Observations and instrumentation at IRSOL:
present and future

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Istituto ricerche solari Aldo e Cele Daccò (IRSOL), Locarno
5th SCOSTEP workshop, Windisch, 16 May 2023

IRSOL
Istituto ricerche solari
Aldo e Cele Daccò

IRSOL

Università della Svizzera italiana

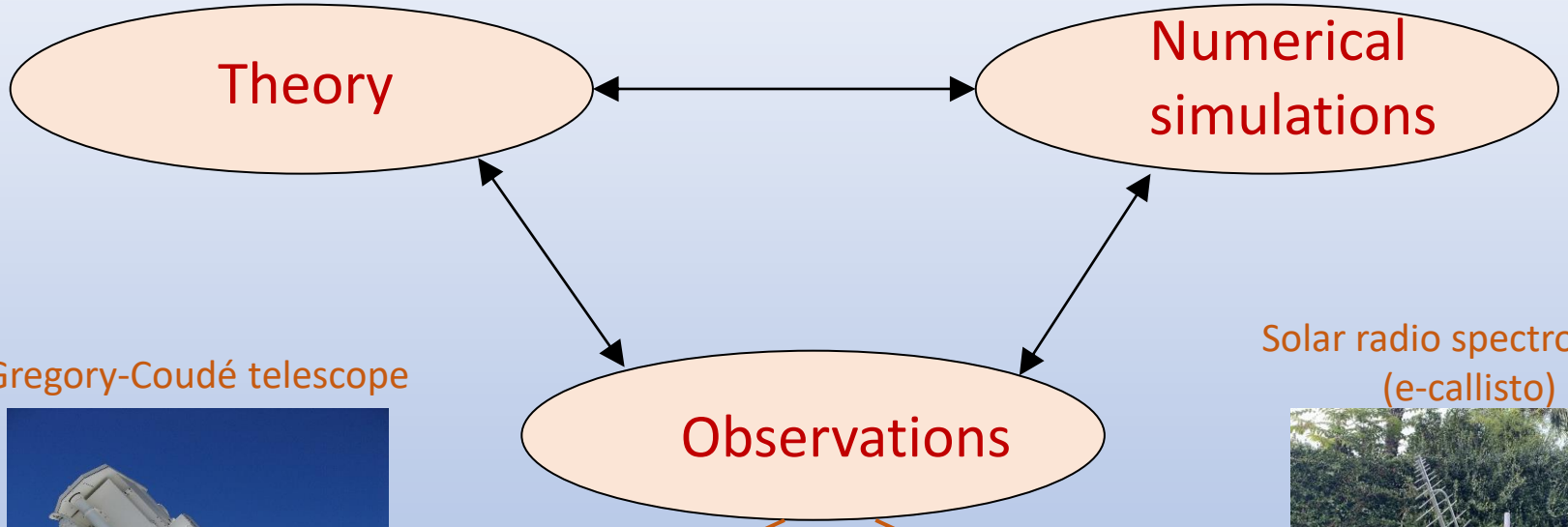
IRSOL = Istituto ricerche solari Aldo e Cele Daccò in Locarno

