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UNEQUAL OPTICAL EMISSIONS BETWEEN THE EAST AND THE WEST PART OF THE SOLAR CORONA

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ABSTRACT

We extent the results of previous studies where the east part of the solar corona had been found brighter than the west in most of the cases. In the present article, conclusions which have been derived by data obtained by the Kislovodsk observatory, support very well the aspects which have been stated by previous studies based on the Pic-du-Midi data. It is very hopeful that two data sets obtained by two observatories located far each other and operating in quite different time spans have driven towards the same results. Perhaps this fact gives the right to think seriously on the possibility the east part of the solar corona to be brighter than the west, in most of the cases.

INTRODUCTION

Unequal optical emissions between the east and the west part of the solar corona have been already detected in both the far and the near past /2/, /3/, /4/, /5/, /6/, /7/. Althought the results in all the references appear confident, they include the disadvantage that the conlusion of the unequal emissions mentioned above have been derived by a single data set. In most of the cases the Pic-du-Midi data set has been used while in two additional cases small samples of the Lomnisky Styt and the Irkutsk observatories have been studied. In the following, we present confident cases of east-west asymmetries in the solar corona emissions which have been arised by the Kislovodsk observatory data set of the green line intensities. The results of this study are impressively positive and support very well the aspect that the east part of the solar corona appears brighter than the west in most of the cases.

PREDOMINANT BRIGHTNESS OF THE EAST SOLAR CORONA IN RELATION TO THE WEST

Data obtained in the Kislovodsk observatory concern to daily green line intensities measured every 5 deg around the solar limb from 1971 to 1991. Figure 1 contains all the Kislovodsk data available and has been made after the following processing. At the begining, we have examined if there is a sufficient number of observations in both the east and the west part of the solar corona. Various reasons of statistical confidence has made us to insert criteria of minimum sample sizes which should be involved in the calculations. If we consider that the effective part of the solar disk extents between $\pm 60^{o}$ on both sides of the equator and the observations are obtained every 5 deg, an ideal sample size of observation on each side of the solar corona should be 25

measurements per day of observation.

After a serious consideration of observation losses and gaps, the minimum sample size criteria which have been inserted are cosistent with 10 measurements on each side of the solar corona at least as well as a sample size difference between the two sides not less than 6. The purpose of this sample size liminations is to protect to some extent the confidence of our results from the induction of very unequal sample size effects between the east and the west solar corona. Sample sizes which finally participate in our calculations have been tabulated in the table 1. All the data which have been satisfied the above mentioned criteria they have been separated in 27 time series which start from the 27 foremost dates of the record and contain data every 27 days. In this way, each time series contains data with time lag of 27, that is data which correspond to the same more or less areas after succesive solar rotations.

TABLE 1 Total number of daily observations obtained by Kislovodsk observatory which participate in our calculations.

TIME SPAN	TOTAL NUMBER OF DAILY OBSERVATIONS	NUMBER OF OBSERVATIONS THEY DO NOT FULFIL CRITERIA	NUMBER OF OBSERVATIONS THEY PARTICIPATE IN OUR CALCULATIONS
1971-1991	2265	378	1887

In the following, we have calculated the asymmetry coefficient A=(E-W)/(E+W), where E, W the mean intensity within the latitudinal zone ±60 ^{o} on both sides of the solar equator of the east and the west solar limb respectively. In the Figure 1 the number of cases for each of the 27 time series where the east part of the solar corona appears brighter ($I_E > I_W$) or fainter ($I_E < I_W$) than the west, has been depicted. From this figure, it is more than evident that the number of cases where the east part is brighter than the west predominate by a factor of 3 to 4.

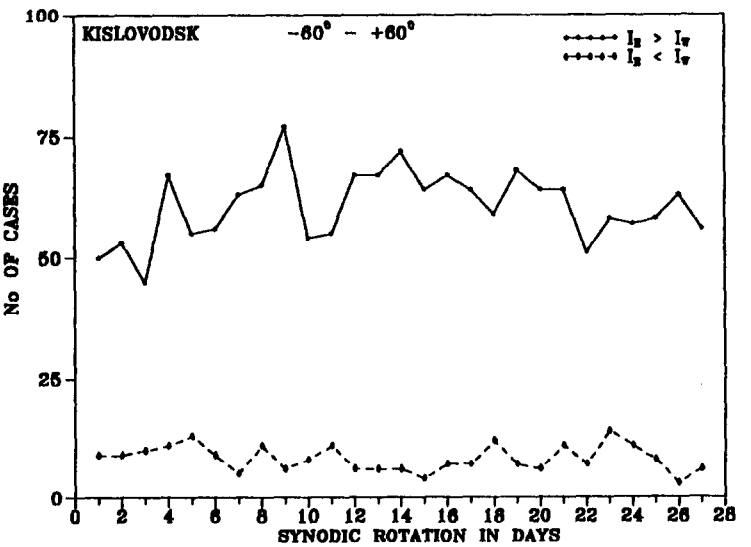

Fig. 1. Number of cases where the east part of the solar corona appears brighter ($I_E > I_W$) or fainter ($I_E < I_W$) than the west in the green spectral emission.

