SHORT COMMUNICATIONS

EFFECT OF SPREAD-F IRREGULARITIES ON THE FADING OF RADIOWAVES AT KAKINADA

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SPREAD-*F* phenomenon has been extensively studied and reviewed[1,2]. Although work done on diurnal, seasonal and sunspot cycle variations on spread-*F* occurrence is extensive, very little work was done on fading characteristics of radiowaves reflected from the ionosphere during spread-*F* conditions. In the present investigation an attempt has been made to study the fading characteristics at Kakinada, a low latitude station.

At Kakinada (Geogr. Lat: 16° 59′ N: Geogr. Long: 82° 15′ E; Geomag. Lat: 7° N), the spread-*F* irregularities were studied at vertical incidence employing a variable frequency pulse transmitter operating in the frequency[3] range 2.5 to 6.5 MHz. The reflected echo from the ionosphere was gated and fed to a strip chart pen recorder driven at a speed of 2 cm/min, 5 cm/min or 10 cm/min. Whenever the fading is more, larger chart speeds were used so that inaccuracies in the calculation of fading frequency did not creep in. The amplitude of the reflected echo was recorded whenever spread-*F* echo appeared on the screen of the C.R.O. In the present investigation only recordings taken on 2.5 MHz during magnetically quiet conditions are utilised.

Fading of the records was analysed according to the criterion of Rice[4] and fading frequencies evaluated in each case eliminating the data influenced by heavy noise. To study the fading frequency dependence on spread-*F*, fading frequency data taken during spread-*F* conditions are averaged and the average value was 33.8 cycles/min, which is higher when compared to the value obtained during non-spread-*F* conditions. To examine this aspect in detail, fading frequency data relating to various ranges of spread-*F* extent *viz* 100–110 km, 115–125 km, 130–140 km, 145–155 km, 160–170 km, 175–185 km, are averaged and presented in table 1.

From a perusal of table 1, it is clearly noticed that fading frequency is larger when spread-*F* extent is larger. Krishnamoorthy and Rao[5] analysed the fading data taken at Waltair during spread-*F* conditions and reported that no significant dependence is present between fading frequency and spread-*F* extent. However Chandra and Rastogi[6] reported that fading rate is more on spread-*F* nights than during non-spread-*F* nights at Thumba. The observed positive correlation in the present investigation is in very good agreement with the results of Chandra and Rastogi[6]. Further work involving fading depth and spread-*F* is in progress and will be published elsewhere.

To examine whether spread-*F* phenomenon occurring at this low latitude station is due to the scattering mechanism, the amplitude of fading records taken during spread-*F* conditions is noted at closely and equally-spaced time intervals and experimental distribution curves were drawn. These curves were then compared with the theoretical distributions obtained by using the formula (given below) by McNicol[7], which considers the presence of steady component in the fading signal in addition to the random component.

$$P(Q) = \frac{Q}{\phi} \exp\left[-(Q^2 + B^2)/2\phi\right] J_0(QB/\phi)$$

where Q is the amplitude of the signal, J_0 is the zeroth order Bessel function with imaginary argument, B is the amplitude of the steady component and ϕ is the square of the random component. The ratio of the steady-to-random component $(B/\phi^{\frac{1}{2}})$ is calculated in each case and the results are presented in table 2.

Table 2 clearly indicates that the steady component is always predominant in almost all cases. The most probable value of the ratio of steady-to-random component was found to be 2.84, which means that weak

Table 1 *Variation of average fading frequency with spread-F extent*

Spread-*F* extent (km)	Average fading frequency (cycles/min)
105	30.2
120	33.1
135	36.0
150	39.0
165	38.1
180	40.2

Table 2 *Percentage occurrence of the ratio* $B/\phi^{\frac{1}{2}}$

Value of $B/\phi^{\frac{1}{2}}$	Occurrence (%)
1 or < 1	2
1.1–1.5	10
1.6–2	10
2.1–2.5	19
2.6–3	16
3.1–3.5	40
> 3.6	3

spread-*F* (in association with strong specular reflection) is observed at this low latitude station more often than strong spread-*F* (in association with weak specular reflection). The results of the present investigation agree with those of Krishnamoorthy and Rao[5] and Klemperer[8]. An attempt to study this aspect in greater detail using more data is under progress.

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THE FORBIDDEN TRANSITION L_1O_1 IN PRASEODYMIUM-59

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ALTHOUGH studies on the *L*-emission spectrum of praseodymium-59 have earlier been carried out [1-8] a careful survey reveals many forbidden transitions left unobserved. It was therefore thought worthwhile to reinvestigate the *L*-emission spectrum of praseodymium, with special attention directed towards the forbidden transitions.

The experimental set-up and technique were similar to those adopted by Shrivastava *et al*[9]. The metallic demountable hot cathode x-ray tube, provided with four-faced rotatable anticathode, was operated at 20–22 kV (fullwave rectified) and 5–7 mA. The praseodymium target was prepared by embedding the specpure praseodymium oxide sample (supplied by M/s Johnson Matthey, London) into closely-spaced horizontal grooves cut on the faces of the massive copper anticathode of the demountable x-ray tube (Beaudouin model B-80). First order reflections from (100) and ($\bar{2}01$) sets of planes belonging to the ⟨010⟩ zone of muscovite mica and yielding a dispersion of about $12\,\mathrm{xu\,mm^{-1}}$ were employed for recording the spectrum on a 40 cm curved crystal spectrograph of transmission type. Using Agfa Curix M 1 x-ray films and with exposures varying from 15–20 hr several spectrograms were obtained. The wavelengths were determined by linear interpolation from the measurements made directly on the negatives with a Carl-Zeiss comparator having a least count of 0.0001 mm.

All our gamma region spectrograms showed the presence of a weak but distinct line very close to and on the long wavelength side of the dipole line $\gamma_{4,4'}$ in the praseodymium spectrum. The intensity of this weak line is about one quarter of that of the γ_8 line, as estimated visually. The wavelength of this weak line, as determined taking $\gamma_{4,4'}$ and γ_3 lines of praseodymium as the reference lines, has been found to be 1821.5 xu. The line has been assigned to the forbidden transition L_1O_1 in praseodymium. Our observed value of its wavelength is in good agreement with the value calculated for the transition from the energy level tables[10].

A survey of the wavelength tables[11] shows that the possible sources of interference with the newly observed line might be ^{67}Ho $L\eta$ ($\lambda = 1822.61$ xu) or second order reflections of either ^{92}U $L\alpha_1$ ($2\lambda = 1817.518$ xu) or ^{78}Pt L_1M_5 ($2\lambda = 1824.4$ xu). As none of our spectrograms showed a stronger line of these elements, the possibility of these interferences can be ruled out completely. The fact that the line is present with the same relative intensity in the photographs taken with both the ($\bar{2}01$) and (100) planes eliminates altogether the possibility of its being second order reflections, since the second order reflections from (100) are known to be very weak compared to that from the ($\bar{2}01$) planes. Further, the interference