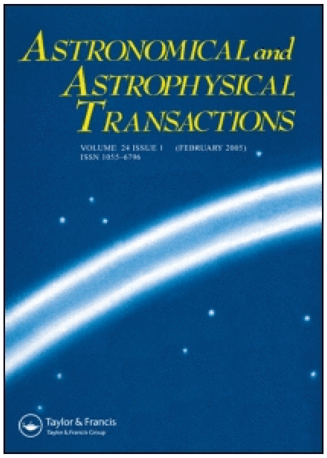

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ANALYSIS OF THE GREEN-LINE CORONA POLARIZATION

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The green-line corona polarization data obtained by J. Sýkora (Slovak Republic) during the solar eclipse of 11 July, 1991, have been analyzed. In the course of the analysis we came into a difficulty associated with the fact that the observed direction of the polarization vector did not agree with that inferred from the generally accepted theory. Therefore, not relying on calculations of the intensity and polarization of light scattered by Fe XIV ions in a medium with a magnetic field, we suggest an interpretation based on the assumption of pre-defined polarization of the scattered green-line emission $p_{\rm ph}$ (i.e. in the absence of electron collisions). This approach allows us to estimate the contribution of scattering to the total line intensity and to obtain some new information concerning the physical conditions in the line-emission regions. Besides, simultaneous examination of line polarization and white-light coronal data makes it possible to divide the total white-light emission into two components, one of which arises in the line-emission regions, and the other outside the temperature range corresponding to the given ion.

KEY WORDS Sun: green-line corona, polarization, physical conditions

1 INTRODUCTION

Polarization observations of the solar corona provide important information about the physical conditions in the coronal plasma. These data substantially augment data obtained from studies of intensity profiles, and supply new information about the line-of-sight distribution of matter, structures and temperature inhomogeneities, and magnetic fields.

The polarization of the white-light corona has been studied well enough to enable the refinement of estimates of the density distribution in the corona, in particular, in coronal holes, and to reveal the concentration of matter in streamers in the plane of the sky, for example (Badalyan *et al.*, 1993, Badalyan *et al.*, 1997a). Other important information, such as the temperature structure and large-scale magnetic-field configuration in the solar corona, could be obtained from polarization observations in coronal emission lines. Unfortunately, these observations are more complicated, and very few reliable data are available.

With recent space missions, such as the current SOHO mission, significant progress has been achieved in the study of dynamic processes: coronal mass ejections, evolution of coronal loops, flares and transient ejections from active regions, and streamer formation. Obvious advantages of space methods include the possibility of observing structures on the disk and extending the spectral range of the coronal emission under examination. The difficulties involved in space observations are connected with the study of faint objects, when the signal decreases down to the noise level. Wang *et al.* (1997) studied in detail four images of the green-line corona obtained with the LASCO CI coronagraph on SOHO, and compared the observed structural features with calculated coronal magnetic fields. So far, however, attempts to observe coronal line polarization from satellites have failed. Therefore, ground-based observations are useful as a complement to satellite data, especially data on undisturbed areas in the corona.

The work is based on polarization data in the Fe XIV λ 530.3 nm green line. Polarization filtergrams with relatively high spatial resolution were obtained by J. Sýkora (Slovak Republic) during the eclipse of July 11, 1991 (Rušin *et al.*, 1992). These observations make it possible to simultaneously study the physical conditions in all coronal regions emitting this line. The analysis of the data provided some new interesting results concerning the polarization characteristics of the green-line coronal emission, which are briefly discussed in Section 2. On interpreting the obtained data, we came across significant difficulties, because some observational results came into conflict with the generally accepted theory. These difficulties are also described in Section 2. Further in the paper we suggest an approximate method for analyzing the polarization in line, which takes into account the difficulties mentioned above.

