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Periodic Variations in the Coronal Green Line Intensity and their Connection with the White-light Coronal Structures

Milan Minarovjech*, Milan Rybanský & Vojtech Rušin, *Astronomical Institute of the Slovak Academy of Sciences, 05960 Tatranská Lomnica, Slovak Republic.*
**e-mail: milanmin@ta3.sk*

Abstract. We present an analysis of short time-scale intensity variations in the coronal green line as obtained with high time resolution observations. The observed data can be divided into two groups. The first one shows periodic intensity variations with a period of 5 min. the second one does not show any significant intensity variations. We studied the relation between regions of coronal intensity oscillations and the shape of white-light coronal structures. We found that the coronal green-line oscillations occur mainly in regions where open white-light coronal structures are located.

Key words. Sun—solar corona—5 min variations—solar activity.

1. Introduction

The heating mechanism of the solar corona is one of the important but unsolved problems in solar physics. It is supposed that this heating is done through certain types of waves (e.g., Ulmschneider 1991). The 5 min. oscillations are one of such candidates. The oscillations have already been observed many times, not only in the emission-line corona but in the white-light corona as well (Tsubaki 1988; Rušin & Minarovjech 1994; Singh 1997). However, regions in the solar corona where these oscillations were observed is not known yet. In this paper we will show a possible connection between 5 min. intensity oscillations of the green-line corona and corresponding structures in the white-light corona (WLC).

2. Observations

Since 1990, observations of the green (530.3 nm) and red (637.4 nm) coronal lines have been made with a photoelectric photometer at the Lomnicky Stit coronal station (Minarovjech & Rybansky 1992). This photoelectrical method is based on spectral flux measurements in the wavelengths where coronal emission lines are located. To subtract scattered light in the spectrum, a nearby continuum is measured simultaneously. Measurements are expressed in absolute coronal units. We note that 'final' coronal intensity is independent neither of the shape nor of the Doppler shift of the emission lines. Measurements of the coronal line intensities are made, mostly, at the height of 55 arcsec above the solar limb. The photometer can provide coronal line

intensity measurements with time resolution of 0.04 s. However, an averaging over 2.56 s is usually applied, and at the fixed position angle the measurements are continued for 20–30 min. (the coronagraph is automatically guided). Examples of such measurements are shown in Rušin & Minarovjech (1994). To compare the green-line oscillations and the corresponding WLC structures, data from Manua Loa High Altitude Observatory MARK-III K-coronameter (Mk3) were used.

3. Data processing

We have processed 541 records of the green-line oscillations and corresponding white-light images corona images as measured on the Mk3 K-coronameter. For each record of green-line data, we computed standard deviation and fast Fourier transform (FFT). The results can be separated into three groups. The first one represents quiet records without significant changes in the coronal line intensity. The second one represents records with maximum FFT power in the range of 250–450 s (5 min.). The last one contains all records that did not belong to the former two groups. These data were not taken into an account in the following studies. To obtain corresponding WLC structures, the qualitative Mk3 image data were processed using digital unsharp masking. Resulting shapes of the WLC structures situated in the position angles corresponding to those of green-line oscillations can also be separated into three groups: open, closed, and uncertain, respectively. We note that such a separation is difficult in cycle maxima, where very complicated systems of structures occur both in the WLC and green-line corona. The separation of WLC structures around solar cycle minima is possible with higher precision. Examples of separation are depicted in Fig. 1. The white line represents the patrol measurements of the green-line intensity. The position angles where 5 min. oscillations of the green-line intensity occur are marked with white circles, while regions quiet in oscillatory variations are marked with white squares.

4. Results and short discussion

Of particular interest here is the relation between regions of coronal green-line oscillations and the shape of corresponding WLC structures. The observations of the green-line oscillations were made mostly at the peaks of the green-line intensity. The local intensity maxima in the green-line corona and WLC structures obtained from processed Mk3 measurements are correlated, as was discussed by Minarovjech (2000). The data analysis shows that quiet records of coronal line intensity are found where the closed WLC structures are located. On the other hand, the records of coronal line oscillations are found where the open WLC structures are located. As a next step, an attempt to observe short period oscillations in the green-line intensity has been done. The presented results make possible an explanation in different behaviour of data results as discussed by Tsubaki (1988) in the green corona line intensity. In order to find more exactly the connection between the white-light corona and the green-line oscillations, simultaneous observations of white-light and emission-line coronae are required.

