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Spectropolarimetry of solar prominences

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Abstract. A large set of high precision full-Stokes spectropolarimetric observations of prominences in He-D_3, Hα and Hβ lines has been recorded with the ZIMPOL polarimeter at the Gregory-Coudé Telescope in Locarno. The observational technique allows us to obtain measurements free from seeing induced spurious effects. The instrumental polarization is well under control and taken into account in the data analysis. We present our observational results for each of the above-mentioned lines. Of particular interest is that most of our Hα measurements show anti-symmetric V profiles that are a characteristic signature of the Zeeman effect in the prominence plasma. A Stokes inversion technique based on the quantum theory of the Hanle and Zeeman effects is being applied on observed Stokes profiles in the He-D_3 line in order to obtain information on the magnetic field vector that confines the prominence plasma.

1. Introduction

Using the same effective technique applied to spicule observations as described in another paper in these proceedings (Ramelli et al. 2006), it is possible also to investigate the magnetic fields present in prominences, via spectropolarimetric measurements. Recent examples of observations of the He-D_3 multiplet are reported also by Casini et al. (2003), while Trujillo Bueno et al. (2002) and Merenda et al. (2006) have analyzed observations of the He I 10830 Å multiplet.

A few years ago, we started at the Istituto Ricerche Solari Locarno (IRSOL) an extended observational project on prominences in He-D_3, Hα and Hβ with the Zurich Imaging Polarimeter (ZIMPOL) (Gandorfer et al. 2004). A preliminary physical interpretation of our observations based on suitable inversion techniques has been applied to the He-D_3 data in order to obtain information on the magnetic field vectors involved. The interpretation of Hα and Hβ Stokes profiles is however postponed to a future work.

2. The observations

The observations were performed with the Gregory-Coudé Telescope at IRSOL with the same technique applied to spicules described in Ramelli et al. (2006). The measurements were performed between May 2003 and June 2005 in different positions and prominences: 49 measurements in the He-D_3 line, 29 in Hα and 9 in Hβ. Particular attention has been given to the correction for scattered light as described in Ramelli & Bianda (2005).

3. Results

A preliminary inversion of the observed Stokes profiles has been applied to part of our He-D_3 observations. In this first analysis, the Stokes profiles used for the inversion are obtained integrating several arcseconds along the spatial region observed through the spectrograph slit where, in the center of the He-D_3 line, we have more than half of the maximum intensity. Two examples of He-D_3 Stokes profiles with inversions are shown in Fig. 1. We usually find magnetic fields of the order of 10 gauss.

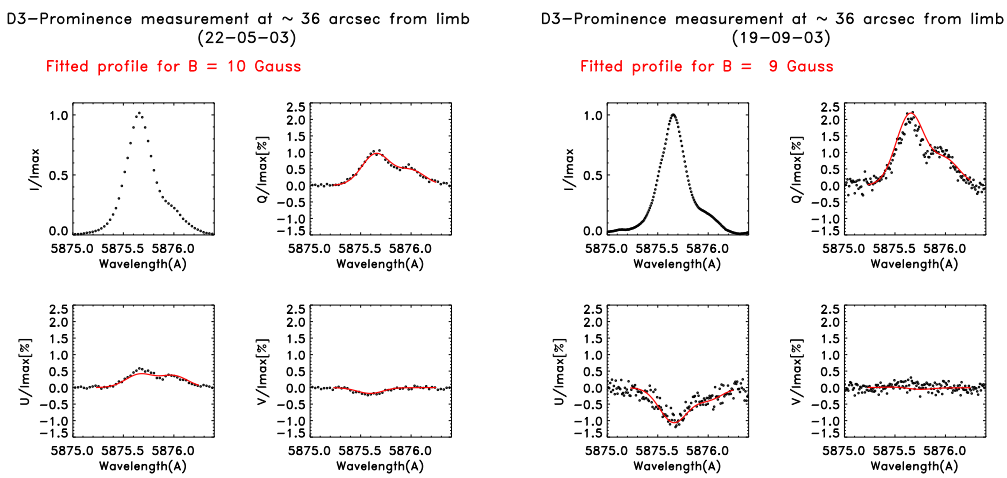

Figure 1. Two examples of He-D_3 Stokes profiles obtained from prominence observations with fitted theoretical profiles (continuous line).

