Sinha's analysis led him to the conclusion that the predicted equivalent widths were substantially greater than the upper limit set by the observations: $W_\lambda(\text{PRED}) \gg W_\lambda(\text{OBS})$. Non-LTE was invoked to resolve this discrepancy. In the present study, the order is reversed and $W_\lambda(\text{OBS}) > W_\lambda(\text{PRED})$ is found. Likely explanations are either that the observations have set only upper limits to the equivalent widths or that the laboratory measurement of the oscillator strength is in error. The suggestion of a non-LTE effect seems premature. It should be possible to look for Phillips band lines in the spectrum of penumbrae where they will be about twice as strong as in the photosphere.

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NITRIC OXIDE IN SUNSPOTS

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The calculated equivalent width of R_1 (26·5) line of the 0—1 vibration-rotation band of NO near 5·3 μm for the sunspot model of Stellmacher and Wiehr (1970) suggests the likelihood of the presence of this band in sunspot spectrum. As the equivalent width of this line increases towards the limb, its detection will be easier near the limb, possibly by extra-terrestrial observations.

Окись азота в солнечных пятнах

Эквивалентная ширина линии R_1 (26,5) 0—1 вибрационно-ротационной полосы NO вблизи 5,3 μm, рассчитанная для модели солнечного пятна Стеллмахера и Виера (1970) указывает на вероятность присутствия этой полосы в спектре пятна. Так как эквивалентная ширина этой линии возрастает в направлении к лимбу, ее детекция будет легче осуществима в его близи, возможно при помощи внеземных наблюдений.

1. Introduction

The dissociation equilibrium calculations (Gaur et al., 1973) in Zwaan's (1965) sunspot model show that the molecule NO is likely to be present in sunspots in significant amounts. Moreover, its abundance is comparable to that of HCl and HF molecules whose fundamental bands have already been identified in the sunspot spectrum (Hall and Noyes, 1969; 1972). These facts led us to calculate the equivalent width of the R_1 (26·5) line of the 0—1 vibration-rotation band of NO, arising from the electronic substate

${}^2\Pi_{1/2}$, in the recent sunspot model of Stellmacher and Wiehr (1970). The selected line corresponds to a j value for which the line should be most intense under sunspot conditions. Here the results of such an investigation are presented.

2. Equivalent Width Calculations

Following Newkirk (1957), the equivalent width $W(\Theta)$ of a weak line, in wavenumbers, is given by

$$(1) \qquad W(\Theta) = \int_0^\infty [g(\tau, \Theta)\, S_{v,j}(\tau)/k_\lambda(\tau)\, \varrho(\tau)]\, d\tau$$

where, (i) $g(\tau, \Theta)$ is the weighting function for a line originating by pure absorption; (ii) $k_\lambda(\tau)$ is the continuous absorption coefficient per gm. of stellar material and has been evaluated from Tsuji's (1966) polynomial formulation for free-free transitions of H^- ion. Other sources of opacity contribute negligibly in the 5·3 μm region; (iii) $\varrho(\tau)$ is the density calculated from the relation

$$P_g = \left[\frac{R}{\mu}\, \varrho(\tau)\, T\right],$$

where P_g, is the gas pressure; R, is the universal gas constant; T is the temperature and the mean molecular weight μ was obtained from Vardya's (1964) tables valid for the solar abundances; and (iv) S_v, $j(\tau)$ is the individual line strength for the fundamental band of NO; vide expression (13) of Carpenter and Franzosa (1965) which also accounts for the effects of the interaction between vibration and rotation.

The experimental value of the total integrated intensity of the fundamental band 76 $\text{atm}^{-1}\,\text{cm}^{-2}$ obtained by Breeze et al. (1964) was used in our calculations.

The molecular constants of NO for calculating the wavenumber of the selected line were also adopted from Carpenter and Franzosa (1965) and the calculated wavenumber is 1954·43 cm^{-1}.

The equivalent width of R_1 (26·5) line was calculated at four center to limb distances, i.e. at $\cos\Theta = 1$, 0·7, 0·5 and 0·3, for the sunspot model of Stellmacher and Wiehr (1970). The resulting equivalent widths are as follows:

$\cos\Theta$	1	0·7	0·5	0·3
$W(\Theta)$ in mA	8·90	9·77	9·79	10·98

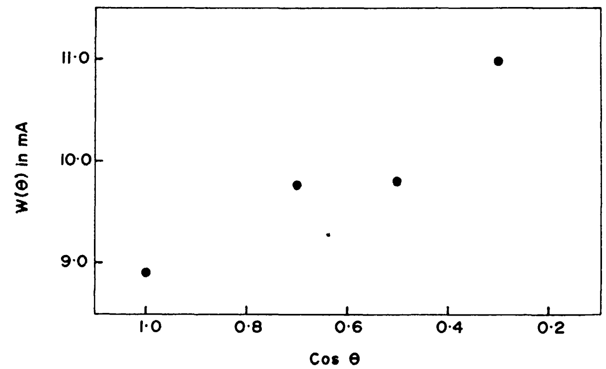

Fig. 1. The center to limb variation of the equivalent width of R_1 (26·5) line of the 0−1 vibration-rotation band of NO.