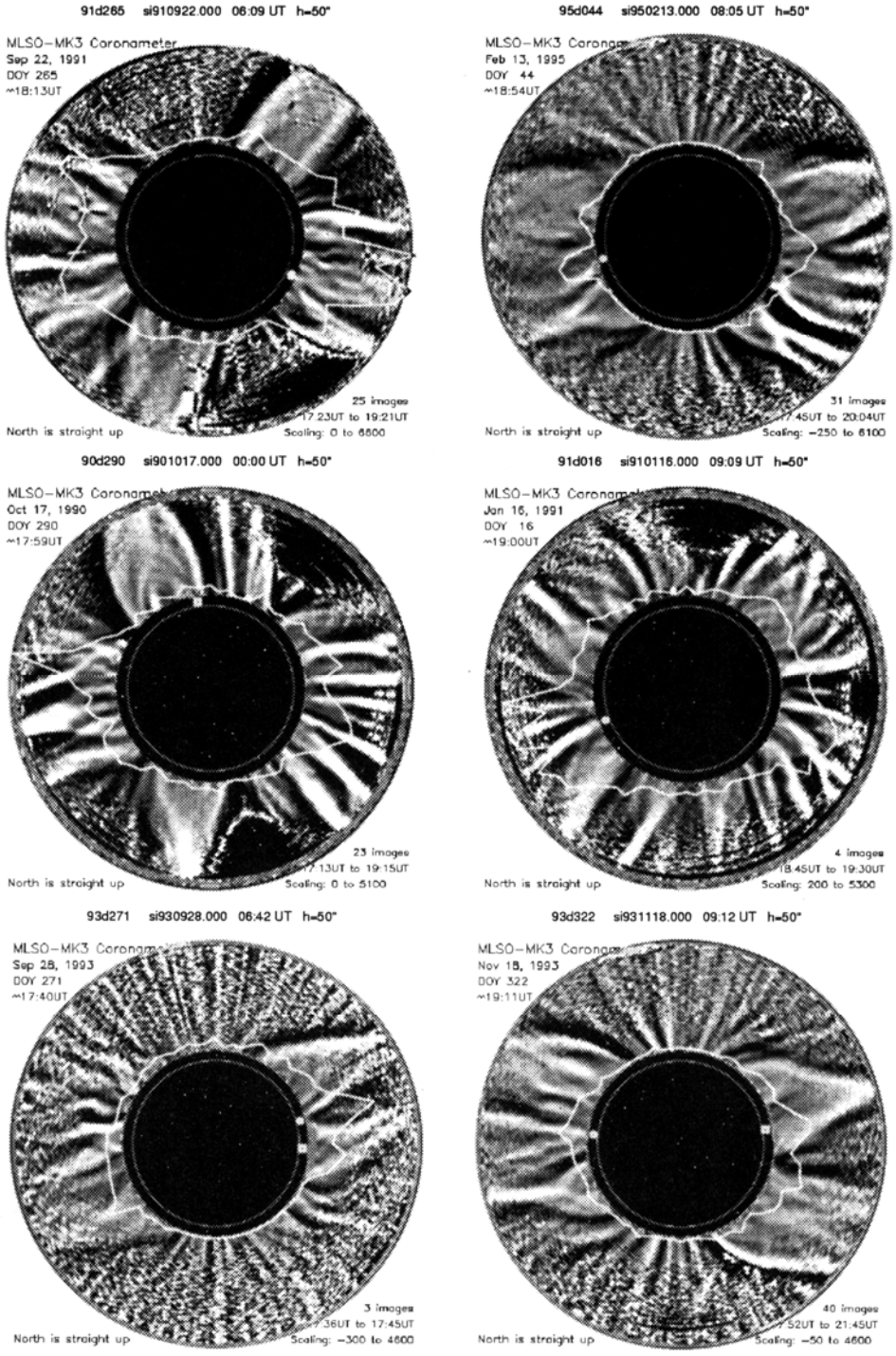

Figure 1. Position angles where the 5 min. oscillations in the green line intensity is observed and is not observed are shown with white circles and squares, respectively. White line polar diagram depict the green line patrol intensity measurement.

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