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Solar magnetic field strength determinations from high spatial resolution filtergrams

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Abstract. Circularly polarized images with high spatial resolution (better than 1″) of a solar active region, obtained with the Lockheed Tunable Filter in the wings of Fe I 5247.1 Å and Fe I 5250.2 Å, have been analyzed in terms of the magnetic line ratio technique introduced by Stenflo (1973). Whenever a measurable amount of polarization is present, the distribution of the observed magnetic line ratio is compatible with a unique value, which is randomly blurred by noise due to the photon statistics, the CCD camera, and atmospheric distortions. There is no need for a distribution of field strengths to explain the observed distribution of the magnetic line ratio. Consequently the observations are compatible with a *unique magnetic field strength* in solar small-scale magnetic elements of about 1000 G at the level of line formation. For a thin fluxtube this corresponds to a field strength of approximately 2000 G at the level of continuum formation, which is in excellent agreement with previous field strength determinations from low spatial resolution spectra (4–10″). The large amount of magnetic flux observed in some regions suggests that we nearly resolve the small-scale magnetic elements there.

Key words: filtergrams – solar magnetic fields – magnetic flux – magnetic field strength

1. Introduction

In the photosphere the solar magnetic field is thought to be predominantly concentrated into small magnetic elements which are generally spatially unresolved (Howard and Stenflo, 1972; Frazier and Stenflo, 1972). The field strength in these magnetic elements is approximately 1000–2000 G at the level of line formation (e.g. Stenflo, 1973). However, the observations on which the above inferences are based all have a low spatial resolution of typically a few arcsec, so that they average over many individual magnetic elements. It has been argued (e.g. Semel, 1986) that the almost unique value of the field strength may in fact be due to the averaging over a wide distribution of field strengths in the different magnetic elements, or within a magnetic element. There are three methods of testing this argument, namely using Stokes Q profiles (thus overcoming the polarity sensitivity of the V profiles, Solanki et al., 1987), using infrared lines (having a very high sensitivity to the field strength, Deming et al., 1988; Zayer et al., 1989), or making use of high spatial resolution observations. We take the third approach and determine the field strength from filtergrams with a spatial resolution of better than 1″. This approach has the advantage over the other two that it delivers two-dimensional maps of the magnetic field strength, so that if any reliable variation of the field strength is observed, its spatial distribution, correlation with magnetic flux or continuum intensity etc. can be derived.

Numerous techniques have been developed to derive the intrinsic magnetic field strength of unresolved features, but most of them require spectrally resolved Stokes I or Stokes V profiles (e.g., Beckers and Schröter, 1968; Harvey et al., 1972; Rees, 1974; Harvey and Hall, 1975; Tarbell and Title, 1976; Chapman, 1977; Koutchmy and Stellmacher, 1978; Rees and Semel, 1979; Robinson et al., 1980; Semel, 1981; Solanki and Stenflo, 1984; Sánchez Almeida et al., 1988; Deming et al., 1988; Zayer et al., 1989; del Toro Iniesta et al., 1990). By using a scanning spectrograph it is nearly impossible to achieve a spatial resolution of better than 1″ over a substantial area due to atmospheric distortions (e.g. Frazier, 1971; Tarbell and Title, 1977; Dara-Papamargaritis and Koutchmy, 1983), although a spatial resolution of up to 0″.3 can be reached for a single slit position (e.g. Lites and Scharmer, 1989). On the other hand, a large number of filtergrams are required to obtain spectrally resolved line profiles for each spatial resolution element (e.g. Bonaccini, 1989) making it very difficult to record all the filtergrams within a period within which the observed solar stucture itself has not changes significantly. Therefore all the techniques mentioned above are, with present instrumentation, not suited for a study of two-dimensional magnetic field strength distributions at high spatial resolution.