Affiliated to USI

Research focus: solar spectropolarimetry (visible) → solar magnetism

IRSOL

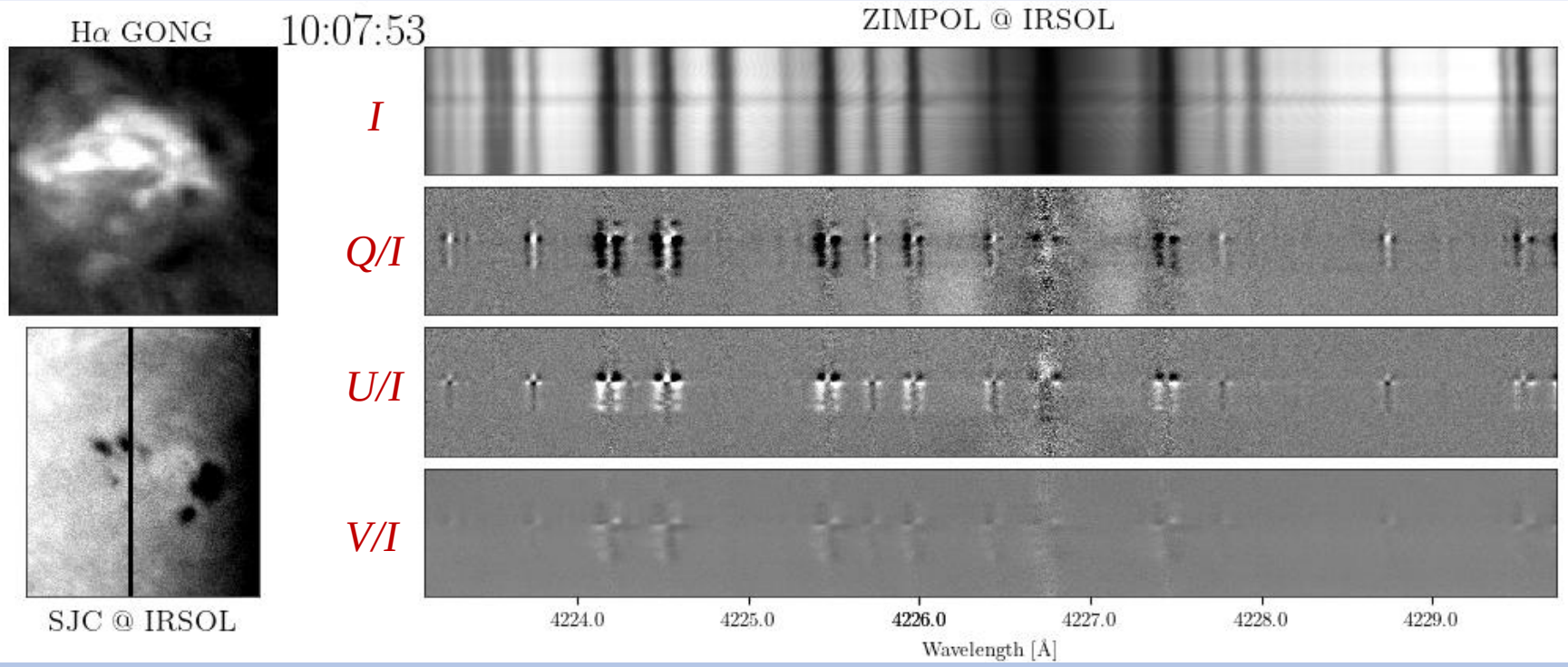
Team: 16 scientific collaborators



Gregory-Coudé telescope

Solar radio spectrometer (e-callisto)

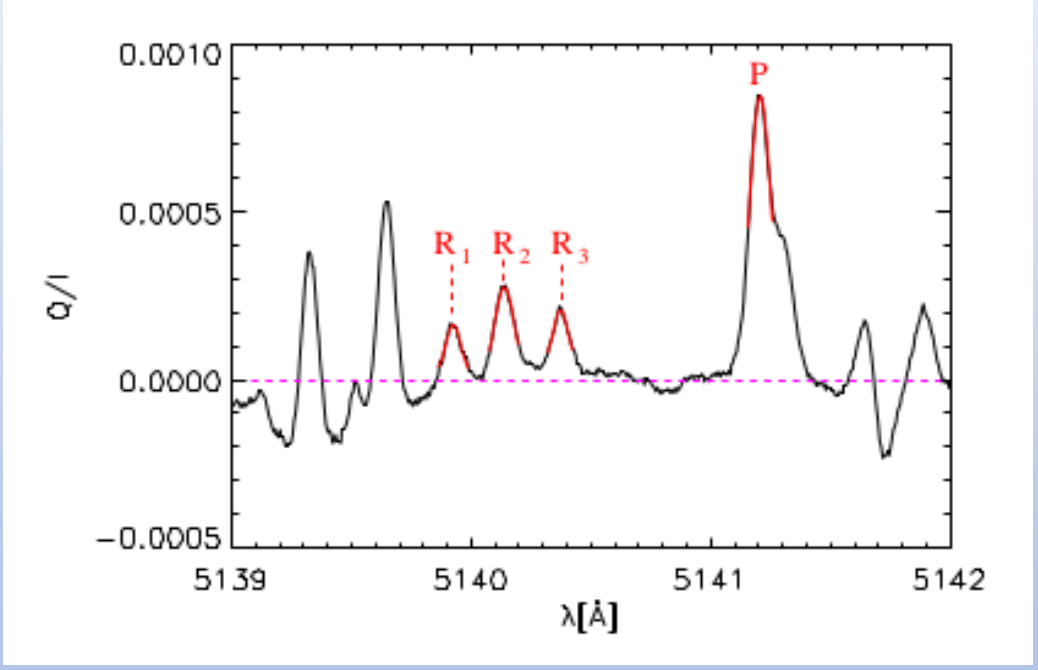
Zeeman effect by strong magnetic fields in sunspots



Courtesy: Franziska Zeuner

Scattering polarization near solar limb: example of C_2 molecular lines

-> See S. Berdyugina's talk



- Polarized signal amplitude modified by unresolved (turbulent) magnetic field (Hanle effect)
- Each line has different sensitivity to the magnetic field (differential Hanle effect)

Scientific goals:

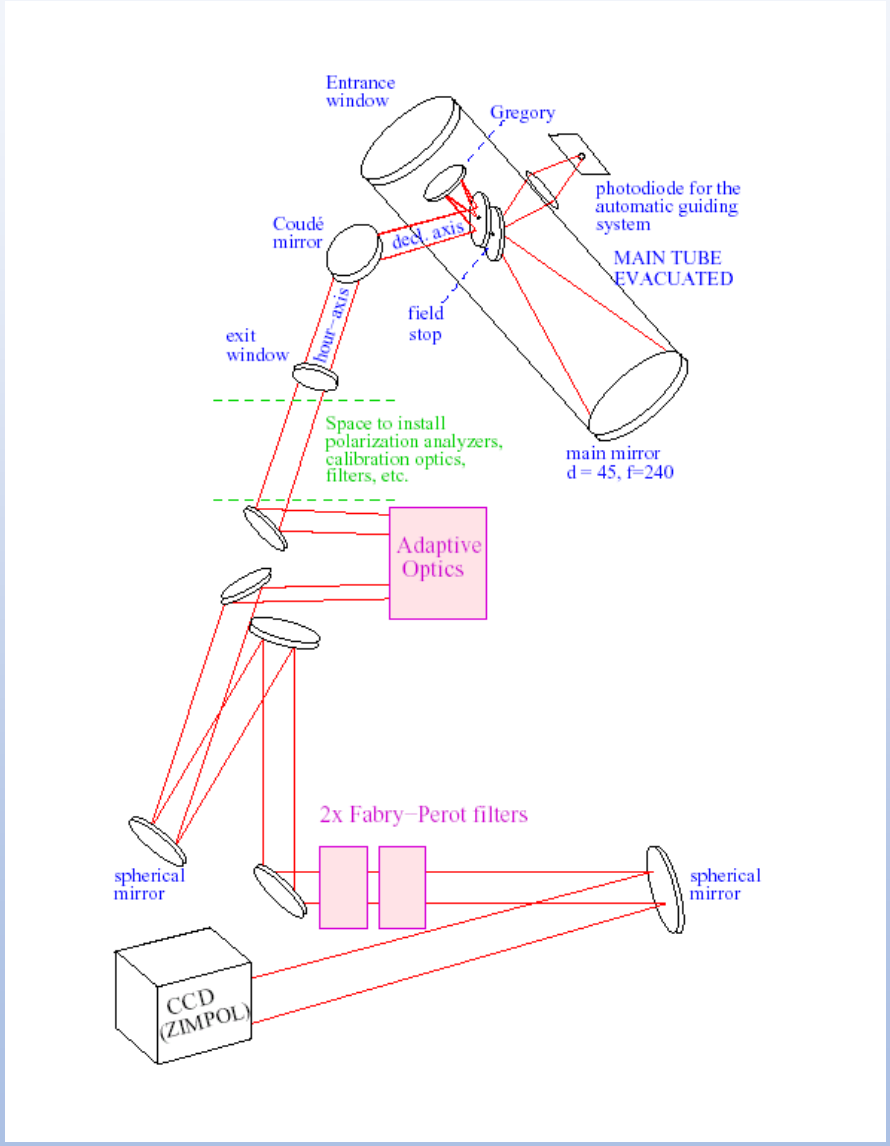
- **Exploring possible variations of the small-scale unresolved fields with the solar cycle**
- **obtaining information on the physical origin of these fields**