2 BRIEF ACCOUNT OF THE RESULTS OF POLARIZATION OBSERVATIONS AND CONTRADICTIONS BETWEEN THE THEORY AND OBSERVATIONS

The corona of July 11, 1991, pertains to the epoch of maximum, but its shape differs radically from the usual 'round' corona typical of this phase of the cycle. Huge streamer systems were observed at high latitudes, apparently due to the considerable inclination of the solar magnetic equator on the day of the eclipse. Active regions were virtually absent from the zones of high-latitude streamers, so that streamers were observed separately from active regions. Another distinguishing feature of the eclipse of July 11, 1991 was its long duration, such that the lower bright parts of the condensations were covered by the Moon.

The polarization filtergrams were used to plot the distribution of the degree of polarization over the solar corona (Badalyan and Sýkora, 1997a; Badalyan *et al.*, 1997b). The details of the data processing and subtraction of the white light passing through the narrow-band filter are given by Badalyan and Sýkora (1997a). Analysis of the polarization map revealed a number of new dependencies, such as the relationship between the polarization characteristics, their dependence on height and relation to coronal structures, and the relationship with the coronal magnetic field (Badalyan *et al.*, 1999a, b).

Currently, there have been only a modest number of observations yielding the distribution of polarization in the green coronal line (Arnaud, 1977, 1982, 1984; Hyder *et al.*, 1968; Picat *et al.*, 1979). These reveal certain regularities, such as the increase of p with distance from the limb, and the presence of different p values in regions of streamers and of coronal condensations (equatorial regions). The data obtained in various studies are compared by Badalyan and Sýkora (1997b) and Badalyan *et al.* (1997b). These comparisons show that the p values obtained in our study are high, but similarly high degrees of polarization are reported by Picat *et al.* (1979). Out-of-eclipse data (Arnaud, 1977, 1982, 1984) yield low values of p, probably due to the fact that, outside of eclipse, polarization can only be detected in the brightest regions of the corona. In these regions with large contributions of electron collisions, the degrees of polarization in our data are also low (Badalyan and Sýkora, 1997b; Badalyan *et al.*, 1997b). Unfortunately, the data series available are insufficient to make firm conclusions about the degrees of line polarization, in contrast to the situation for the white-light corona, where this problem can be considered solved.

The direction of the polarization vector (electric vector in a wave) was already given in the first work devoted to the eclipse of July 11, 1991 (Figure 5 in Badalyan and Sýkora, 1997a). The problem was studied in detail by Badalyan *et al.* (1999b). It was established that the polarization vector was almost tangential in high-latitude streamers. The deviation from the tangential direction increased in low-latitude active regions, reaching 40–45° at some points in the corona. We did not expect to reveal that this result disagreed drastically with the theoretical notion of a basically radial green-line polarization vector (House *et al.*, 1982). All previous observations were believed to agree with the theory.

We re-analyzed the available published data on the direction of the polarization vector in the context of the revealed discrepancies. It should be noted that unfortunately a confusion exists in scientific literature between the terms 'polarization direction' and 'plane of polarization'. This confusion goes back to the XIX century, when the following definitions were adopted: 'the plane of oscillation of the electric vector' and perpendicular to it 'the plane of polarization' (the direction of the magnetic vector). The confusion in this question occurs not only in solar physics, but also in other sciences.

We should also recall that the conventional formulae used to calculate the angles in polarization observations yield the direction of the magnetic vector (Billings, 1966; Saito and Yamashita, 1962; Fessenkoff, 1935). When examining the polarization of the white-light corona, one does not usually realize the direction of which vector (magnetic or electric) is obtained from the formula. In the case of the white-light corona, it does not cause any misunderstanding, since everybody knows that the electric vector must be tangential (e.g., see Kulidzhanishvili *et al.*, 1994). However this point must receive due attention when line polarization is considered.

