

## DEPENDENCE OF MOLECULAR DISSOCIATION EQUILIBRIUM ON MAGNETIC FIELD STRENGTH IN SUNSPOTS

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Received 3 January 1971

It is shown that the total number of CO, CN, C<sub>2</sub>, OH, NH and CH molecules varies significantly with magnetic field strength in sunspots. The equivalent widths of two first overtone lines of CO belonging to 0—2 vibration-rotation band as a function of magnetic field strength are also given. It appears that upto 2500 gauss the equivalent widths change linearly with magnetic field strength.

*Зависимость молекулярного диссоциативного равновесия от напряженности магнитного поля в солнечных пятнах. Показано, что полное число молекул CO, CN, C<sub>2</sub>, OH и CH существенно изменяется с напряженностью магнитного поля в солнечных пятнах. Также приводятся эквивалентные ширины двух первых обертонов линий CO, принадлежащих 0—2 колебательно-вращательной полосе, как функция напряженности магнитного поля. Оказывается, что до 2500 гаусс эквивалентные ширины изменяются линейно с напряженностью магнитного поля.*

### 1. Introduction

Zeeman splitting of MgH lines in sunspot spectra has recently been observed by Wöhl (1969). This splitting can be used for magnetic field measurements. Such determinations of the magnetic field strength need very high resolution and high dispersion spectra. It appears that the dissociation equilibrium of molecules in spots will be affected by the magnetic field strength because the magnetic field determines the physical conditions, prevailing in a sunspot. The aim of this paper is to test this proposition for six molecules viz., CO, CN, C<sub>2</sub>, OH, NH and CH. For this purpose we have used Stankiewicz's (1967) magneto-hydrostatic sunspot models with vertical magnetic fields 1500, 2000, 2500, 3000 and 3500 gauss in intensity.

### 2. Dissociation equilibrium calculations in Stankiewicz models

The procedure adopted for dissociation equilibrium calculations is the same as outlined in our earlier

papers (Pande et al., 1969a,b). Vardya's (1966) initial guess solution and the abundances given by Müller (1967) with a helium to hydrogen ratio of 0.16 (Zwaan, 1965) and Tatum's tables (1966) for dissociation constants were used. The concentration-optical depth curves (at 4500 Å) were numerically integrated upto an optical depth  $\tau = 3$  for various values of magnetic field strength. The results are summarized in Table I and Fig. 1.

### 3. Equivalent widths of two CO lines near 2.3 microns

The calculations of the line profiles and then of the equivalent widths of two CO lines at 23007 Å and 23023.9 Å were made. These lines belong to the R branch of (0—2) band with  $J$  values 31 and 29, respectively. Following Waddell (1958) the dip can be defined as:

$$\Upsilon = \int_0^{\infty} G \Psi \frac{k_{\Delta\lambda}}{k_{\lambda_0}} d\tau.$$

Table I

Integrated number of molecules i.e.  $\text{In.}(ab) = \int_0^3 N(ab) d\tau$

Magnetic field strength in Gauss	In.(CO) . 10 <sup>-13</sup>	In.(CN) . 10 <sup>-9</sup>	In.(C <sub>2</sub> ) . 10 <sup>-8</sup>	In.(CH) . 10 <sup>-10</sup>	In.(OH) . 10 <sup>-12</sup>	In.(NH) . 10 <sup>-10</sup>
1500	3.472	3.857	8.408	5.520	1.828	5.440
2000	4.164	5.278	12.521	7.289	4.114	7.256
2500	5.807	5.841	12.573	8.441	4.813	9.595
3000	7.438	8.053	15.861	10.063	6.645	12.285
3500	9.493	11.095	22.577	13.237	9.835	16.616