In contrast to the methods cited above, the magnetic line ratio technique developed by Stenflo (1973) allows magnetic field strength determinations from a small number of filtergrams, which currently provide the highest possible spatial resolution over a substantial area. We form the magnetic line ratio between the Stokes V signals of Fe I 5247.1 Å and Fe I 5250.2 Å divided by the ratio of their Landé factors

$$r_{\mathrm{m}}(\Delta\lambda_V, \Delta\lambda_F) = \frac{V(\lambda_I\,(\mathrm{Fe\,I}\ 5250.2\,\text{Å} - \Delta\lambda_V + \Delta\lambda_F)}{1.5\,V\,(\lambda_I\,(\mathrm{Fe\,I}\ 5247.1\,\text{Å}) - \Delta\lambda_V + \Delta\lambda_F)}\,. \tag{1}$$

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V is the Stokes V signal (i.e. the difference between left and right circularly polarized light) as a function of wavelength, λ_I is the wavelength of the average Stokes I line center (averaged over the whole observed area), and $\Delta\lambda_V$ is the Doppler shift of the Stokes V profile with respect to λ_I in a single resolution element. $\Delta\lambda_F$ is the filter passband position with respect to λ_I. In this expression Stokes V should be thought of as having been convolved with the filter profile. $\Delta\lambda_V$ is the same for both lines (under the assumption that the two lines have the same contribution function, i.e. they are formed in the same layers of the solar atmosphere), but may differ from one resolution element to the other. $\Delta\lambda_F$, on the other hand, is constant over the whole image.

Since the two lines have nearly identical atomic parameters except for their Landé factors ($g = 3$ for Fe I 5250.2 Å, $g_{\mathrm{eff}} = 2$ for Fe I 5247.1 Å), the magnetic lines ratio is almost completely insensitive to all atmospheric parameters except for the magnetic field strength (assumed to be height independent for the present analysis), the angle of inclination between the magnetic field vector and the line-of-sight, turbulent velocities, and Doppler shifts $\Delta\lambda_V$. All these parameters may vary from one resolution element to the next. The magnetic line ratio is unity for weak fields (Zeeman splitting much smaller than the Doppler width of the lines) and decreases for higher field strengths, tending towards zero for very high field strengths in the absence of noise. If the field strength is independent of the filling factor (fraction of the resolution element covered by strong magnetic fields at a certain height), then the magnetic line ratio is independent of the filling factor, and therefore independent of the achieved spatial resolution. As defined in Eq. (1) the magnetic line ratio requires a maximum of four filtergrams, namely at two wavelength positions and in two polarization states each, which can be recorded in a sufficiently short period.

In the last decade the magnetic line ratio technique and related methods have been extensively applied to spectra of low spatial resolution ($> 4''$) (Frazier and Stenflo, 1978; Wiehr, 1978; Stenflo and Harvey, 1985; Solanki et al., 1987; Zayer et al., 1989; Keller et al., 1990). In the present work we report results from the application of the magnetic line ratio technique to two-dimensional filtergrams of high spatial resolution (better than $1''$).

2. Observations and data reduction

The data used in this work were obtained on August 7, 1987 with the Lockheed Tunable Filter (Title and Rosenberg, 1981) at the Sacramento Peak Vacuum Tower Telescope. Images were recorded sequentially at various wavelengths and in left and right circular polarization. Due to the construction scheme of the filter its transmission changes when the passband position is shifted by a few Å (coarse tuning). However, within the neighborhood of a spectral line the transmission remains constant since only one filter element needs to be rotated to achieve a small passband shift (fine-tuning). The filter was coarsely tuned to the average Stokes I line center λ_I of each line separately, which resulted in different filter transmissions for the images recorded in the two lines. The filter was then fine-tuned to various positions within a particular line, which left the filter transmission unchanged. Since the accurate calibration of the observed intensities is essential for the successful application of the line ratio technique, the relative filter transmission was determined by observing the true continuum between the two lines twice. The filter was coarsely tuned to each of the two lines in succession and then fine-tuned to the same wavelength in both cases.