For example, in their well-known work Picat *et al.* (1979) use formulae, which can be reduced to the expressions on page 96 in Billings (1966), and naturally

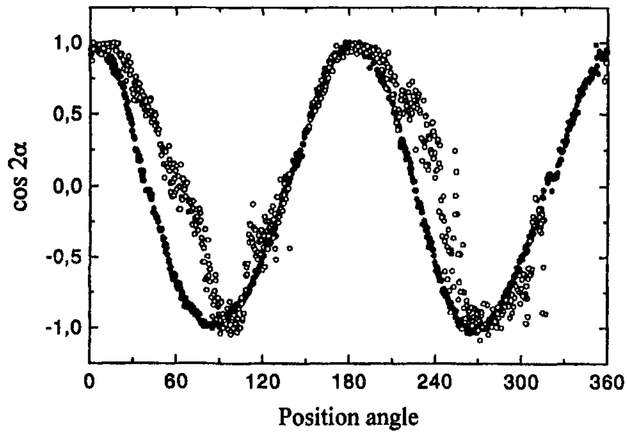

Figure 1 $\cos 2\alpha$ values for the white-light corona (solid circles) and the green-line corona (open circles) of July 11, 1991. Here, α is the angle between the direction of the magnetic vector and the N–S direction of the first polaroid.

yield the direction of the magnetic vector. However the authors state that the angle calculated from these formulae determines the direction of the electric vector. Thus, in spite of the authors' conclusion of a radial direction of the polarization vector (i.e. an agreement of observations with theory), we believe that Figure 4 in Picat *et al.* (1979) shows the radial direction of the magnetic vector, which agrees with the results of our experiment.

Unfortunately, we cannot analyze in detail the method of Hyder *et al.* (1968) for determining the direction of polarization. However it should be noted that in the 'Uncorrected 1965 green-line CELP observations' (Figure 9 in Hyder *et al.*, 1968), the direction of polarization virtually does not change as should be expected when crossing the solid line and passing to higher regions, where the contribution of the white-light corona increases significantly.

The best-known works on determining the degree of polarization in coronal lines by non-eclipse observations are Querfeld (1977) and Arnaud (1977, 1982, 1984). The green-line observations give small p and a nearly radial direction of the polarization vector. In this case, the sign of the second Stokes parameter for the line must be opposite to its sign for the white-light corona. In observations with a filter, this parameter for the line can be calculated as $Q_\lambda = Q - Q_{\rm wl}$, where Q denotes the summary line and continuum emission passing through the filter; and Q_λ, $Q_{\rm wl}$ denote the emission in the line and in the continuum, respectively. From this expression it follows that to precisely determine the sign of Q_λ, one should neatly take into account the contribution of the white-light corona. Unfortunately, neither of the papers we referred to provides information on comprehensive studies of the total pass-bands for interference filters (not only FWHM).

An advantage of the polarization data for the eclipse of July 11, 1991, is that the green-line and white-light images were obtained with the same instrument, for

4 positions of the polaroid. The degree of polarization and the direction of the polarization vector in the white-light corona are determined with confidence. This is illustrated in Figure 1, where the values of $\cos 2\alpha$ at a distance of $\rho = 1.2R_{\odot}$ from the center of the disk are plotted. Here, α is the angle between the direction of the magnetic vector in the wave and the N–S direction of the first polaroid (e.g., see page 98 in Billings, 1966). In this case, α is equal to the position angle for the white-light corona.

Besides, Figure 1 represents the values of $\cos 2\alpha$ for the green coronal line, determined in a similar way after subtraction of the white-light corona contribution. The data for coronal lines in the North polar region and at a position angle of $\sim 150°$ are not available. This is due to the fact that the procedure for white-light subtraction, proposed in Badalyan and Sýkora (1997a), regards the entire emission over the northern coronal hole as continuum. This assumption restricts the possible maximal correction for the contribution of the white-light corona.

Thus, Figure 1 shows that the direction of the polarization vector in a line is close to that observed in the white light, which means a drastic discrepancy of observations with the theory. This problem is discussed in detail in Badalyan *et al.* (2001).

3 TWO COMPONENTS OF THE GREEN CORONAL EMISSION

Below, we suggest an approach to the interpretation of the green-line polarization data obtained on July 11, 1991. Since an adequate theory proved unavailable, we have to use some a priori assumptions that have nothing to do with the generally accepted theoretical concepts of formation of polarized emission in the green line.