Analyzing our Hα measurements we find that the Stokes V profiles show usually a typical antisymmetric Zeeman like structure (e.g. Figs. 2, 3, left panel, and 4). In the only example we have found a symmetric Stokes V profile (Fig. 3, right panel) the amplitude was very small (a few 10^{-4}). Therefore, our observational results are different from those presented by López Ariste et al. (2005), whose observed V profiles show generally a larger symmetric signature often dominating the antisymmetric Zeeman effect signal. It is also interesting to note that it is quite common to observe self-absorption in the center of the Hα line, which suggests radiative transfer effects (see, e.g., Fig. 2).

In the Hβ measurements smaller polarization signals than in Hα are observed. In the linear polarization profiles, the largest amplitudes found are

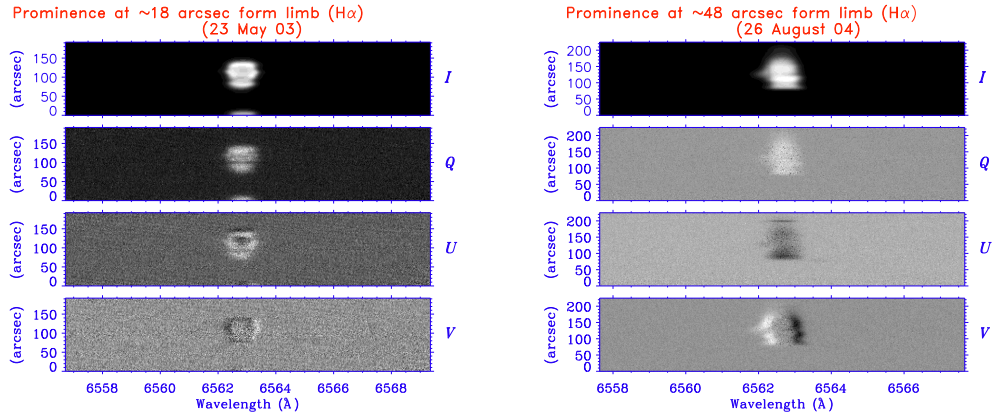

Figure 2. Two examples of Hα measurements.

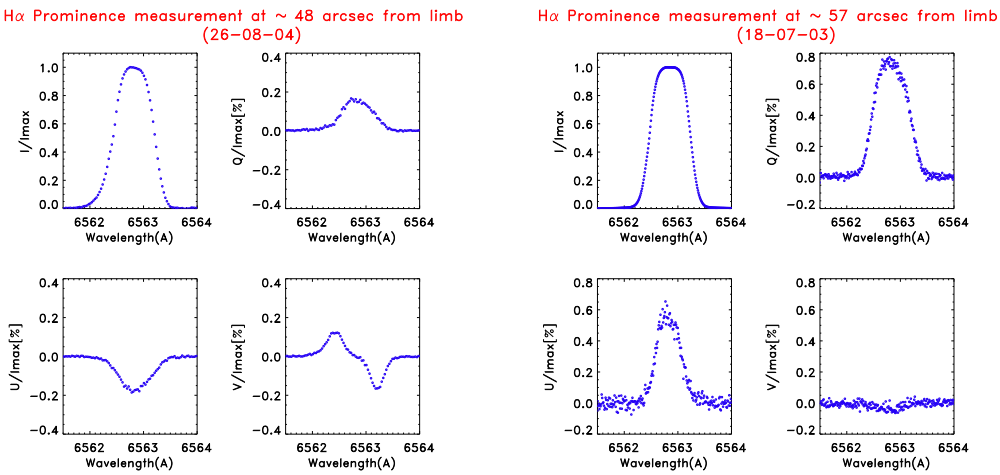

Figure 3. Two examples of Hα Stokes profiles. In the first example left we see a typical antisymmetric Zeeman like structure in Stokes V. The second example right is the only case where we find a symmetric structure in Stokes V. The amplitude in this case is only a few 10^{-4}.

around 0.4%. No signal above the noise level could be detected in the circular polarization. Examples of Hβ Stokes profiles are shown in Fig. 5.

