Spectropolarimetry with ZIMPOL-3 at the IRSOL observatory

R. Ramelli and M. Bianda

Istituto Ricerche Solari Locarno, CH-6605 Locarno, Switzerland

Abstract:

Thanks to the Zurich Imaging Polarimeter (ZIMPOL) installed at the IRSOL observatory in Locarno (Switzerland) we are able to carry out spectro-polarimetric observations with very high polarimetric sensitivity (10^{-5}). Recently we have implemented a new improved version of the system (ZIMPOL-3) and we are employing it for different observing programs. These include for example observations of scattering polarization near the solar limb, forward scattering polarisation, spectropolarimetry of prominences in the He-D3 multiplet and a synoptic program to detect variation in the properties of the turbulent magnetic field in the solar atmosphere.

1. Introduction

IRSOL focus its activity on high sensitive spectro-polarimetry.

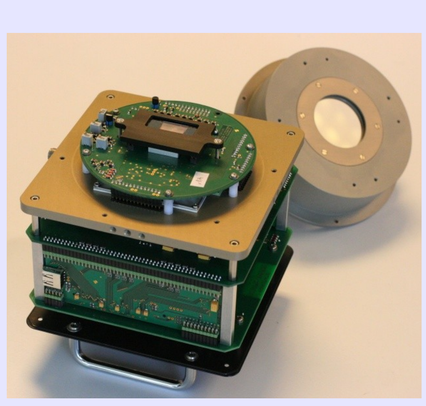
Observations are carried out with the ZIMPOL polarimeter, which allows to reach a polarimetric precision of about 10^{-5},thanks to the high modulation frequency (up to 42 kHz).

The Gregory-Coudé Telescope is very suited for polarimetry thanks to its low degree of instrumental polarization which basically depends on declination only and thus easy to correct for. It even vanishes when observing on the celestial equator at the equinoxes.

The observatory is equipped with a Czerny-Turner spectrograph, a tunable Fabry-Perot filter system and a AO system (Ramelli, Bucher et al. 2010).

2. New version of the polarimeter: ZIMPOL-3

(see Ramelli, Balemi, Bianda, et al. 2010)

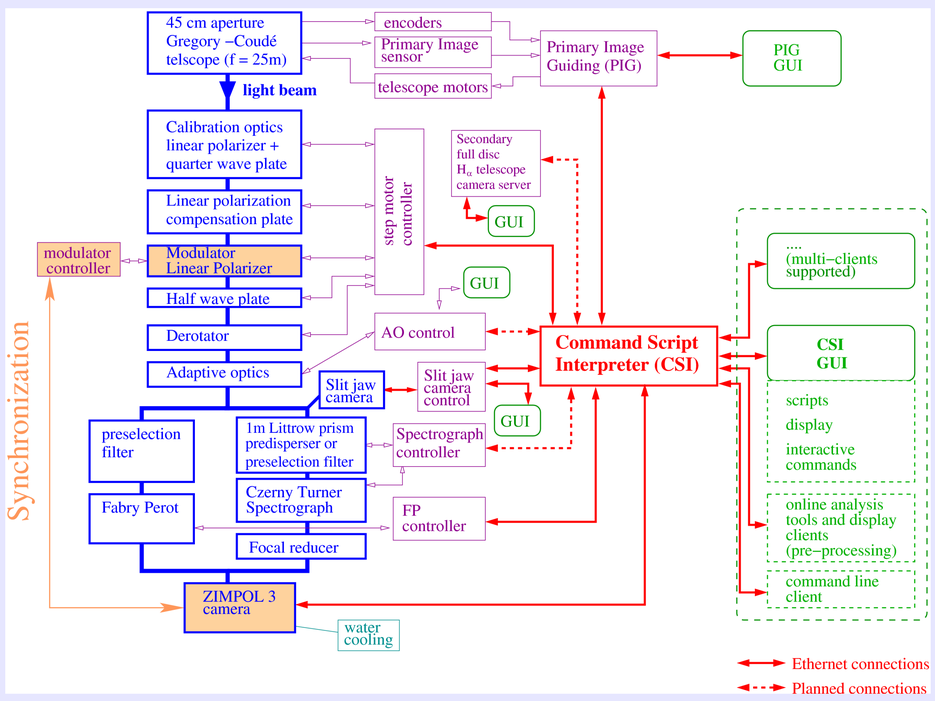


Improvements ZIMPOL3 versus ZIMPOL2:

- more flexible and compact system
- adaptable to different cips
  - new cips for UV with microlenses (1250 pixels x 560 pixels)
- more efficient and faster
- exposure and readout simultaneously
- based on newer technology (replace components available on the market)
- more functions (readout modes, binning, subframe readout, different demodulation schemes, electronic compensation of telescope pol. offset)
- night astronomy application possible: longer integration time, better cooling

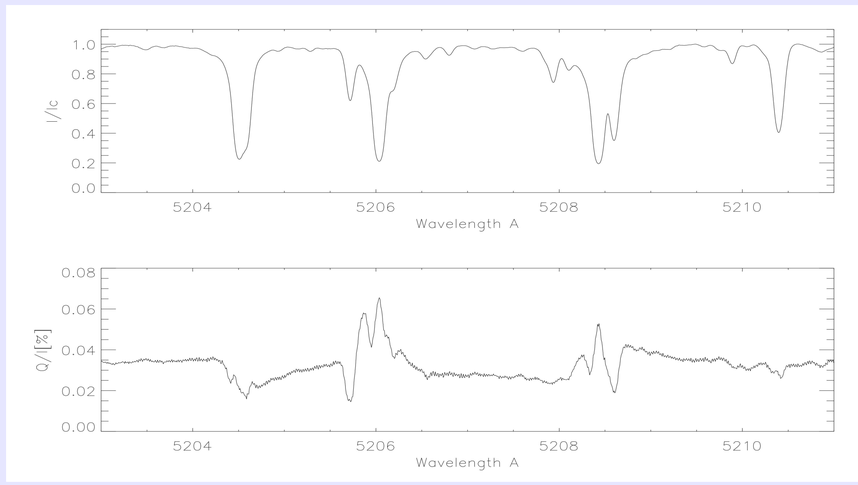
Thanks to several improvements (microlenses, better sensors, high transmission pre-selection filters for the spectrograph, smaller read-out dead time) it was possible in the past 5-6 years to increase the overall photon collection efficency of almost 1 order of magnitude!