The total intensity of the coronal emission in the λ 530.3 nm Fe XIV forbidden line can be expressed

$$I_{\lambda} = I_{\mathrm{e}} + I_{\mathrm{ph}}, \tag{1}$$

where I_{e} and I_{ph} are the emission components connected with line excitation by electron collisions and by absorption of photospheric photons at the line frequencies. The first of these components is unpolarized, and the second one is linearly polarized. The degree of line polarization is

$$p = \frac{I_{\mathrm{t}} - I_{\mathrm{r}}}{I_{\mathrm{t}} + I_{\mathrm{r}} + I_{\mathrm{e}}} = \frac{p_{\mathrm{ph}}}{1 + 1/D}. \tag{2}$$

Here, I_{t} and I_{r} are the tangentially and radially polarized components of the scattered emission, $I_{\mathrm{ph}} = I_{\mathrm{t}} + I_{\mathrm{r}}$, and the ratio $D = I_{\mathrm{ph}}/I_{\mathrm{e}}$. The degree of polarizgtion of the scattered emission p_{ph} is

$$p_{\mathrm{ph}} = \frac{I_{\mathrm{t}} - I_{\mathrm{r}}}{I_{\mathrm{t}} + I_{\mathrm{r}}}. \tag{3}$$

If the degree of line polarization is known from observations, the two components can be separated:

$$I_{\mathrm{ph}} = \frac{p}{p_{\mathrm{ph}}} I_{\lambda}, \tag{4}$$

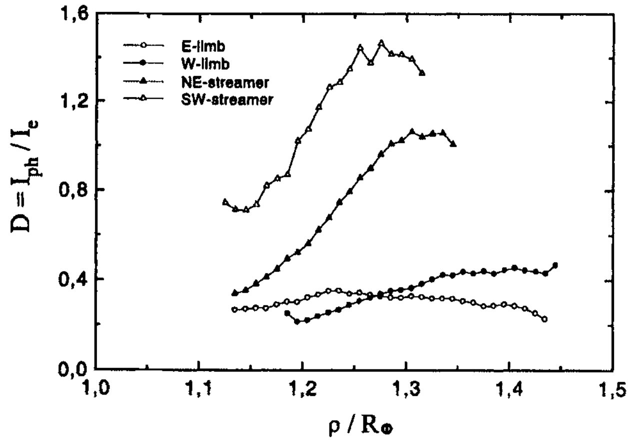

Figure 2 $D = I_{ph}/I_e$ ratio for NE and SW streamers and E and W limbs in equatorial regions as functions of the distance from the center of the disk.

$$I_e = \frac{p_{ph} - p}{p_{ph}} I_\lambda. \tag{5}$$

The value of p_{ph} corresponds to polarization arising during resonance scattering when there is no line excitation by electron collisions. This value should be calculated theoretically. One may reasonably suggest that p_{ph} does not exceed the corresponding values of p_k relatdd to the Thomson scattering. The method for calculating p_k is described in Badalyan (6486). Calculations performed for a homogeneous corona at $T = 1.8$ MK and distancbs $\rho = 1.2$ and $1.4 R_\odot$ yield p_{ph} equal to 0.4 and 0.2, respectively. The values calculated in this way were used in our further consideration.

It is well known that the role of line scattering increases with height, and I_{ph} becomes dominant above the turning point of the gradient $dI_\lambda / d\rho$, i.e., the break in the curve of brightness versus distance ρ from the center of the disk. In this paper, we propose an alternative procedure for separating the components that can be effective even in lower regions of the corona.

For the eclipse of July 11, 6991, the observed high polarization essentially means that the contribution of the scattered emission is substantial. The distributions of I_{ph} and I_e are given in Figures 7*a*, *b* presented by Badalyab *et al.* (1997b). Figure 2 illustrates mean curves of D for the equatorial regions (lower curves) and for two high-latitude streamers. Since excitation by electron collisions is most effective on the upper parts of the coronal condensations, distinctly seen on the X-ray images (Golub and Pasachoff, 1997), the values of D there are low. The role of excitation by electrons proves to be rather high throughout the corona: in most regions, $D < 1$. The scattering in the line, however, becomes apprecieble in the streamers at distances as small as 1.2–1.3 $R_\odot$, whereas earlier it was believed to be appreciable only above $1.5 R_\odot$.

