OBSERVED LARGE-SCALE EAST-WEST ASYMMETRIES IN THE SOLAR CORONA

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Abstract. Some new results are presented and discussed about the problem of the asymmetries in the observed corona between the east and west limbs. "Local effects" are analysed. Relations within one eleven-year solar activity cycle are shown.

Key words: Solar Corona – Asymmetries – Emission Lines – K-Corona

1. Introduction and Data Processing

The problem of the observed east-west limb asymmetries in the measurements of the solar coronal emission lines intensities was discussed by several authors (Trellis, 1959; Sýkora, 1971; Tyagun and Rybanský, 1981; Tritakis *et al.*, 1988). We propose here an analysis which gives an indication about the local effects on the Pic-du-Midi complete set of values. The data were obtained by the coronal Pic-du-Midi survey for the green (5303 Å), red (6374 Å) emission line intensities (1944-1974) and the K-corona (1964-1976). The parameter used in this study is the daily asymmetry ratio. For each complete observing day this is the ratio between the average of the observed values (line intensities or Pb) from 30 to 150 with a 5 step position (Ie or Pbe) for the east limb, and 210 to 330 for the west limb (Iw or Pbw).

2. Annual Variations of the Asymmetry Coefficient

Fig. 1 shows the annual variations of the E-W asymmetry ratio for the 5303 Åline and the K-corona with an 18-month-scale X-axis. R(5303 Å) (straight lines), R(6374 Å) and R(K) (dashed lines) are the values of the asymmetry coefficient, respectively,

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calculated in the periods 1944-74, 1944-74 and 1964-76. For these three components of the corona the results present similar annual variations with a minima of the asymmetry in summer and maxima in winter plus a relative maxima in the middle of spring. The amplitude and the mean level of the curve for the green line are greater than that for the K-corona. We must keep in mind that the emission line intensities are sensitive to the square of electron densities at the temperature of ions. Pb values are sensitive to the total number of electrons along the line of sight. All the averaged values are greater than 1 but Trellis (1959) and Sýkora (1971) have noticed that this mean level is different for data coming from different coronal stations and deduced that differences may be due to instrumental effects. For the Pic-du-Midi set of data the measurements of the line intensities and the K-corona polarization were performed with two quite different instruments, using different calibration and observing mode process (visual and photoelectic). So we can think that the similarities shown in Fig. 1 are not produced by systematic instrumental errors.

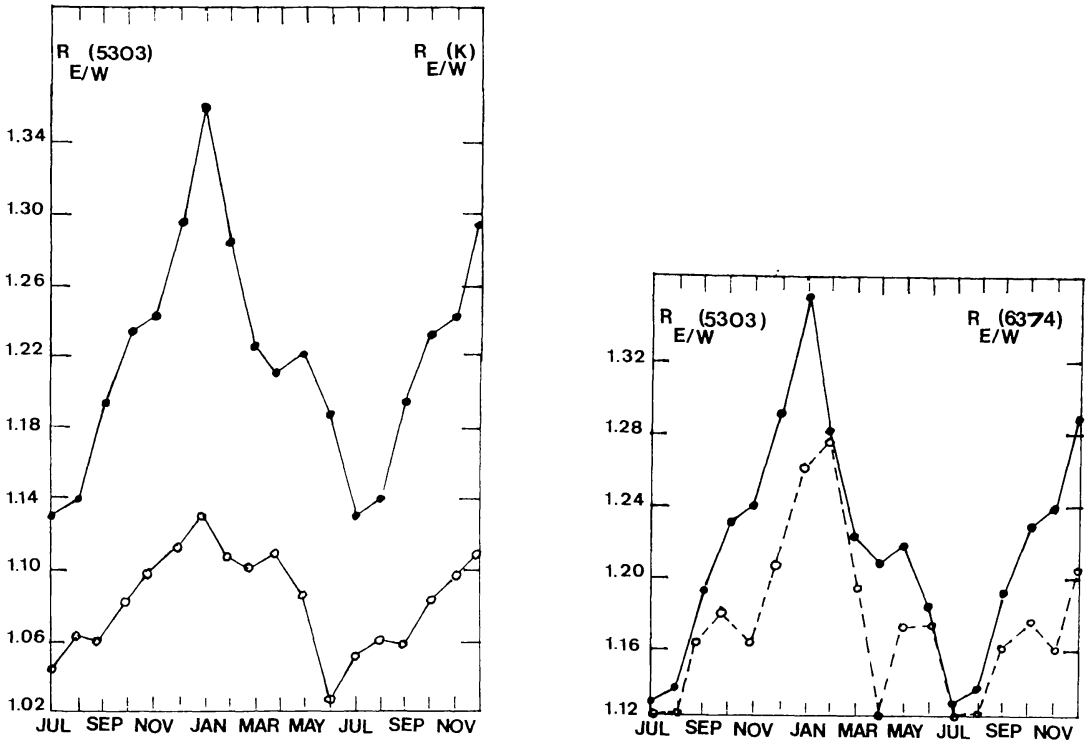

Figure 1. Annual variations of the asymmetry coefficient.