The IRSOL instrumentation

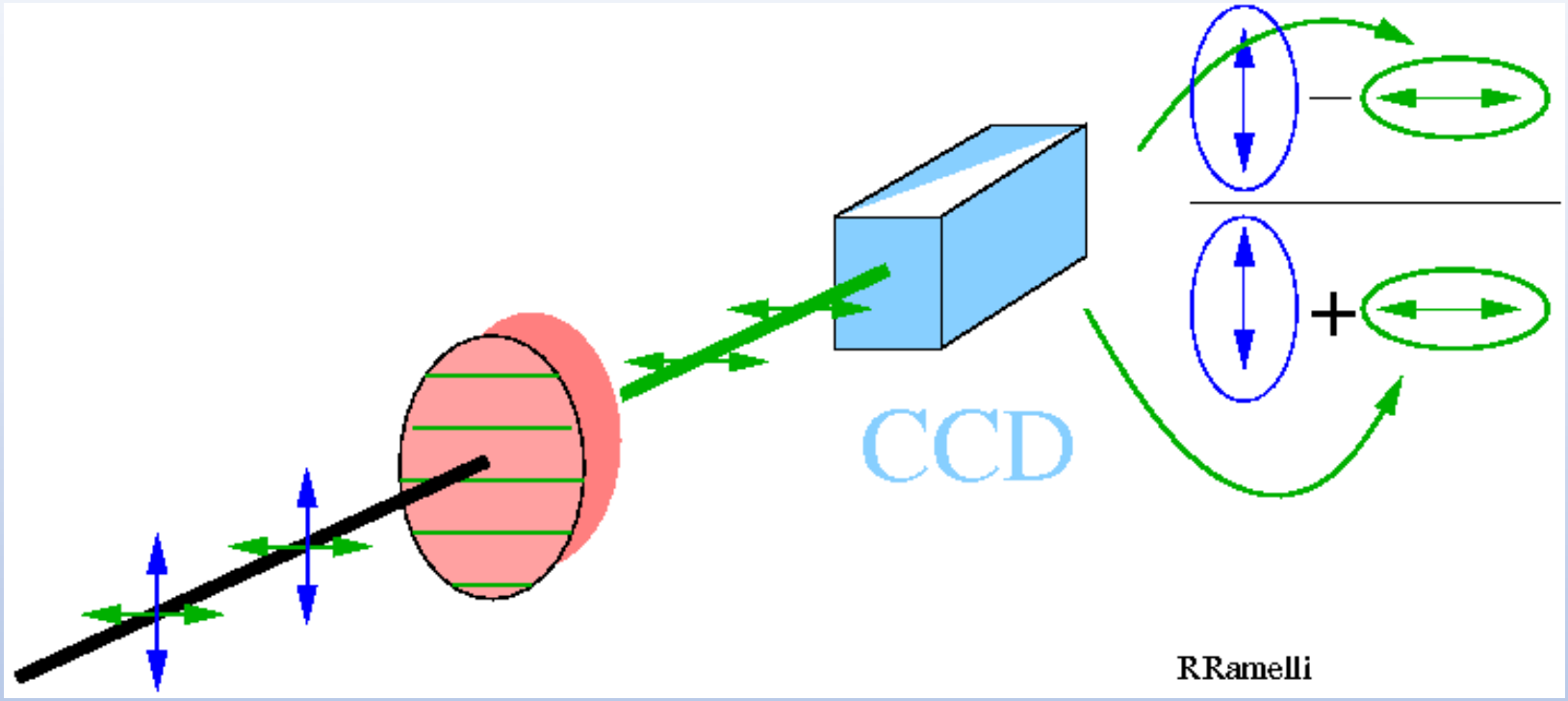
Telescope

- **Telescope:** Gregory - Coudé, evacuated
  - Diameter of primary mirror: 45 cm
  - Total focal length: 25 m
- **Spectrograph:**
  - Echelle grating 18 cm × 36 cm
  - Resolution: $\lambda/\Delta\lambda \sim 10^6$
  - 316 lines / mm, blaze 63˚
- **Fabry Perot filter system:**
  - Tunable, based on 2 Lithium-Niobate Fabry-Perot etalons
  - Bandwidth ~ 30 mA
  - Novel configuration with FP+spectrograph
- **ZIMPOL polarimeter**

Instrumental setup at IRSOL



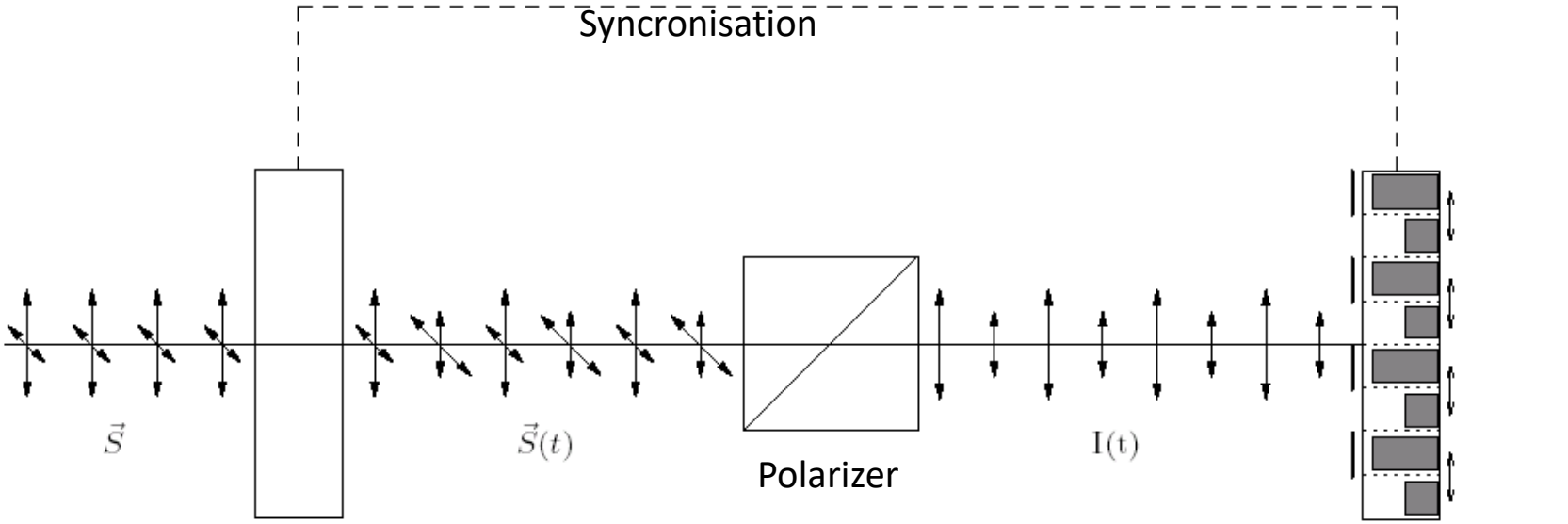
How to measure polarization



- Problem if intensity is not constant:
  - if modulation cycle <~ 10^3Hz, measurements are affected by seeing