Observing setup with the ZIMPOL system at IRSOL



3. Observation examples

Scattering polarization (second solar spectrum)

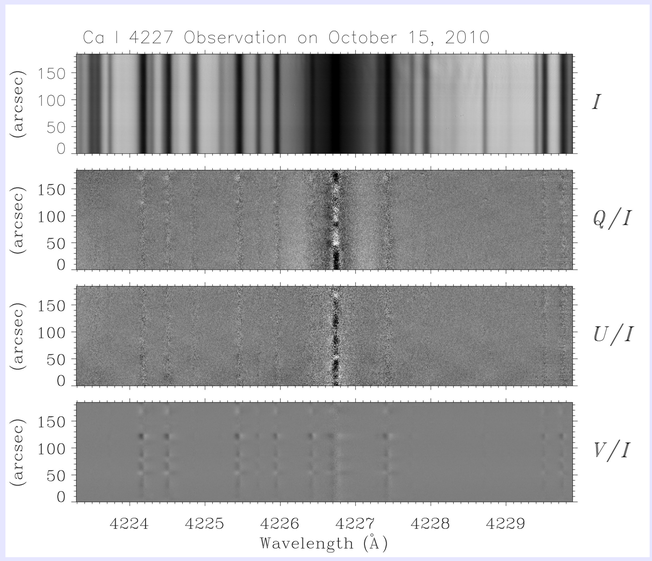


10 arcsec from limb (mu=0.15), 2000 seconds integration time

Recent publications on the second solar spectrum topic:
Anusha et al. 2010, Sampoorna et al. 2009, Shapiro et al. 2011.

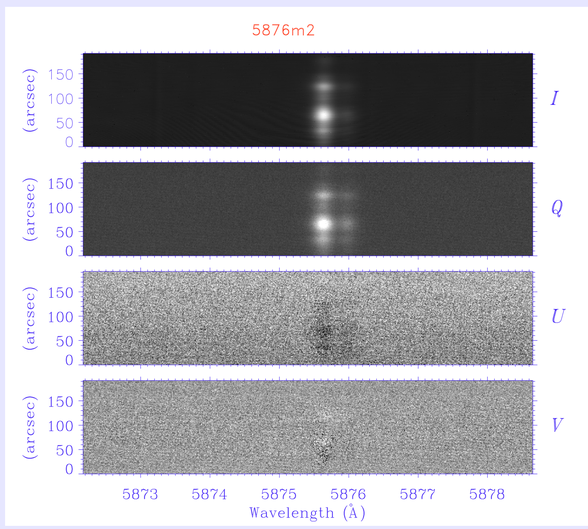
We started at IRSOL also a program to detect variation of the turbulent magnetic fields with the solar cycle via the Hanle effect on the scattering polarization (Kleint et al. 2010)

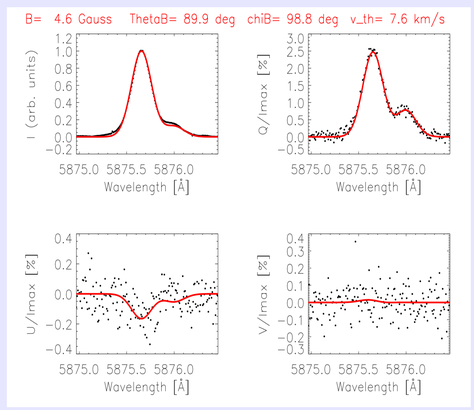
Forward scattering polarization (at disc center)



(see Bianda et al. 2011 and Anusha et al. 2011)

Spectropolarimetry of prominences





(see Ramelli et al. 2011)

References:

Anusha, L.S., Nagendra, K.N., Stenflo, J.O., Bianda, M., et al. 2010, ApJ, 718, 988
Anusha, L.S., Nagendra, K.N., Bianda, M., et al. 2011, ApJ, 737, 95
Bianda, M., Ramelli, R., Anusha, L.S., Stenflo, J. O., Nagendra, K. N. et al., 2011, A&A, 530, L13
Kleint, L., Berdyugina, S.V., Shapiro, A.I., & Bianda, M. 2010, A&A, 524, A37
Ramelli, R., Trujillo Bueno, J., Bianda, M., & Asensio Ramos, A. 2011, ASPCS, 437, 109
Ramelli, R., Balemi, S., Bianda, M., et al. 2010, Proc. SPIE, 77351Y
Ramelli, R., Bucher, R., Rossini, L., Bianda, M., & Balemi, S. 2010, Proc. SPIE, 77363K
Sampoorna, M., Stenflo, J.O., Nagendra, K.N., Bianda, M., Ramelli, R., & Anusha, L. S. 2009, ApJ, 699, 1650
Shapiro, A.I., Fluri, D.M., Berdyugina, S.V., Bianda, M., & Ramelli, R. 2011, A&A, 529, A139