3. Relations to Solar Activity

In order to evaluate the effects of the solar activity we separated low and high values data. RQ and RA are the asymmetry coefficients obtained by selecting values of line

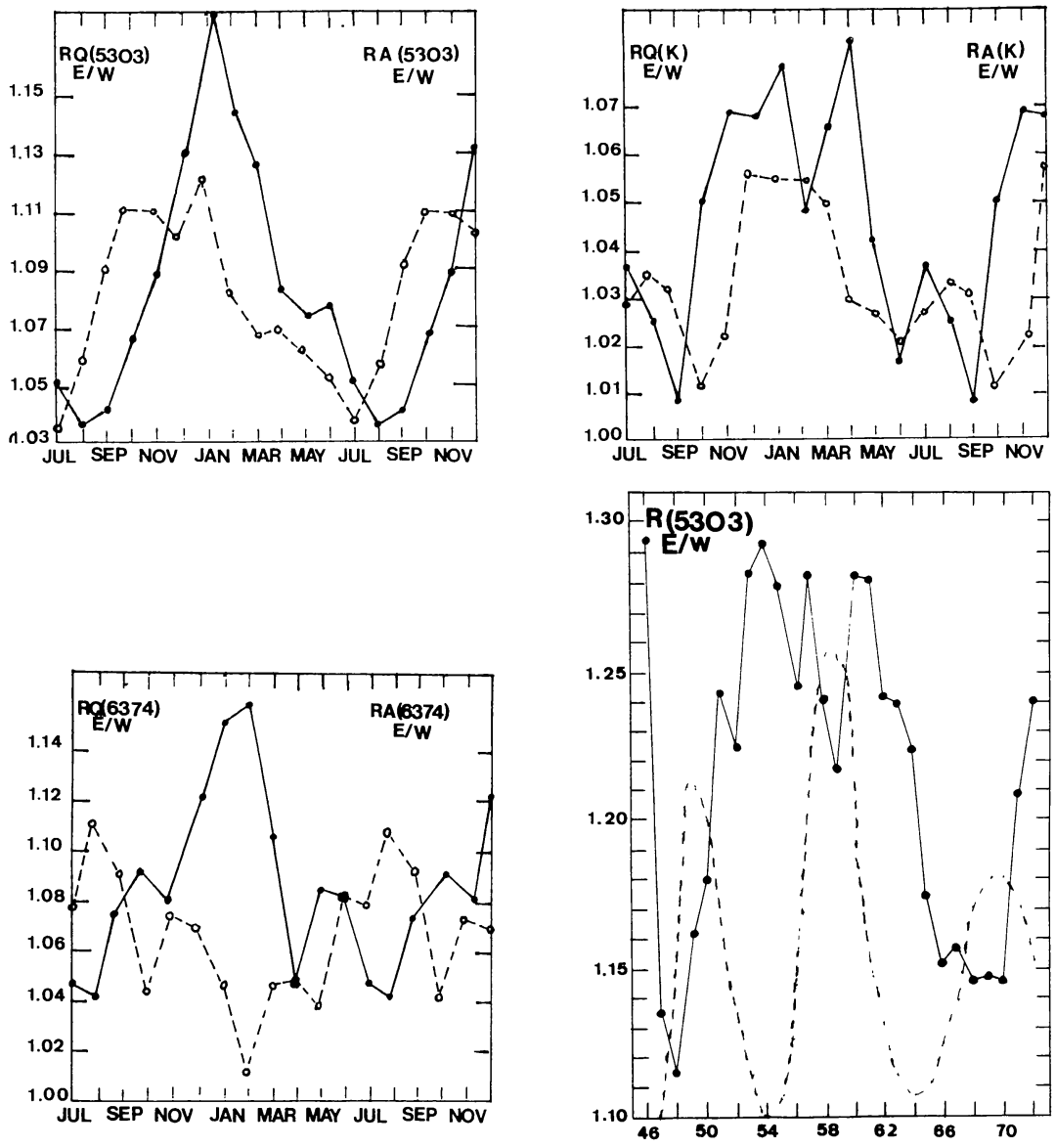

Figure 2. Relations to solar activity.

intensities, respectively, smaller or greater than a threshold value. This is a rough approach of an imaginary "quiet" or "active" corona. There is no significant difference between the annual average levels of the curves for "quiet" (straight lines) and "active" (dashed lines) corona. For the K-corona and the green line the annual variations are in the same way for "quiet" and "active" corona and the amplitude of the curves is greater for the "quiet" corona. This is an indication that it does not seem to be an effect of a systematic error in the altitude of the observed field on each opposite limb.

Moreover, the situation is quite different for the red line: in this case the two curves clearly are in an opposite phase. It is well known that the green line and the K-corona have closed relations to the solar activity. The red line produced in regions at 1 MK has not the same property. In the same way we can compare the time variations of the total number of sunspots (Fig. 2 bottom right, dashed line) and the daily asymmetry coefficient fitted on a five years period for the green line (straight line) for three solar cycles (1944-74). The asymmetry coefficient get relative minimum values at periods closed to the maxima of the solar cycle, and relative maximum values near the minima of the cycle.

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