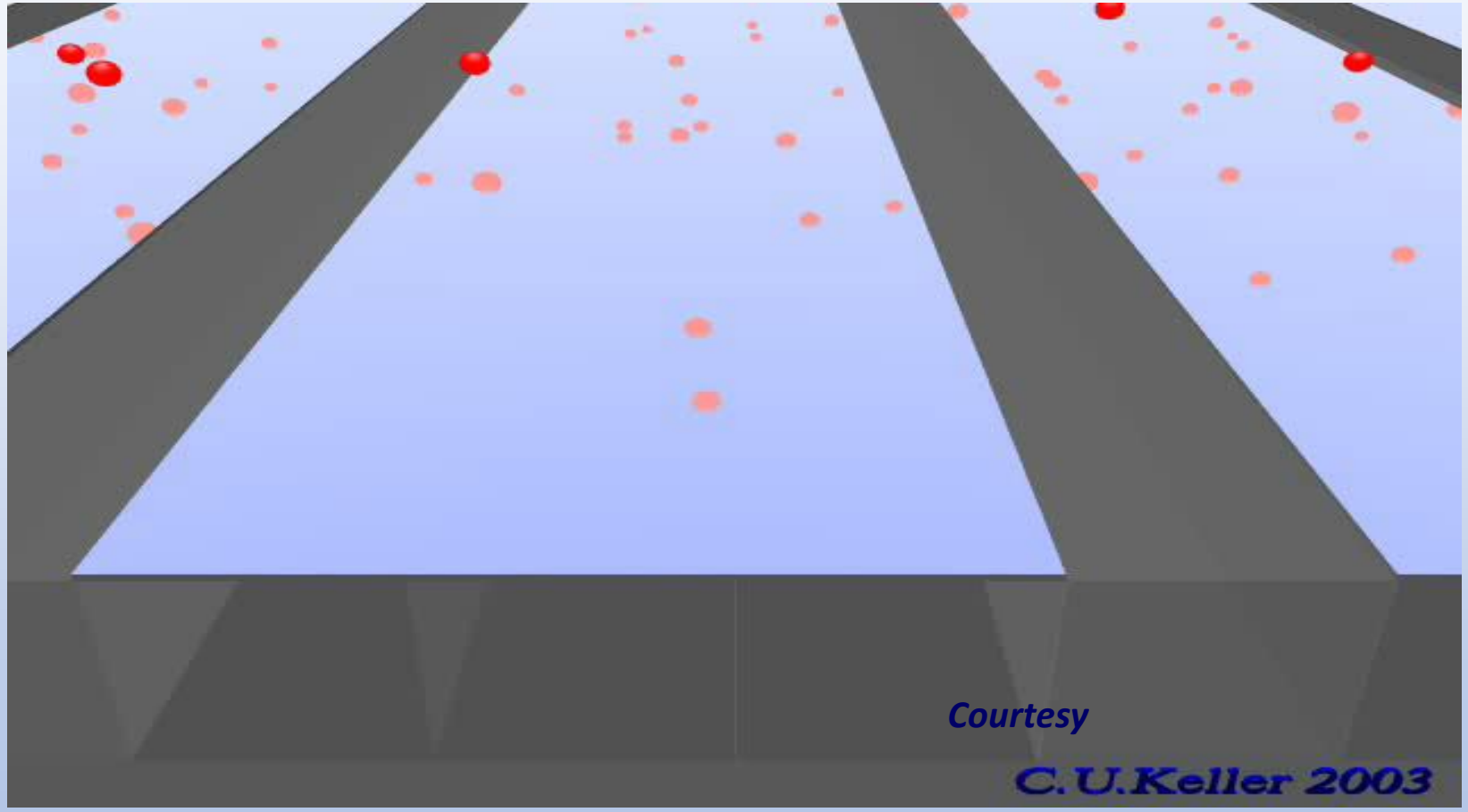
ZIMPOL polarimeter

- Fast modulation (1kHz-42kHz) allows observations almost free from seeing induced crosstalks (error dominated by photon noise statistics)
- Max. precision $<10^{-5}$
- ZIMPOL development carried out in collaboration with SUPSI, Lugano