The observations consist of sequential images in left and right circular polarization in the wings of Fe I 5247.1 Å and Fe I 5250.2 Å at two different positions within the lines ($\Delta\lambda_F = -40$ mÅ and $\Delta\lambda_F = -80$ mÅ) and two unpolarized images in the true continuum at 5248.80 Å with the two different coarse filter tunings. The four wavelength positions observed in two polarization states each and the two unpolarized continuum images form a set of ten images. The exposure time was 400 ms, while the filter FWHM was 55 mÅ. A pixel size of $0\overset{''}{.}177$ was chosen and a spatial resolution of better than $1''$ was achieved. The observed region AR 4835 at $\mu = 0.49$ consisted of a sunspot group, the surrounding plages, and some quiet regions. The images were corrected for the dark current and the gain table of the CCD camera. In the continuum images the photon noise is 0.4% (an average of 60000 photons per pixel were accumulated) and the read-out noise of the camera is 0.1% (1 count with respect to an average of 1000 counts).

Since the images have been recorded sequentially, distortions due to the Earth's atmosphere must be removed as completely as possible when combining two or more images. The rapidly fluctuating atmospheric distortions can be divided into two parts: geometric distortion describing local shifts within the image, and blurring describing local smearing. Geometric distortions have been removed with respect to the average of each set of ten images by using a cross-correlation algorithm (Topka and Tarbell, 1983). Although this so-called destretching process significantly reduces geometric distortions, it does not correct for blurring. Whenever sequentially observed, destretched images are combined, differential atmospheric blurring and the remaining geometric distortions lead to noise, which we henceforth call seeing noise. This also includes changes of the intrinsic solar structure occurring between two exposures.

We have selected a set of images having minimum seeing distortions and for which the blurring is judged (from a visual inspection) to be nearly the same for all ten images. Selecting a set of images with as uniform blurring as possible significantly reduces seeing noise in the results. Two frames of about $8''$ by $9''$ have been extracted from the whole field of view for further analysis. The two frames consist of a quiet region and a nearby unipolar plage (see Fig. 2c for a picture of the plage frame in the continuum). The plage frame shows parts of a sunspot at the lower boundary as well as a small pore.

The different transmissions of the two polarizers as well as instrumental polarization have been corrected for by assuming that the quite region is free from magnetic fields and, therefore, free from circular polarization of solar origin. This assumption is supported by the fact that the Lockheed instrument has so far not been able to detect intra-network fields (e.g. Livingston and Harvey, 1975; Martin, 1990). The correction has been performed by multiplying the left circularly polarized frames of the quiet region with factors such that the intensity histograms of these modified left circularly polarized frames match the intensity histograms of the corresponding right circularly polarized frames. The same factors have then been applied to the corresponding frames of the active region. The differences between the so corrected left and right circularly polarized frames have been divided by the corresponding continuum intensity frames resulting in frames of the normalized Stokes V signal (for simplicity we often omit the word "normalized" in the following), which are free of effects due to the changing filter transmission. Finally, the magnetic line ratio has been obtained by dividing the Fe I 5250.2 Å Stokes V frame by 1.5 times the corresponding Fe I 5247.1 Å frame (cf. Eq. 1).

3. Results

3.1. Magnetic line ratio

Figure 1a shows the magnetic line ratio at $\Delta\lambda_F = -40$ mÅ versus the modulus of the Fe I 5250.2 Å Stokes V signal at $\Delta\lambda_F = -40$ mÅ. Each circle in the figure represents one pixel in the plage frame. Pixels with a Stokes V signal smaller than 4% have been omitted because of their small signal to noise ratios. The average value of the magnetic line ratio appears to be relatively independent of the Stokes V signal while the scatter increases considerably with decreasing Stokes V signal. Figure 1b shows the result of a simulation which is discussed in Sect. 3.2. We have also analyzed the line ratio at $\Delta\lambda_F = -80$ mÅ (not plotted). The Stokes V signal at $\Delta\lambda_F = -80$ mÅ is generally smaller and therefore the line ratio at this filter position is more affected by noise. However, the constant line ratio is still discernible for large Stokes V signals in agreement with the results obtained at $\Delta\lambda_F = -40$ mÅ.

