being observed on the 20 hour record. As seen in the figure the fluctuations in the cosmic noise record started earlier on the 27th instant with a corresponding shift in the time of occurrence of F scatter.

Diurnal variation of cosmic radio noise attenuation: dependence on critical frequency of F layer

Fig.3.2 and 3.3 are curves reproduced from a paper by Ramnath and Bhonsle (1959). Fig.3.2 shows on sidereal time scale the diurnal variation of cosmic radio noise attenuation on 25 mc/s. The curve has been built up from a series of observations extending over a year, during periods of negligible ionospheric absorption, such as during early mornings. Fig.3.3 shows the expected variation of cosmic radio noise attenuation with changes in foF2. Knowing the critical frequency of the F layer one can compute the expected absorption in the cosmic radio noise at a given time.

It is difficult to read off the exact foF2 on most occasions in the presence of large F-scatter; moreover, foF2 may undergo rapid changes during periods of F scatter. It is
Fig. 3.2 Dependence of Cosmic Radio Noise power (25 mc/s) at Ahmedabad on sidereal time. All observations used for this curve relate to early morning hours when ionospheric absorption is minimum.

Fig. 3.3 Cosmic Radio Noise attenuation (25 mc/s) Ahmedabad; dependence on Critical frequency of F$_2$ layer.
not easy therefore to interpret as to how much of the fluctuations in cosmic radio noise are due to variations in foF2 and as how much due to other causes.

**F scatter and increase in cosmic radio noise**

However, abnormally large increases in the level of cosmic radio noise have been noted at times when these cannot be explained on the basis of foF2 variations alone.

Two such instances are shown in Fig. 3.4. On March 24, 1957, a large increase was observed at 2030 hours with subsidiary rises at 2115 and 2135 hours. The neighbouring Fig. 3.5 shows the hourly ionograms taken during this period at Ahmedabad. The 2000 hour ionogram does not show any scatter but the 2100 hour record indicates the appearance of F-scatter. The scatter must have begun shortly after 2000 hours.

The other instance is on March 26, 1957. As seen in the middle record in Fig. 3.4 it shows a sharp rise at 2020 hours, 75° E.M.T. The ionograms on this day, not shown in the diagram, indicated the beginning of F scatter between 2000 and 2100 hours. For the sake of comparison the record taken on March 30, 1957 is shown side by side corresponding to the same sidereal hour. On the 26th March, the increase in intensity at 2020 hours is found to be 4.3 db over the
Fig. 3.4 Cosmic Radio Noise (25 mc/s) Ahmedabad on 24 and 26 March 1957 showing increased noise during F scatter at time of minimum galactic noise (9 hr sidereal time). No scatter on March 30.

Fig. 3.5 Hourly h.f. ionospheric records on 24-3-57 showing F scatter at 21-23 hrs. There was no scatter at 20 hrs.
pre-scatter level. The computed attenuation for the pre-scatter frequency is seen to be 3.2 dB from the scatter diagram of Fig. 3.3. The decrease in foF2 could have in an extreme case reduced the observed absorption to that extent, namely 3.2 dB. The observed reduction in attenuation of 4.8 dB, in the presence of F-scatter at 2020 hours is, therefore a clear case of an additional noise coming in from elsewhere and not of foF2 variation alone.

**F scatter and decrease in cosmic radio noise**

Till now instances showing increased noise during F scatter were discussed. There are occasions when the noise power is known to decrease during the presence of F-scatter. Such instances however appear to be restricted to about an hour either around 0600 or 1930 hours sidereal time. Fig. 3.2 shows that both these hours relate to time when there was maximum radio noise temperatures over the aerial system.

Fig. 3.6 and 3.3 show many such instances. In the top record in Fig. 3.6 on the night of the August 11, 1957 there is a depression in the noise level during 2200 to 2300, 75° E.M.T. Ionograms were taken at 15 minutes interval during this event (as can be seen by the gaps in the cosmic noise record); however, only hourly curves have been reproduced in Fig. 3.7. The presence of F scatter is clearly seen during the period of depression in the cosmic noise.
Fig. 3.6 Cosmic Radio Noise (25 mc/s) Ahmedabad, 11 and 20 August 1957 showing decrease in noise during F scatter at time of maximum galactic noise (19 hr sidereal time). No scatter on August 19.

Fig. 3.7 Hourly h'r ionospheric records, Ahmedabad, August 11/12, 1957 showing appearance and decay of F scatter.
A similar depression is observed in Fig. 3.6 on the night of August 20. Here, however, the F scatter existed for a much shorter duration. The middle record of August 19th shows the normal trend of cosmic noise received in the absence of F scatter.

All the three records discussed above have been arranged in Fig. 3.6, one below the other on the sidereal time scale. It may be noted that the depressions on August 11 and on the 20th instant are associated around 1900 hours sidereal time corresponding to the time of the maximum of the galactic radiation to be overhead.

Two examples of depressions during F scatter around 0600 sidereal hour when the subsidiary peak in the galactic radiation is overhead are seen in Fig. 3.6. The disturbed records refer to the night of December 13/14, 1957 and of 15/16 instant. A typical record corresponding to the same sidereal time but in the absence of F scatter is seen at the top of the Figure. This was taken on the night of December 19/20, 1957.

The depressions in the cosmic radio noise discussed above and similar depressions observed in the presence of F scatter on many other occasions were mostly found to be associated with slightly increased foF2 and could not entirely be ruled out as not due to the variations in foF2.
Fig. 3.3 Cosmic radio noise (25 mc/s) Ahmedabad on December 13/14 and 15/16, 1957 showing decrease in noise during F scatter at time of a peak in galactic noise (6 hr. sid. time). No scatter on 19/20.

It may be noted here that at least no substantial rise above the expected cosmic noise was observed on any day during these sidereal times with the presence of F scatter. If at all there was a depression in the noise level with the appearance of F scatter during the hours of maximum galactic radiation.
Discussion

Associated with F scatter therefore there are both increases as well as decreases in the cosmic radio noise intensities. The percentage increase being maximum around 0300 and 2300 sidereal hours whereas a decrease around 0600 and 1930 hours. Just as the atmospherics get enhanced during the presence of F scatter the possibility of some distant transmitting stations or noise sources contributing to the observed cosmic noise during such periods is not entirely ruled out. However the sidereal time dependence of such a contribution is difficult to understand.

Bhagavantam (1961) and collaborators working on cosmic radio noise intensity on 28.6 mc/s at Bangalore (Lat.12°53'N, Long.77°35'E) have reported similar depressions of intensity as also increases. In the example shown in their paper, the depression appears to be at the time when the galactic peak was overhead. It would be worthwhile to observe spread F at the time of occurrence of the depression.

The other possibility which appears to be the most likely would be that the presence of F scatter would be cutting out a part of the vertical cosmic radiation but would be permitting a part of the scattered radiation from oblique directions. Effectively this would be a covering of the aerial aperture with a diffused source blurring out a bright sky when in front of the aerial whereas intensifying dimmer
portions of the sky by contributions from neighbouring
brighter parts. It may be noted that the percentage increases
in intensity were maximum around 0300 hours. Sidereal time
when the aerial was pointed to the weakest part of the sky.

There appears to be little dependence of the
received cosmic radio noise on sporadic E scatter. This
could however be due to the generally low critical frequency
of the E scatter compared to 25 mc/s as also the lower height
and width of the layer compared to F layer.

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