Source: D. Gisler, PhD thesis

Demodulation: ZIMPOL 2 and 3

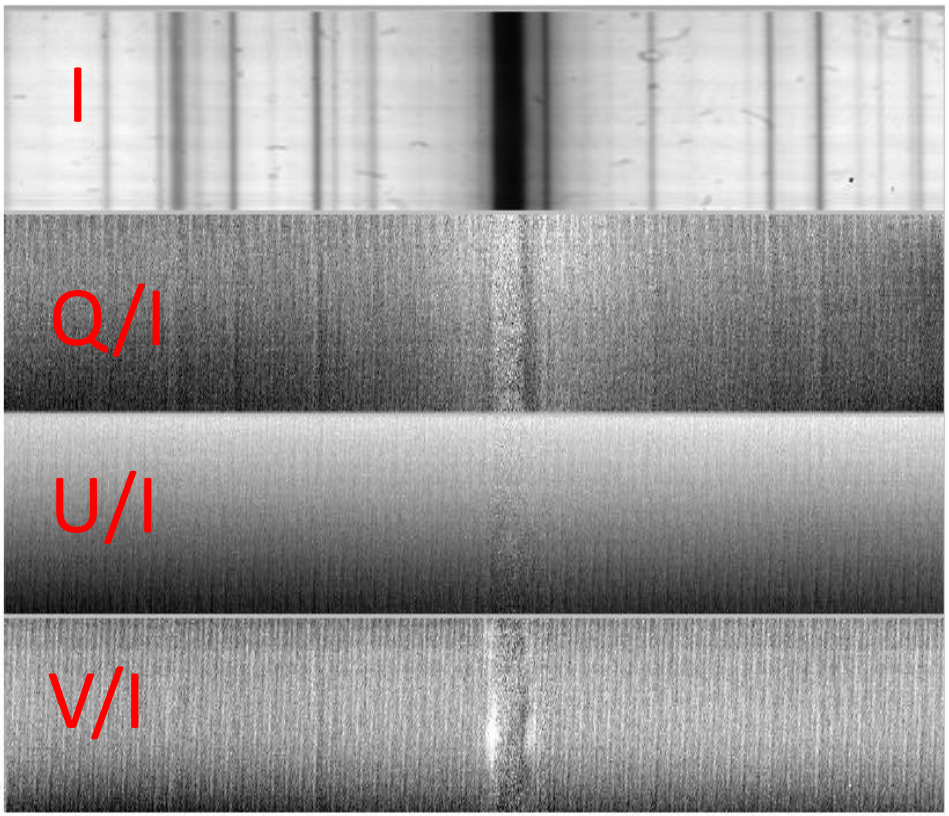


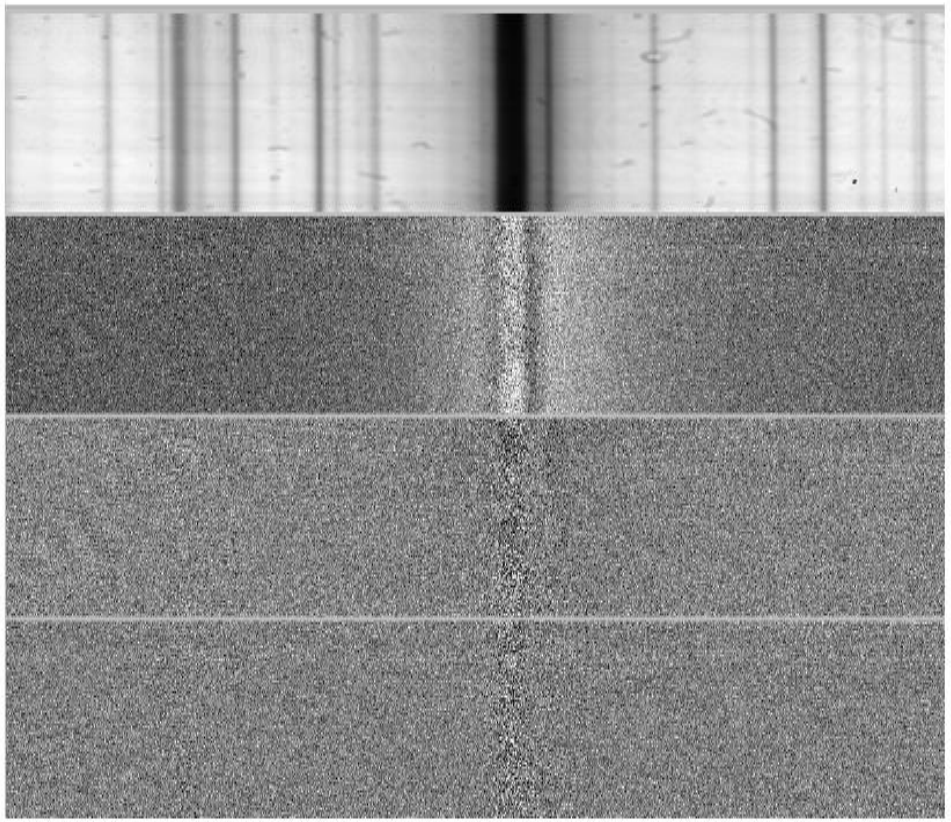
- 3 out of 4 raws are masked
- full Stokes measurement with one camera

News about ZIMPOL

- 2022: New redesign of the electronics @ SUPSI
- Working on efficency improvements (read out speed, better pipelining of readout)
- Installation at GREGOR telescope -> goal premanently
- Collaboration OMEL,ETH (Optical Materials Engineering Laboratory): using ZIMPOL and involving IRSOL (Gisler) patented method for measuring opitcal activity of chiral molecules in laboratory (pharmaceutics)
- Considering new version (based on CMOS)
- Combination fast-slow modulation