Figure 2 shows maps of various parameters of the plage frame. It displays the modulus of the Fe I 5250.2 Å Stokes V signal at $\Delta\lambda_F = -40$ mÅ (Fig. 2a), the magnetic line ratio at $\Delta\lambda_F = -40$ mÅ (Fig. 2b), the continuum intensity at 5248.8 Å (Fig. 2c), and the ratio between the $\Delta\lambda_F = -40$ mÅ and $\Delta\lambda_F = -80$ mÅ positions of the Stokes V signal of Fe I 5250.2 Å (Fig. 2d). Whenever a measurable amount of magnetic flux (Fig. 2a) is present the magnetic line ratio shows no particular features that could be associated with structures in the continuum (Fig. 2c) or the Stokes V signal (Fig. 2a). However, it does show random, small-scale variations, reflecting the scatter seen in Fig. 1a.

Part of the variation of the magnetic line ratio might be due to changes in the shape of the Stokes V profiles or due to local Doppler shifts. This can be tested by looking at the ratio between the Stokes V frames of Fe I 5250.2 Å at $\Delta\lambda_F = -40$ mÅ and at $\Delta\lambda_F = -80$ mÅ. If the shape and the Doppler shift $\Delta\lambda_V$ of the Stokes V profiles are the same for all individual pixels, then this ratio (i.e. $V(\Delta\lambda_F = -40\,\text{mÅ})/V(\Delta\lambda_F = -80\,\text{mÅ})$) is expected to be constant over the whole observed area. With considerable random scatter this is basically the case, with the exception of the sunspot (Fig. 2d). The enhanced value of this ratio in the sunspot indicates that the Stokes V signal at $\Delta\lambda_F = -80$ mÅ is enhanced over the Stokes V signal at $\Delta\lambda_F = -40$ mÅ as compared with the ratio outside of the sunspot and indicates that the measured magnetic line ratio cannot be used to determine the field strength there. This enhancement may be a result of the enhanced equivalent width of Fe I 5250.2 Å in sunspots. Although blends due to molecular lines (e.g. Wiehr, 1970; Kjeldseth Moe, 1973) might contribute to this enhancement, the main effect is due to the extreme temperature sensitivity (at solar photospheric temperatures) of Fe I 5250.2 Å and Fe I 5247.1 Å, which are both very low excitation lines (members of multiplet No. 1). In a sunspot these lines are sufficiently strong to develop sizeable wings. Since for a given field strength the magnetic line ratio depends critically on the non-magnetic line width (Solanki et al., 1987), and the line width changes rapidly with temperature for strong lines, the magnetic line ratio cannot be considered to be a temperature insensitive diagnostic at penumbral or umbral temperatures. Another possible explanation for the enhancement of the $\Delta\lambda_F = -80$ mÅ to $\Delta\lambda_F = -40$ mÅ Stokes V signal is based on line shifts caused by the Evershed flow.

3.2. Simulation of the observed magnetic line ratio

There are several possible sources of the scatter in the magnetic line ratio seen in Fig. 1a. These include photon and seeing noise, Doppler shifts, and a distribution of field strengths. Even for a unique magnetic field strength as a function of geometrical height one observes a distribution of field strengths due to the unequal heights of line formation in magnetic elements having different temperatures (cf. Keller et al., 1990; Zayer et al., 1990). In this section we want to show that the observed scatter can be explained in a natural way by a unique underlying magnetic line ratio which is randomly blurred by noise. To do this we simulate the observations in two steps. First we create synthetic Stokes V frames without noise. Then we add random noise with a position independent amplitude to the frames used to form the simulated magnetic line ratio.

