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# Studies of Simultaneous Observation of Spread-F Occurrence on Oblique & Vertical Incidence Records

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Results of simultaneous observation of spread-F irregularities on vertical and oblique incidence are presented. The vertical incidence data relate to Kakinada while the oblique incidence data relate to CW transmissions recorded from All India Radio, Hyderabad, at 4.8 MHz during 1800-2230 hrs IST. Comparison of these data revealed that in a majority of the cases, there is no time delay in the spread-F occurrences on vertical and oblique incidence data indicating that the agency causing spread-F irregularities has an extent greater than 200 km in the east-west plane.

Spread-F phenomenon has been extensively studied and detailed reviews are given by Herman[1] and Fejer and Kelley[2]. Although the work done on the diurnal, seasonal and sunspot cycle variations of the occurrence of spread-F is extensive, little work was done on the extent of spread-F irregularities. In the present investigation an attempt has been made to measure the extent of spread-F irregularities by studying the ionosphere by both vertical and oblique incidence techniques.

The spread-F irregularities were studied by vertical incidence at Kakinada (geogr. lat., 16°59′ N; geogr. long., 82°15′E; geomag. lat., 7°N) using a variable frequency pulse transmitter (2.5-6.5 MHz) described by Rao[3]. CW transmissions from All India Radio, Hyderabad, on a frequency of 4.8 MHz were recorded at Kakinada on a strip chart pen recorder driven at a speed of 5 cm/min during 1800-2230 hrs IST.

Rao and Rao[4], Murthy and Rao[5] and Rao[3] reported that fading rate of CW transmissions increases whenever spread-F is present. So the time of onset of fast fading in CW records is now taken as the time at which spread-F irregularities appear at 200 km west of Kakinada, since Hyderabad is at an aerial distance of 400 km west of Kakinada. The time of appearance of spread-F echo on the cathode ray oscilloscope (CRO) on a frequency of 4.2 MHz at Kakinada was recorded each day. The time delay between the onset of fast fading in CW records and the appearance of spread-F echo on CRO is measured in each case and the results are presented in Table 1.

Table 1 clearly shows that in a majority of cases, there is no time delay indicating that spread-F occurrences are simultaneous at Kakinada and at 200 km west of Kakinada. The absence of time delay in majority of the cases indicates that the agency that gives rise to triggering spread-F irregularities must be having the east-west extent greater than 200 km. If the internal atmospheric gravity waves were the agency, it would appear that the half wavelength in the east-west direction would be 200 km which is within the range of wavelengths that can be expected from the spectrum of the internal atmospheric gravity waves[6]. This result is in good agreement with the values reported by Cohen and Bowles[7], Calvert and Cohen[8], Clemesha[9], Beynon and Jones[10] and Aarons *et al*[11]. It can also be noticed from Table 1, that whenever time delay occurs, the most probable one lies within 30 to 50 min, indicating that the spread-F irregularities move from west to east with speeds ranging between 240 and 400 km/hr. This is in good agreement with the results of Aarons *et al*[11]. The absence of time delays greater than 1 hr also indicates that whenever spread-F irregularities appear, they travel with velocities greater than 200 km/hr. Further work in this aspect is in progress.

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Table 1—Percentage Occurrence of Time Delays

| Time delay min. | Number of instances | Percentage |
|---|---|---|
| 0 | 40 | 59 |
| 1 to 20 | — | 0 |
| 21 to 30 | 4 | 6 |
| 31 to 40 | 10 | 15 |
| 41 to 50 | 10 | 15 |
| 51 to 60 | 4 | 6 |
| 61 and above | — | 0 |

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