Slow modulation at GREGOR





Without

With

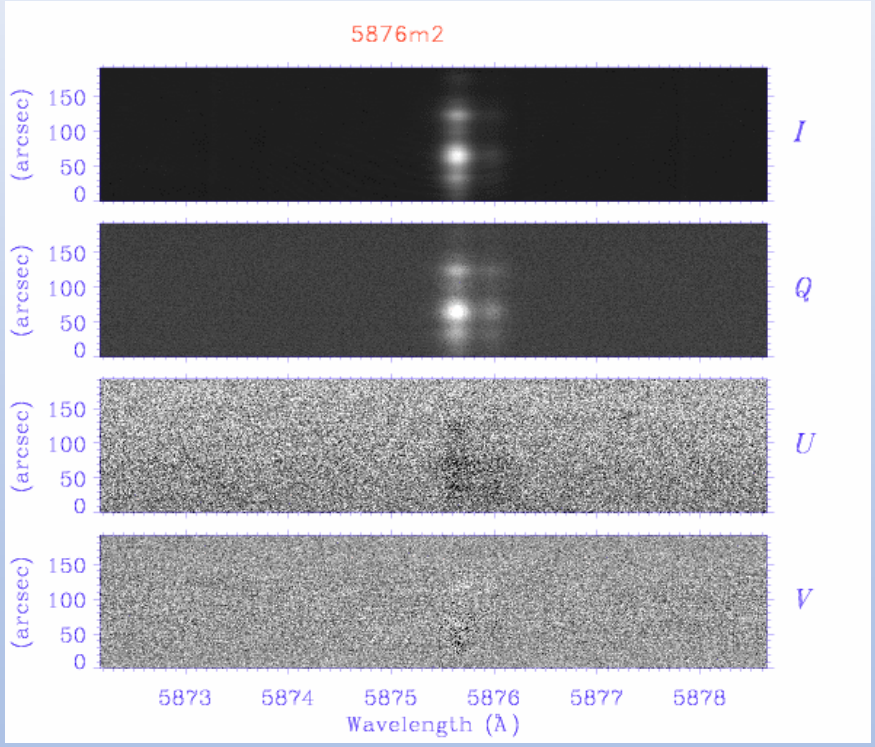
Courtesy F. Zeuner

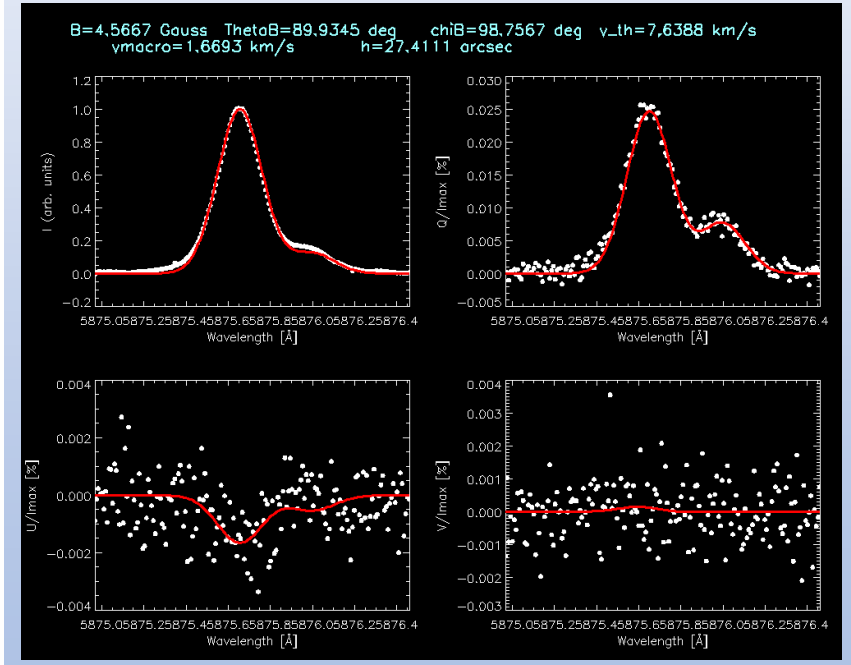
Examples of recent scientific observation programs

- Synoptic program in C_2 molecular lines (Berdyugina's talk)
- Hanle rotation in Sr 4607 line (Zeuner's talk)
- Magneto-optical effect in Ca 4227 (Belluzzi's talk)
- He D_3 measurements in prominences
- He D_3, Na D_1 D_2 measurements in flares
- …