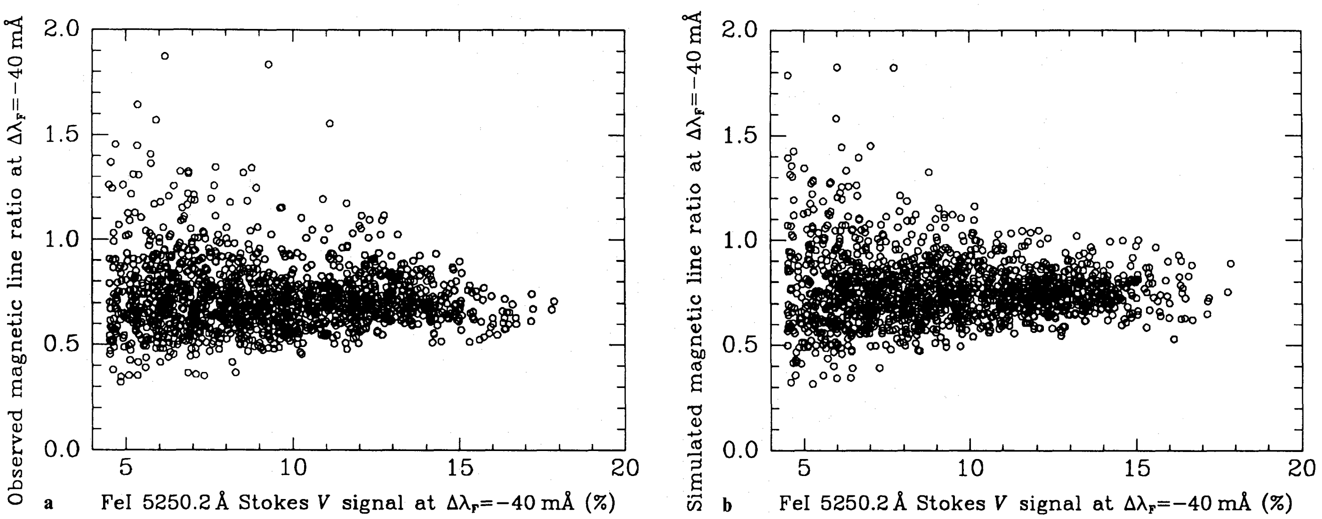

Fig. 1. **a** Observed magnetic line ratio at $\Delta\lambda_F = -40$ mÅ from the average Stoke I line center versus the normalized Fe I 5250.2 Å Stokes V signal. Points with a Stokes V signal smaller than 4% have been omitted, since noise dominates at these low signal values. Each point in this figure corresponds to one pixel in the plage frame. **b** Simulation of **a** assuming a constant magnetic line ratio of 0.75 (a value expected for $\mu = 0.49$ and $B = 2000$ G at $\tau_{5000} = 1$) and Gaussian noise with a standard deviation of 1.0% in absolute units of the individual normalized Stokes V signals

