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Solar variability in the CaII K line during solar cycles 21 and 22

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Abstract. We have monitored the sun in the light of the CaII K line and obtained the disc integrated profiles for the years 1974-91. From these profiles we have estimated the variability of the sun as a star as seen in the various K line parameters. The 1 Å index shows an increase of about 35% in 1990 from its minimum value attained in 1986-87.

Key words : solar variability—CaII K line

1. Aim

The programme for measuring the solar cycle variation of the chromospheric output using the CaII K line (3933.684Å) profiles is in progress since 1969 (Sivaraman *et al.* 1987). The observations consist of spectra in the K line in the integrated light i.e. the sun as a star obtained on as many occasions as possible. The results for the years 1974-1991 are presented below.

2. Observations

The observations till 1989 are entirely from the Solar Tower Telescope at Kodaikanal (figure 1) while from 1989 we have in addition observations from the double pass spectrograph installed at the Indian Institute of Astrophysics, Bangalore Campus.

The observations consist in obtaining spectra in the K line region in the integrated sun light. We have done the disc integration by covering the mirror M_3 with a diffusing screen coated with white pigment. We have then allowed this diffused light to fall on the slit without the objective O_1 on the path. We have obtained the spectra on 103a-0 emulsion using the grating in the VI order of the K line where the dispersion is ~ 9.4 mm/Å.

At the Bangalore campus, we use a double pass spectrograph fed by a two mirror coelostat system without any imaging optics in between. We scan the K line profile by rotating the grating and record the line profile with a 1P21 photomultiplier and associated recording system (Kariyappa *et al.* 1993).

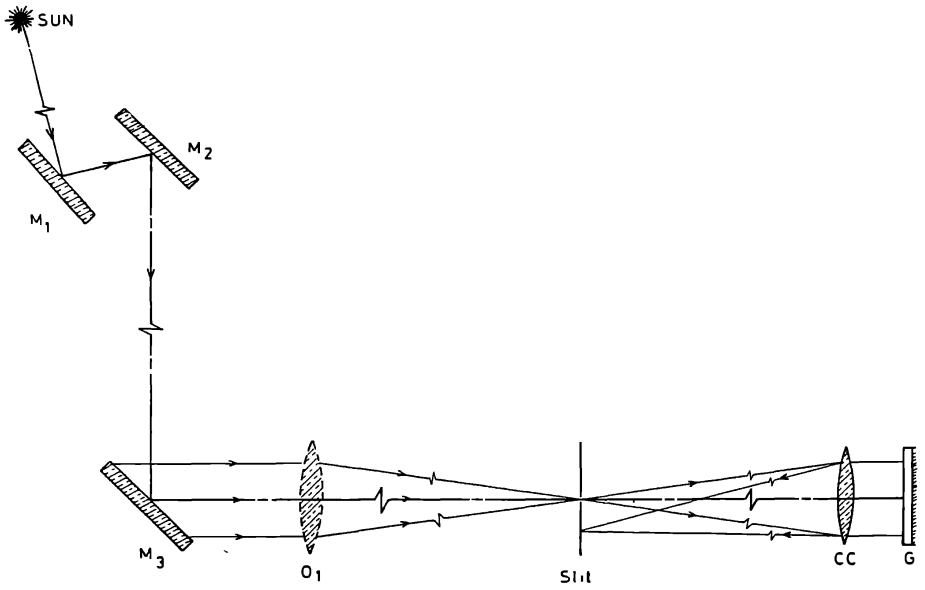

Figure 1. Schematic layout of the Kodaikanal Solar Tower Telescope and spectrograph. M_1 & M_2 coelostat mirrors of dia. 60 cm; M_3 mirror identical to M_1 and M_2 folds the incoming beam and feeds the sunlight to the objective O_1; O_1 objective dia. = 38 cm, f = 36 m, removable; Spectrograph : Littrow type; CC collimator cum camera lens, dia. = 20 cm; f = 18.3 m; G grating 600 grooves/mm and of size 200 mm × 135 mm.