In a recent paper, all the possible errors which could introduce a pseudo-asymmetric emission between the east and the west part of the solar corona have been discussed /1/. The final, conclusion of that article was that atmospheric diffusion during early observations could overestimate the east limb measurements. In our effort to exclude the possibility of a diffusion error, in the present study we have separated the data set under consideration in two samples. The first sample contains all the early observations that is, observations made before 07.30 UT while the second contains those made after this critical time. The Figures 2 (a) and 2 (b) are similar to the Figure 1 and represent results which have been derived by the application of the same processing which has been made for the Figure 1, on the two data samples mentioned previously. It is evident that the east part of the solar corona appears brighter than the west in both of the samples that is, the predominance of the east brightness on the west is indepentent from the time when the observations have been made. In other words, east-west asymmetric emission has not been found to be introduced by atmospheric diffusion.

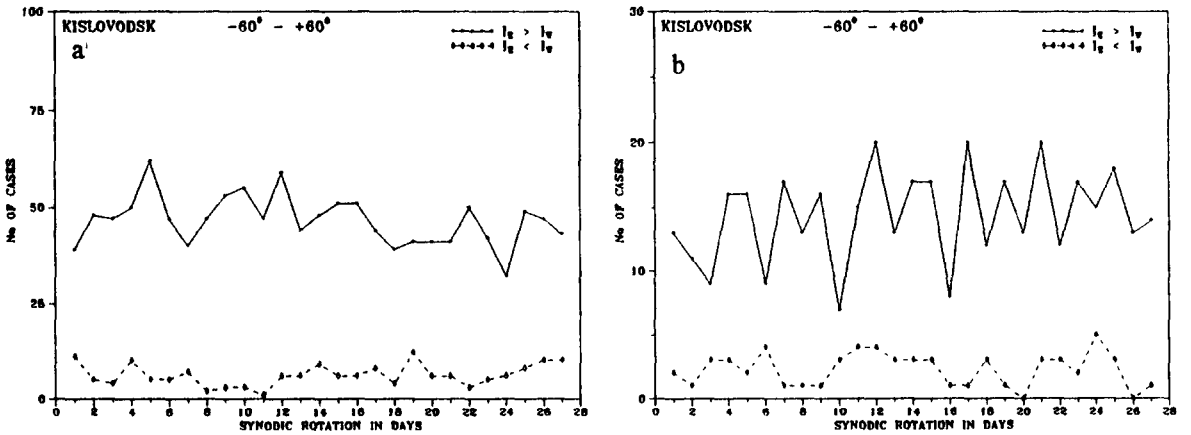

Fig. 2. (a) Number of cases where the east part of the solar corona appears brighter ($I_E > I_W$) or fainter ($I_E < I_W$) than the west in the green spectral emission for observations obtained before 07.30 UT, when the sun is located close to the horizon and the diffusion error predominates. (b) Similar to (a) concerning to data obtained after 07.30 UT, when the sun is located far from the horizon and the diffusion error has been minimized.

In the Figure 3 the variation of the green line intensity for each solar quarter for the time span 1971-1991 has been depicted. If we take in mind the correspondance 1=Northeast, 2=Southeast, 3=Northwest, 4=Southwest, it is very interesting that the Northeast solar quarter which in the time span 1946-1970 had been found to appear brighter than the others, in the period 1971-1991 does not predominate any more but a slight excess of the southeast quarter brightness is obvious /7/.

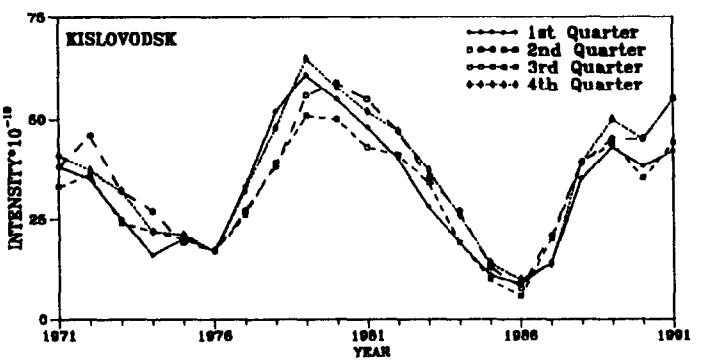

Fig. 3. Yearly values of the green line intensity calculated in each solar quarter, separately.

This probably has to do with a new 22-year solar magnetic cycle which started at the beginning of the seventies and reversed the principal polarity of the sun transforming in the the well-known N-S asymmetry of the solar magnetic field in S-N.

DISCUSSION

The analysis of the data set obtained by the Kislovodsk observatory came to support in the best way the aspect we have already presented in previous communications. Detailed studies on the Pic-du-Midi data set have been pointed out that the east solar corona part appears brighter than the west in all the optical emissions. The same result in the most impressive way has been also come out from the Kislovodsk data, reducing drastically the possibility that this inequality has been induced by some kind of error. It is noteworthy that positive cases that is, cases where the east part of the corona appears brighter than the west, have been counted three to four times more than the megative. After all, it is very difficult for somebody to accept that two quite different data sets obtained by two different observatories far each other could present the same effect which has been introduced by the same reason. Nevertheless, additional verification by data sets of other observatories is necessary before we start thinking about physical mechanisms which could make the east solar corona to appear brighter than the west in all the optical emissions.

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