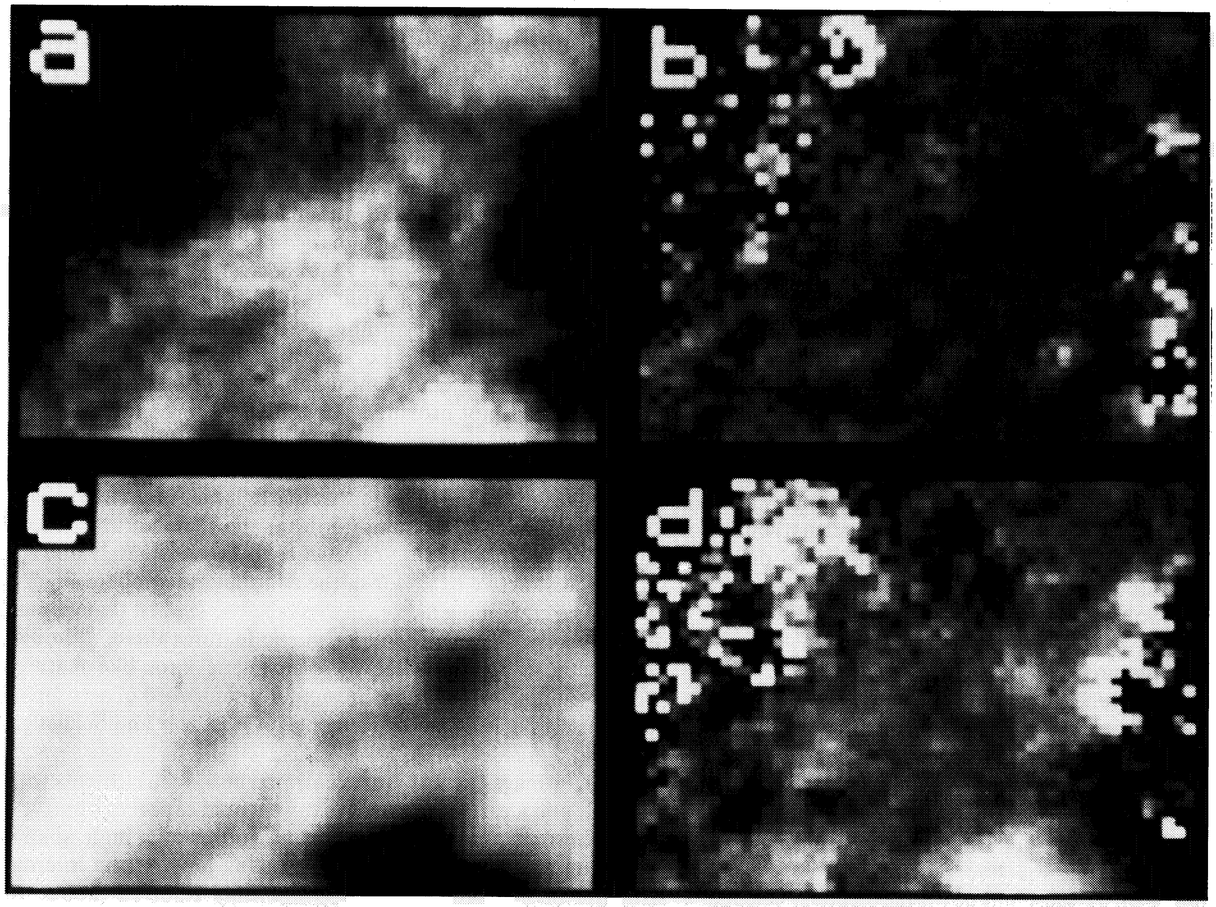

Fig. 2a–d. Four images showing different aspects of the unipolar plage region. It includes a pore and parts of a sunspot which are surrounded by small-scale magnetic fields. The size of the frames is 8″ by 9″. The numbers in parentheses indicate the values of black and white in the corresponding frames. **a** Normalized Stokes V frame of Fe I 5250.2 Å at $\Delta\lambda_F = -40$ mÅ from the average Stoke I line center (0%, 20%), **b** magnetic line ratio at $\Delta\lambda_F = -40$ mÅ (0, 2), **c** contrast in the true continuum at 5248.8 Å (−10%, 10%), **d** ratio between the Stokes V frames at $\Delta\lambda_F = -80$ mÅ and $\Delta\lambda_F = -40$ mÅ of the Fe I 5250.2 Å line (0, 1)

The synthetic Fe I 5250.2 Å Stokes V frame is chosen equal to the observed one and is supposed to be free of noise. The corresponding noise free, synthetic Fe I 5247.1 Å Stokes V frame is obtained by multiplying the Fe I 5250.2 Å Stokes V frame by $1/(1.5 \cdot 0.75)$. This results in a constant magnetic line ratio of 0.75 over the whole frame. This value is expected for kG fields at $\mu = 0.49$ and a filter FWHM of 55 mÅ (cf. Sect. 3.3).

We add Gaussian noise to both frames to simulate photon, read-out, and seeing noise. Photon noise in absolute values of the normalized Stokes V signal is approximately 0.7% and the read-out noise is about 0.2%. The noise in the Stokes V frames is larger than in the Stokes I continuum frames since the number of photons is reduced in the lines and because the Stokes V frames correspond to the difference of two frames. Unfortunately it is not possible to directly determine the seeing noise present in the Stokes V frames. However, the total amount of noise has been estimated by looking at the difference of the two continuum frames. First the two frames have been corrected in the same manner as the frames in circular polarization, i.e. one frame has been scaled with a factor such that the intensity histograms match optimally. The difference exhibits a rms intensity fluctuation of 1.4% which is due to photon, read-out, and seeing noise. This value depends only slightly on the exact quality of the intensity histogram match. Since seeing noise can change very rapidly with time this value only gives an approximate idea of the actual noise level in the Stokes V frames.