3. Data reduction

We converted the profiles to the intensity scale following the standard photometric reduction procedure. We then calibrated them in absolute intensity units using the reference intensity at λ3935.16Å as 13.8% of the continuum intensity for centre of disc measurements (White

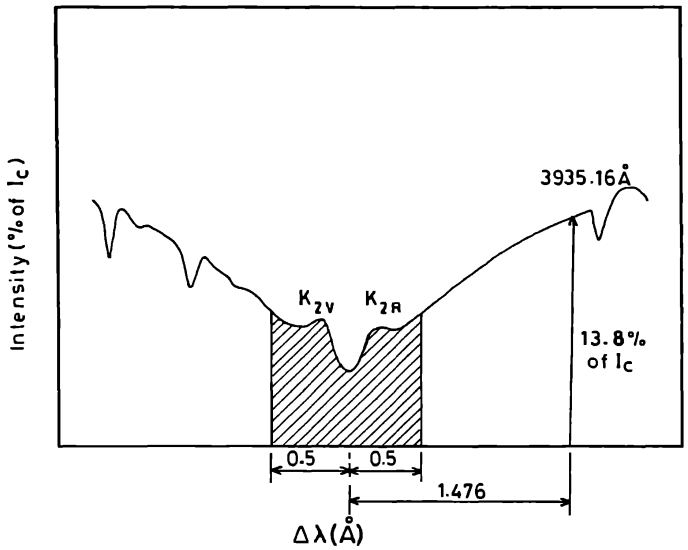

Figure 2. Typical K line profile showing the self reversed emission in K_{2V} and K_{2R}. The intensity I_W at 3935.16Å is 13.8% of the continuum. The area of the hatched region representing the flux from the sun in the 1Å pass band is the K-1Å index.

& Suemoto 1968) and as 16.5% of the I_c for full disc measurements. This calibration factor for full disc contains the limb darkening function.

4. Results

K emission index : The parameter that quantifies best the chromospheric emission in the K line is the emission index which is the integrated intensity (or flux) over a 1Å band centred on the K line (figure 2). This index is proportional to the total emission from the chromosphere (Sivaraman *et al.* 1987). This being also the index used for the measurements of chromospheric emission from sun like stars, comparison of the chromospheric behaviour of sun like stars with the sun becomes easier. We have computed this index from the K line profiles for all the days of our observation and the plot for the years 1974-1991 is shown in figure 3. We find that the chromospheric emission output during the solar maximum years 1989-90 rose by 35% compared to that in the minimum years of 1986 and 1987.

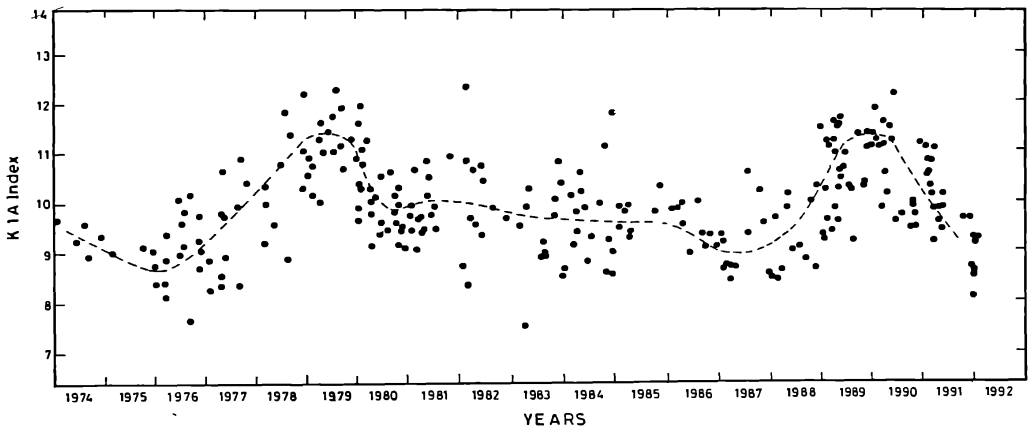

Figure 3. K-1Å index versus years.

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