4. Conclusion

Using ZIMPOL at the GCT telescope in Locarno it has been possible to obtain a large set of high quality full Stokes spectropolarimetric measurements of prominences in the He-D$_3$, Hα and Hβ lines. A preliminary inversion has been applied on part of the He-D$_3$ measurements.

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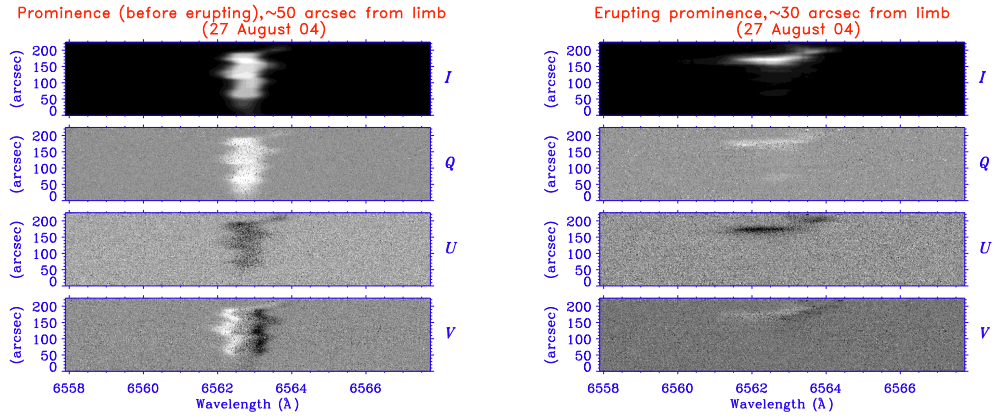

Figure 4. Example of Hα measurements. *Left:* Prominence before erupting *Right:* Prominence during eruption

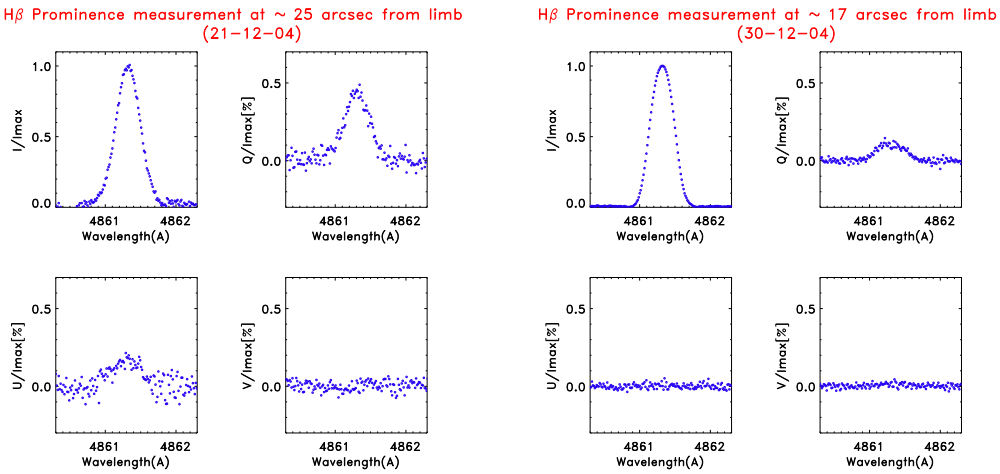

Figure 5. Two examples of Hβ recordings of Stokes profiles.

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References

Casini R., López Ariste A., Tomczyk S., and Lites B. W., 2003, ApJ 598, L67.
Gandorfer A. et al., 2004, A&A 422, 703.
López Ariste A. et al., 2005, ApJ 621, L145.
Merenda, L., Trujillo Bueno, J., Landi Degl'Innocenti, E., & Collados, M. 2006, ApJ, in press
Ramelli, R., Bianda, M., Merenda, L., & Trujillo Bueno, J. 2006, these proceedings
Ramelli, R., & Bianda, M. 2005, in Astronomy and Astrophysics Space Science Library, vol. 320, *Solar Magnetic Phenomena*, (Dordrecht: Springer), 215.
Trujillo Bueno, J., Landi Degl'Innocenti, E., Collados, M., Merenda, L., & Manso Sainz, R. 2002, Nature, 415, 403