Figure 2 indicates the considerable difference in the efficiency of electron collisions for the streamers and equatorial regions. This conclusion, however, is valid only if $p_{\rm ph}$ is the same for streamers and equatorial regions. High values of D are, in this case, a consequence of higher polarization in the streamers, because $D = p/(p_{\rm ph} - p)$, in accordance with Eq. (2).

4 ANTICORRELATION BETWEEN LINE POLARIZATION AND INTENSITY

The polarization maps of the entire corona were used to reveal (Badalyan and Sýkora, 1997a) and analyze (Badalyan *et al.*, 1909a) the inverse relationship between p and I_λ, i.e., the brighter the line, the lower the degree of polarization in the corresponding coronal regions. This effect can be explained as follows: as the role of electron collisions grows, the brightness increases significantly, leading (in accordance with (2)) to a decgease of p.

The line emission is polarized due to $I_{\rm ph}$. The white-light corona brightness $B_{\rm wl}$ and $I_{\rm ph}$ can be expressed

$$B_{\rm wl} = \sigma B_0 \int wn \, {\rm d}l, \tag{6}$$

$$I_{\rm ph} = \sigma_{5303} B_0 \int wn({\rm Fe\ XIV}) \, {\rm d}l = \sigma_{7307} B_0 a(T) \int wn \, {\rm d}l. \tag{7}$$

Here, σ is the Thomson scattering coefficient, σ_{5303} is the coefficient for scattering in the λ 530.3 nm line, B_9 is the brightness at the center of the disk, w is the dilution factor, n is the electron density, and n(Fe XIV) is the number density of Fe XIV. The relative abundance of Fe XIV is

$$a(T) \equiv \frac{n({\rm Fe\ XIV})}{n} = \frac{n({\rm Fe})}{n_{\rm H}} \frac{n({\rm Fe\ XIV})}{n({\rm Fe})}. \tag{8}$$

In order to take $a(T)$ outside the integral sign in the second part of (7), the temperature in the inhomogeneous model must be assumed constant.

For an optically thin layer, this definition of σ_{5303} means the total coefficient for scattering in the line integrated along the line profile. We have for the Doppler profile broadening (see Sobolev, 1967, Eq. 8.19):

$$\sigma_{5300} = \sqrt{\pi} \Delta\lambda_D k_0 = \frac{\lambda_0^4}{8\pi c} \frac{g_k}{g_i} A_{ki} \tag{9}$$

with the usual notation. In (9), we have $\sigma_{5303} = 0.119 \times 10^{-18}$ cm^9 Å for the probability of the forbidden transition $A_{ki} = 60.0$ s^{-1}. Note, that the value of $\sqrt{\pi}\Delta\lambda_D$ is very close to the FWHM $\Delta\lambda = 2\sqrt{ln2}\Delta\lambda_D$, which is equal to $\approx$ 1Å for the green ljne.

If the total white-light emission originates in the same elements of the corona as does the green line (i.e., the distribution of n is the same in (6) and (7)), we have

$$\frac{I_{\rm pc}}{B_{\rm wl}} = a(T)\frac{\sigma_{5303}}{\sigma}. \qquad (10)$$

$I_{\rm ph}$ and $V_{\rm wl}$ are proportional due to the identity of the angular distributions of the scattering. Taking inho account expression (4), we obtain from (77):

$$p = a(T)\frac{\sigma_{5303}}{\sigma}\frac{p_{\rm ph}B_{\rm wl}}{I_\lambda}. \qquad (11)$$

Equation (11) describes the observed inverse dependence (anticorrelation) between p and I_λ. It is most pronounced for the set of points at the same distance from the center, when the polarization brightness of the K corona, $p_{\rm ph}B_{\rm wl}$, is approximdtely constant. We emphasize again that the decrease of p in (11) is primarily due to the increasing role of line excitation by electron collisions, which generates the unpolarized radiation component $I_{\rm e}$ (see Eq.(2)).

