LETTERS TO THE EDITOR

SOLAR CYCLE CONSTANT OF IONOSPHERIC ABSORPTION

THE solar cycle variation of ionospheric absorption of pulsed radio transmissions at 2·4 MHz measured at Waltair during the period 1971–73 has been studied to obtain the solar cycle constant *'b'* using the relation $L = L_0 (1 + bR)$ in which L is the noon absorption in dB, R is the Zurich sunspot number and L_0 is the absorption in dB for $R = 0$. Earlier measurements of solar cycle constant *'b'* at equatorial and low latitudes showed wide variability[1-4]. Hunter[5] drew attention to this discrepancy in the measured value *of 'b'* and suggested further measurements. Subsequently Mbipom[6] re-examined the ionospheric data at Ibadan with additional data on 2·4 MHz echoes obtained during 1966–68. He found that *'b'* values are in close agreement at Colombo and Ibadan. More recently Kotadia *et al.*[7] studied the solar cycle variation of absorption on 2·2 and 2·5 MHz at Ahmedabad. The availability of absorption data on 2·4 MHz enabled us to study the solar cycle variation and to see whether the result is consistent with those at other equatorial stations.

TABLE I

Monthly mean values of 'b' *in* $L = L\ (1 + bR)$

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
$b \times 10^3$	5·7	4·5	4·7	4·5	8·1	5·1	5·7	6·6	9·4	5·3	6·4	6·9	6·1
L_0 (dB)	35	44	42	44	37	39	35	30	32	38	31	29	36

The seasonal control on absorption has to be removed to study the sunspot cycle variation. It is done in two ways, either by taking 12 month running means or by studying the variation for each individual month. The latter method was used by Appleton and Piggott[8] and Lastovicka[9] and is useful since it gives the parameter *'b'* for each month. In this method the absorption data is grouped month-wise and plotted against Zurich sunspot number (obtained from solar geophysical data bulletins) and best fit lines are drawn. The slopes of these best fit lines give the values of *'b'* and the average values are given in Table I. The monthly mean values of the solar cycle constant *'b'* vary from a minimum of $4·5 \times 10^{-3}$ to a maximum of $9·4 \times 10^{-3}$. The annual mean value of *'b'* obtained is $6·1 \times 10^{-3}$. If the two high values of *'b'* obtained in May and September are omitted, the annual mean becomes $5·5 \times 10^{-3}$. It may not be out of place here to mention that the monthly mean *'b'* values, derived from Al absorption data by Appleton and Piggott[8] showed wide variation from month to month while the *'b'* values derived from f_cE data were practically uniform throughout the year. The variation in the monthly mean values of *'b'* is mainly due to the different contributions of deviative absorption to the total absorption.

It is clear from Table II, in which the average value of *'b'* obtained in the present investigation is compared with those at other equatorial stations, that our value of *'b'* is reasonably in good agreement with those at other stations and the discrepancy observed in earlier measurements are no longer evident. One important conclusion from this study is that the solar cycle constant at low and equatorial latitudes and for E region echoes can be taken as $5·5 \times 10^{-3}$ approximately.

TABLE II

Values of solar cycle constant 'b' *at different low latitude stations*

Station	Frequency MHz	Period of observation	$b \times 10^3$	Ref. No.
Colombo	2·6	1964–68	5·1	4
Ibadan	2·4	1955–68	4·9	6
Singapore	2·4	1954–58	4·8	4
Ahmedabad	2·2	1972–75	6·6	7
Ahmedabad	2·5	1972–75	5·0	7
Waltair	2·4	1971–73	6·1	Present work

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ON THE L-CONVERSION OF THE 77 keV TRANSITION IN ^{197}Au