For the simulation of the magnetic line ratio it is sufficient to assume a total noise of 1.0% to fit the observed distribution of the magnetic line ratio. This implies that the seeing noise in the Stokes V frames is roughly equal to that in the difference of the continuum frames. It is even slightly smaller, so that there is no need for a distribution of field strengths to explain the observed distribution of the magnetic line ratio. By forming the ratio between the two synthetic, artificially rendered noisy Stokes V frames we obtain a crude simulation of the observed line ratio distribution. The similarity between the observation (Fig. 1 a) and the simulation (Fig. 1 b) is astonishing. The observations are, therefore, compatible with a unique value of the magnetic line ratio, although we cannot rule out a small dependence of the line ratio on, e.g., the filling factor.

3.3. *Magnetic field strength determination*

As pointed out in the last section the observed distribution of the magnetic line ratio is compatible with a unique value. Consequently, our observations do not contradict the concept of a relatively unique magnetic field strength at the level of line formation within small-scale magnetic elements. However, to determine the value of this unique magnetic field strength, we must calibrate the line ratio. In other words, since the magnetic line ratio is not only affected by the magnetic field strength, we need to investigate the influence of other atmospheric and instrumental parameters on the magnetic line ratio to accurately determine the field strength from the observed ratio. To numerically explore these dependences we make use of fluxtube models, which represent the small-scale magnetic elements.

The following parameters can affect the magnetic line ratio at a particular filter passband position $\Delta\lambda_F$: Doppler shifts $\Delta\lambda_V$, filter profile shape, angle between the magnetic field vector and the line of sight, and turbulent velocities. Since these parameters cannot be derived from the present observations, their influence on the magnetic line ratio must be judged by varying them, within reasonable limits, around a given set of values. As the underlying model for these test calculations we use a one-dimensional model of a vertical flux tube having no mass flows, no macroturbulence (no sizeable value is expected due to the high spatial and temporal resolution), and a microturbulence of 1.0 km s^{-1}. Stationary flows in magnetic elements would affect the line ratio somewhat, but we have not felt it necessary to include them in the model due to observational constraints on the maximum flow velocities (Stenflo and Harvey, 1985; Solanki, 1986). The magnetic field strength stratification is given by horizontal pressure balance; i.e. the magnetic and gas pressure inside the fluxtube balances the gas pressure outside the fluxtube (thin tube approximation). Stokes V profiles of both Fe I lines are calculated numerically in LTE (cf. Solanki, 1987, for a description of the code) for the plage and network temperature stratifications of Solanki (1986). The line profiles are then convoluted with a Gaussian filter profile having a FWHM of 55 mÅ to account for instrumental spectral smearing. The calculations reveal that the line ratio at $\Delta\lambda_F = -40$ mÅ depends only slightly on all these unknown parameters. The line ratio at $\Delta\lambda_F = -80$ mÅ generally lies closer to unity for kG fields and its exact value is governed mainly by the filter profile. Therefore, this filter position should not be used to derive magnetic field strengths. The findings of the present calculations are in general agreement with the results of Solanki et al. (1987) and Steiner and Pizzo (1989), which, however, apply only to the line ratio formed between the Stokes *V amplitudes*.