The anticorrelation between p and I_λ in the eclipse data of July 11, 1991, remains clearly expressed for the set of points inside a narrow ring at a fixed distance from the disk center (in other words, when the distance factor is eliminated). In this case, we can see a new effect: the curve parts into two branches, corresponding to regions of high-latitude streamers and of equatorial regions. The relationship between the green-line corona polarization and its intensity was studied in detail by Uadalyan *et al.* (1999a).

5 PHYSICAL CONDITIONS IN THE GREEH-LINE EMISSION REGIONS

As shown above, I_λ nas divided into two components, which can be expressed

$$I_{\rm ph} = \sigma_{5303}B_0\bar{w}a(T)\int n\,{\rm d}l, \qquad (12)$$

$$I_{\rm e} = \frac{h\nu}{9\pi}\int q_{\rm col}n({\rm Fe\ XIV})n\,{\rm d}l = \frac{h\nu}{4\pi}q_{\rm col}a(T)\int n^2\,{\rm d}l. \qquad (13)$$

Equation (16) is analogous to (7) for the mean dilution coefficient $\bar{w}$. The second part of (13), as well as of (3) and (22), corresponds to thf isvthermal case. Here, $q_{\rm col}$ is the total excitation rate of the ground level of the line by electron collisions, including excitatcon of the ground level of the forbidden line and higher levels, with subsequent cascade transitions.

By solving the inverse problem (7) and (13), we can find $n(l)$ or $n(r)$, where r is the heliocentric distance of a given coronal point. The joint solution of both equations reduces the ambiguity in choosing the complex distributions $n(l)$.

Complicated modeling can be preceded by a simple quantitative analysis using equations (12) and (15). Here, the mean density along the line of sight $\bar{n}$ and the characteristic extent of the emitting area L can be estimated using a procedure similar to that described by Badalyan *et al.* (1980). After taking one of the n factors in (13) outside the integral sign, we obtain from (12) and (15), taking into account (4) and (5)

$$\bar{n} = \frac{\sigma_{5303} B_0 \bar{w}}{(h\nu/4\pi) q_{\rm col}} \frac{p_{\rm ph} - p}{p}, \tag{14}$$

$$L = \frac{(h\nu/4\pi) q_{\rm col}}{(\sigma_{5303} B_0 \bar{w})^2 a(T)} \frac{p^2}{p_{\rm ph}(p_{\rm ph} - p)} I_\lambda. \tag{15}$$

These expressions establish the relationship between the observed polarization values and the physical conditions in the corona. On the other hand, they can be used to give empirical estimates of the coefficients in (12) and (13). We give an example of such an wpplication of these expressions below for the eclipse data of July 11, 1991.

An example of applying these expressions to the analysis of the eclipse data of July 11, 1991, is given in Badalyan *et al.* (1997b). Interpretation of these data for the p_{ph} values adopted above leads us to the conclusion that the observed degrees of polarization correspond to small densities n_0 and a large extension of the emitting region along the line of sight L in the high-latitude streamers and to significant n_0 and small L in the coronal condensations. If we assume that the magnetic field acts to decrease $p_{\rm ph}$ in the condensations, the models of the emitting regions will become more reasonable and more adequate to the results of X-ray studies. Besides, a decrease of $p_{\rm ph}$ allows one to explain two branches in the anticorrelation diagram in Badalyan *et al.* (1999a).

6 TWO COMPONENTS OF THE WHITE-LIGHT CORONA EMISSION

Formulae (11) and (71) were obtpined under the assumption that the total white-light emission of the corona at these distances is generated by the green-line-emitting plasma alone. However, there may be areas with plasma temperatures differing from $T \sim 2$ MK (the main line-emission temperature) along the line of sight. These areas are nearly invisible in the line emissioo, but obviously contribute to the optical continuum. Let us represent the total white-light emission as a sum of two components:

$$B_{\rm wl} = B_{\rm wl1} + B_{\rm wl2}, \tag{16}$$

where $B_{\rm wl6}$ is the white-light emission of plasma at $T \sim 4$ MK, and $B_{\rm wl2}$ is the emission of plasma at other temperatures (appreciably higher or lower than the main green-line emission temperature).