THE radioactive isotope ^{197}Hg essentially decays (98%) to the 77 keV state in ^{197}Au, which subsequently decays to the ground state (3/2+). The nature of the 77 keV transition is of interest from the viewpoint of inferring the structure of the 77 keV state. The transition properties are summarized in the recent *Nuclear Data Sheets*[1]. On the basis of the Deshalit's model[2], the 77 keV state was essentially considered as a core excitation state. On the other hand in the wave functions furnished by Kisslinger and Sorensen[3], a large part of this state was viewed as of single particle origin. The state was also considered on the basis of the Intermediate coupling model in the Unified Scheme with considerable success[4]. Since the energy of the state is lower than the K-shell binding energy in Au (B_k = 80·7), K-conversion does not take place. In the present experiment, the L-shell conversion coefficient of the 77 keV transition is determined since no such determination was made earlier[1], although L-subshell ratios were studied.

A direct determination of the L-conversion coefficient is possible from the L-X-ray and the 77 keV gamma ray intensities recorded with a Si (Li) detector. This method, however, is not used in the present study since it is hard to correct from the contributions of other transitions to the L-X-ray. In addition, the 77 keV gamma ray is not resolved completely from the K_β X-ray line arising due to the K-conversion of other transitions. Hence a coincidence method is employed for the determination of the L-conversion coefficient in the present study, using a Ge-(Li)-NaI (Tl) coincidence system with a ND 512 channel analyser. The Ge (Li) detector (coaxial 35 cc) is employed to detect the K-X-rays associated with the K-capture, while the NaI (Tl) detector (1½" dia × 1 mm thick with a thin aluminium window, attached to DuMont 6292 photomultiplier), is employed to detect the X-rays following L-capture and gamma rays associated with the 77 keV transition. The output from the Ge (Li) detector is employed to gate the multichannel analyzer in which the coincident spectrum detected in the NaI (Tl) is recorded. The resultant spectrum shows peaks corresponding to the 77 keV gamma ray and the L-X-ray. The intensities under these lines N_L and N_γ obtained by graphical analysis are used to estimate the L-shell *conversion coefficient using the relation*

$$\alpha_L\,(77\ \text{keV}) = \frac{N_L}{N_\gamma}\cdot\frac{\epsilon\gamma}{\epsilon_L}\cdot\frac{1}{\omega_L} \qquad (1)$$

where ϵ_γ and ϵ_l are the relative photopeak efficiences and ω is the L-shell fluorescent yield which is taken as $-0{\cdot}41 \pm 0{\cdot}04$ from the data of Bambynek *et al.*[5]. An auxiliary experiment was conducted to determine the relative intensities using a ^{57}Co source which yielded $\epsilon_\gamma/\epsilon_l = 0{\cdot}96 \pm 0{\cdot}03$. The final value of the L-conversion coefficient is obtained as

$$\alpha_L\,(77\ \text{keV}) = 2{\cdot}46 \pm 0{\cdot}26$$

which includes an overall error of 10%, essentially due to the error in the L-shell fluorescent yields. The statistics of counting did not involve more than 1% error. The theoretical values obtained from the computer interpolation programme of Hager and Seltzer[6] are

$$\alpha_L\,(\text{M}\,1) = 2{\cdot}28$$
$$\alpha_L\,(\text{E}\,2) = 12{\cdot}8,$$

The present value of α_l suggests an essentially M1 assignment to the 77 keV transitoin. Young *et al.*,[7] obtained a value for the total conversion coefficient from their coulomb excitation study as 4·0 ± 0·2 and employed it for the estimation of the penetration parameter. Assuming this penetration parameter and the value of the mixing ratio derived from Mossbauer study (δ^2 = 8·1218 ± 0·0007), L-conversion coefficient is estimated with the theoretical 'no penetration' values. The resultant value is obtained as,

$$\alpha_t\,(77\ \text{keV})\ \text{Young} = 3{\cdot}12 \pm 0{\cdot}10,$$

A similar estimate, made from the data of Krpic *et al.*[8] yielded α_t (77 keV) (Krpic) = 2·92 ± 0·3.