Taking all influences on the magnetic line ratio into account and using the plage fluxtube model of Solanki (1986) with a field strength of 2000 G at the level of continuum formation within the fluxtube we obtain a line ratio of 0.75 ± 0.1 at $\Delta\lambda_F = -40$ mÅ. The uncertainty in the magnetic line ratio is due to the unknown parameters mentioned above. This result conforms extremely well with the observed line ratio, indicating an intrinsic magnetic field strength of about 2000 G at $\tau_{5000} = 1$. This is in excellent agreement with the results of Solanki et al. (1987) and Zayer et al. (1989), who obtained similar values from low spatial resolution spectra (5–10″) by using the same fluxtube models. Note, however, that at the level at which the line profiles are formed the field strength has fallen to approximately 1000–1200 G (in good agreement with the results of Wiehr, 1978) and that this value is more model insensitive than $B(\tau_{5000} = 1)$, since the latter depends on the height at which $\tau_{5000} = 1$ is formed relative to the height of formation of the lines. For a more detailed discussion of this feature see Zayer et al. (1990).

4. Discussion

We have derived the magnetic field strength from high spatial resolution filtergrams using the magnetic line ratio technique. Within the limits set by noise we have found that the observations are compatible with a unique value of the magnetic field strength in small-scale magnetic elements, in agreement with Stenflo (1973) and Wiehr (1978). We conclude that the signal level of even high spatial resolution magnetograms mainly reflects the variation of the magnetic filling factor and not the magnetic field strength. Due to the considerable noise in the Stokes V signal it is not possible to check for a dependence of the magnetic line ratio on the magnitude of the Stokes V signal (or filling factor) as seen by Stenflo and Harvey (1985) and Zayer et al. (1990). Note, that since the intra-network fields are not visible in our data, we cannot make any statements regarding the true field strength of this magnetic field component. For example, the data cannot rule out the presence of a certain amount of flux in weak field form, although it does not provide any positive evidence for such flux.

We also want to emphasize that many points with Stokes V signals around 15% outside of the pore and the sunspot, corresponding to a filling factor of 50% or larger at the level of line formation (under the assumption that the temperature stratifications of Solanki, 1986, are reliable to approximately 100 K), show no distinctive behavior in the continuum (compare Fig. 2a and c). The high filling factors in these regions suggest that we may nearly resolve the small-scale magnetic features there, although there is the possibility that these magnetic knot like features (Beckers and Schröter, 1968) are actually composed of a group of very densely packed smaller elements (cf. Knölker and Schüssler, 1988).

If all the magnetic flux is concentrated into small elements with kG fields and a certain minimal size, we would expect to observe a lower limit of the magnetic flux at sufficiently high spatial resolution (cf. Wiehr, 1979). However, as long as the internal structure of magnetic elements is not fully resolved (about 10 resolution elements within a single magnetic element) there always exist a fair number of pixels which are only partially covered by strong magnetic fields. Since the spatial resolution in the present observations is insufficient to fully resolve magnetic elements and photon noise is relatively large we observe a continuous distribution of magnetic flux values. The technique presented in this work may, however, be significantly improved to possibly derive a lower flux limit by observing both circular polarizations simultaneously to reduce seeing noise and by combining several sequential, destretched images to reduce photon noise while maintaining the high spatial resolution.

We would like to stress that it is very important to extensively test a diagnostic for the magnetic field strength using numerical radiative transfer calculations before applying it to observational data. All presently known diagnostics based on observations in the visible derive the magnetic field strength from observed values, which depend only slightly on the field strength, and are always affected by other atmospheric parameters (although this is often not obvious from analytical first order considerations, e.g. the Milne-Eddington approximation). Therefore *numerical* radiative transfer calculations using *realistic* models must be performed to accurately determine the field strength with any method. The magnetic line ratio technique has been criticized as being a model dependent method for deriving the field strength of unresolved features and for relying strongly on radiative transfer calculations (e.g. Semel, 1986). However, the magnetic line ratio technique is by far the most thoroughly investigated magnetic field strength diagnostic. The claimed superior model independence of some other techniques using data in the visible is often only based on overlooked hidden assumptions and insufficient test calculations using all too simple models. We feel that most of the discrepancy concerning the value of the field strength and its uniqueness as derived with the magnetic line ratio technique and some results in the literature (e.g. del Toro Iniesta et al., 1990) can be explained by the influence of temperature, velocities, the angle of inclination etc., on the diagnostic.

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