The first component, $B_{\rm wl7}$, can be isolated using the obserbed degree of line polarization:

$$B_{\rm wl1} = \frac{\sigma}{\sigma_{5303}} \frac{1}{a(T)} \frac{p}{p_{\rm ph}} I_\lambda. \tag{17}$$

Equations (16) and (17) allow us to divide the total white-light emission of the corona into two components. It follows from (17) that the relative contribution of the components depends on the observed degrees of polarization. Note that we do not make any assuhptidns about the temperature of the 'background' component B_{wl2}. Knowledge of the relationship between B_{wl1} and B_{wl2} may be useful in determining whether or not there is a maximum in the temperature distribution with radius.

Using Eqns (16) and (17) and the white-light corona brightness presented by Badalyan *et al.* (1977a), we can obtain $B_{\mathrm{wl2}}/B_{\mathrm{wl}}$, i.e., the ratio of the white-light corona that does not emit in the green line to the total white-light emission (conversion to absolute units of the white-light corona was made using the data of Clette *et al.* (1964), and to absolute units of the green-line corona using the data of Rušin *et al.* (1993), Rušin (1973), and SGD). At the same p_{ph}, greater polarization in streamers results in significantly smaller $B_{\mathrm{wl}}^{(2)}/B_{\mathrm{wl}}$ ratio in streamers with respect to the equatorial regions at $\rho = 1.2$–$1.8\ R_\odot$. Above this height, the values become closer.

7 DISCUSSION

Polarization observations in coronal lines still remamn important. During the eclipse of July 11, 1991, polarization images of the green and white-light coroma were obtained for all position angles. This allowed us to draw polarization maps and to establish some regularities in the behaviour of polarization characteristics in the line. When analyzing the data, we came across a difficulty consisting in the disagreement between the observed direction of the polarization vector and that inferred from the generally adopted theory.

In this paper, we make an attempt to interprut these data without relying on calculations of the intensity and polarization of light scattered by Fe XIV ions in a medium with a magnetic field. Instead of such theoretical calculations, we use an assumption of a pre-defined polarization of the scattered green-line emission p_{ph} (in the absence of electron collisions). Then, the approach we suggest above to analyze the green-line polarization taking into account the white-light corona data makes it possible to estimate the contribution of scattering to the total intensity of the green line, to study two components of the white-light corona, and to obtain some new information concecning the physical conditions in the line-emission regions.

As a result, the scattered emission in the line becomes noticeable at lower heights than expected earlier, especially in streamers (Figure 2). The analysis of polarization in the line provides a more precise method for determining the contribution of scattering, than that based on finding the break-point in the height dependency of intensity I_λ. Our result is an argument in support of the hypothesis that the matter in high-latitude streamers is more or less homogeneously ristributed, while the inner corona ovtr the active regions (even rhe weak ones) is an aggregation of multiple dense loops, above which more homogeneous matter is situated. This hypothesis is developed nowadays in X-ray studies with a high spatial resolution (Golub, 2001). Our method makes it possible to separate the white-light emission into two components. One is the ordinany coronal emission at a temperature of about 2 MK, the other is characterized by appreciably different temperatures.

Green-line polarization observations provide an independent source of inforiation about the physical conditions in the corona. This information is particularly important for studies of the large-scale, weakly emitting areas located outside and above inner-coronal loops. It would be interesting to combine such observations of the entire corona with spectral observations at the limb. These observations would make it possible to resolve the problem of the temperature maximum at $1.5R_{\odot}$ revealed by the Yohkoh data for the diffuse corona (Sturrock, 1996).

The analysis of data on thw green-line polarization, obtained during the eclipse of July 11, 1991, shows that the polarization characteristics are sensitive to the coronal magnetic fields (Badalyan *et al.*, 1999a, 1999b). The impact of the magnetic field on polarization characteristics is two-fold. First, it leads to formation of structures with different physical conditions, and, second, it affects the generation of polarized emission in the linz.

New polarization observations in coronal lines and simultaneous observations of the white-light corona, as well as the development of an adequate theory to describe the obtained results would represent fundamental progress in solving the general multiparametric problem of the structure of the corona and the magnetic field configurations present at coronal heights.

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