These are also plotted in Fig. 1 which shows that the equivalent width of the R_1 (26·5) line increases with $\cos\Theta$.

3. Concluding Remarks

The calculated equivalent widths suggest the possible presence of the lines of the fundamental band of NO in sunspot spectrum. It may be desirable to investigate the sunspot spectrum in the spectral region around 5·3 μm preferably near the limb so as to resolve the question of the presence or absence of the fundamental band of NO in sunspots definitively. However, terrestrial CO_2 and H_2O along with the solar CO show strong absorption in this spectral region of the solar spectrum. It may be worthwhile making extra-terrestrial survey of the sunspot spectrum to detect the weak lines of the 0−1 band of NO. Investigations to assess the effect of the choice of the sunspot model on the above prediction are also needed.

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ON THE SPATIAL DISTRIBUTION OF SOLAR ACTIVITY PHENOMENA IN THE 20th SUNSPOT CYCLE

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Drawing on the data of photospheric background magnetic fields, photospheric faculae, CaII plages, solar flares, sunspot groups and solar corona for 1964—1970 the peculiarities of the active longitudes in the current 11-year cycle are investigated. Two types of active longitudes (main and secondary ones) have been detected, the former penetrating the whole thickness of the solar atmosphere and the latter — only some of its regions. The spatial distribution of the background magnetic fields is shown to be less stable than the solar activity phenomena considered in the present paper. The reasons in favour of a relationship between the active longitudes and the 80 ÷ 90 — year cycle are given. An attempt to interpret the detected peculiarities of the active longitudes is made.

О пространственном распределении явлений солнечной активности в 20-м цикле солнечных пятен

На основе данных о фотосферных фоновых магнитных полях, фотосферных факелах, кальциевых флоккулах, солнечных вспышках, группах солнечных пятен и солнечной короне за 1964 ÷ 1970 г.г. изучаются особенности активных долгот в текущем 11-летнем цикле. Выведено два типа активных лолгот (основные и вторичные), причем первые из них охватывают всю толщу солнечной атмосферы, а вторые — только отдельные ее области. Показано, что пространственно распределение фотоных магнитных полей менее устойчиво, чем изученных в данной работе явлений солнечной активности. Приведены соображения в пользу связи активных долгот с 80 ÷ 90-летним циклом. Сделана попытка интерпретации выявленных особенностей активных долгот.

1. Introduction

Although a number of papers deals with the study of spatial (especially longitudinal) distribution of various phenomena in solar activity (for instance: Bumba, 1972; Vitinskij, 1969a and the references to these papers), the observational data, available at present, do not permit us to consider many of the results as conclusive. It is especially true of the photospheric background magnetic fields and proton flares. Therefore, investigations including as much solar activity phenomena as possible, can provide reliable corroboration of the previous results, provided a uniform method is used; they can also contribute to detecting the unknown properties of the spatial distribution of solar activity.

A study of the latitudinal-longitudinal distribution of photospheric, chromospheric and partly coronal active formations in the current 11-year solar cycle, is the purpose of this paper.

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2. The Data and Method

The synoptic charts of the photospheric background magnetic fields, which were obtained at the Mount Wilson Observatory during rotations 1486 ÷ 1562, published partly (Howard et al., 1967) mostly prepared for press and offered kindly to the present author by Dr. Bumba, were used as initial data. Beside these, we also used the Zurich synoptic charts of the photosphere and the Meudon charts of the solar chromosphere during the same rotations. The list of proton flares during 1964 ÷ 1972, including the recent unpublished data contributed by Dr. Křivsky (1969), the list of the largest sunspot groups with an area of more than 500 millionths of the visible solar hemisphere (m. s. h.) for 1964 ÷ 1969 by R. S. Gnevysheva (1972), the data on the same groups for 1970 (Gnevysheva, 1973) and the reduced data on the intensity of the 5303 Å coronal line for 1964 — 1970 (Sýkora, 1973) were also employed. It should be noted that the coronal data, unlike the other materials, are reduced for a period of solar rotation equal to 27·7 days instead of