Examples of scientific observation programs

Example of prominence observations in He D3 and inversion

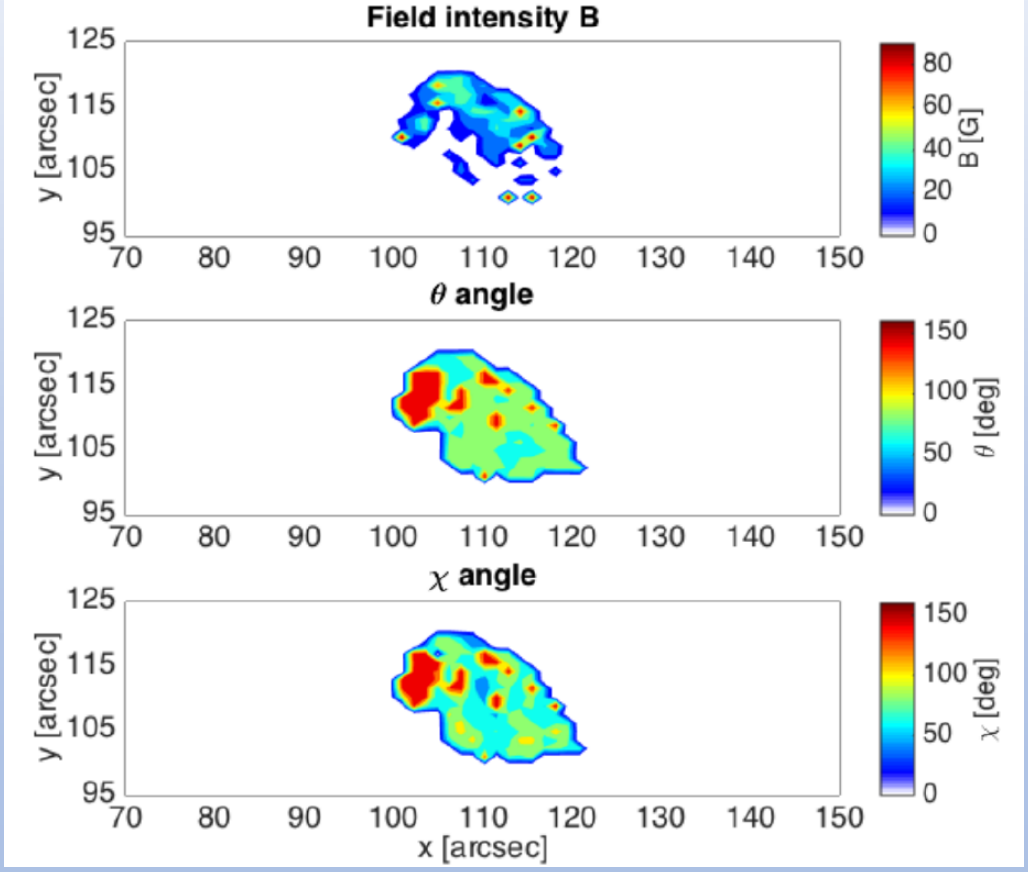




Examples of scientific observation programs

Prominence observations with Fabry-Perot

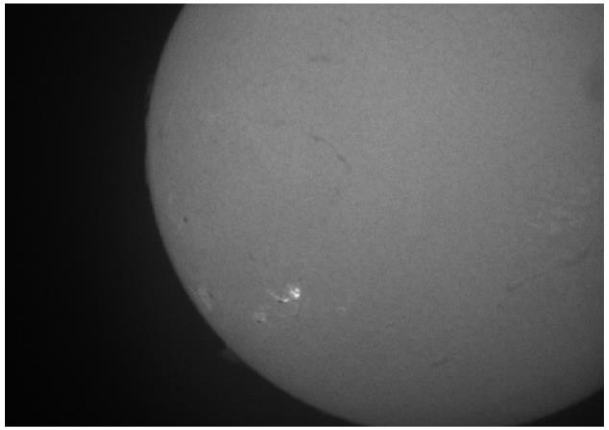
Inversion with Hazel



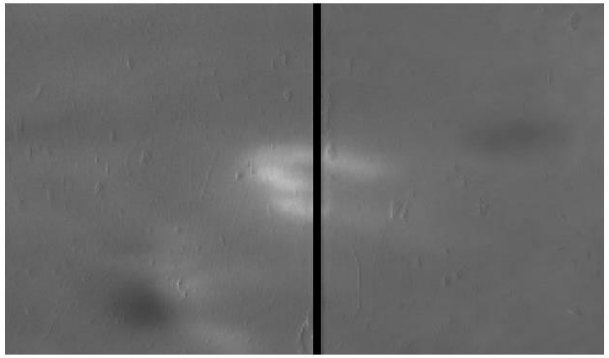
(Di Campli et al. 2020)

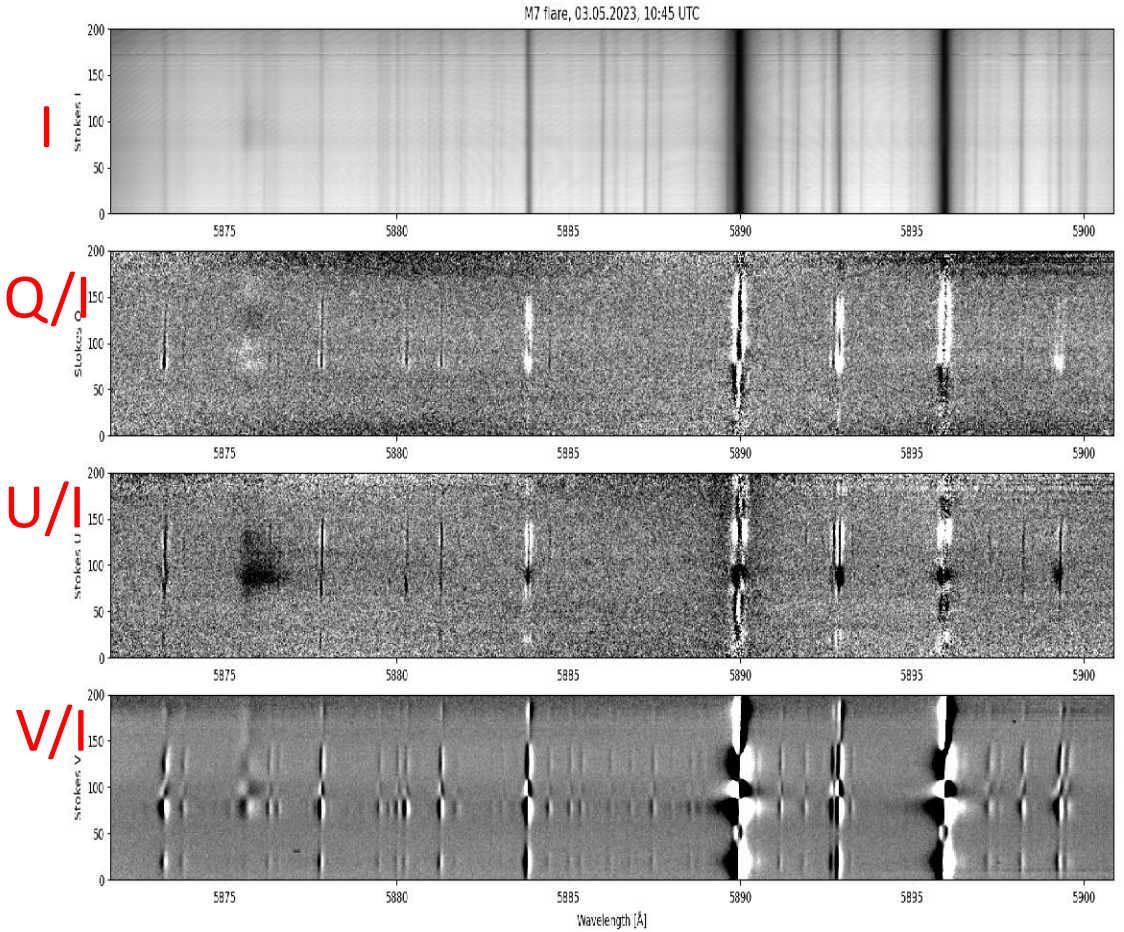
Flare observation at IRSOL in He D3 and Na D1 and D2

Hα @ IRSOL



Slit jaw @ IRSOL





Courtesy by F. Vitali

Outlook

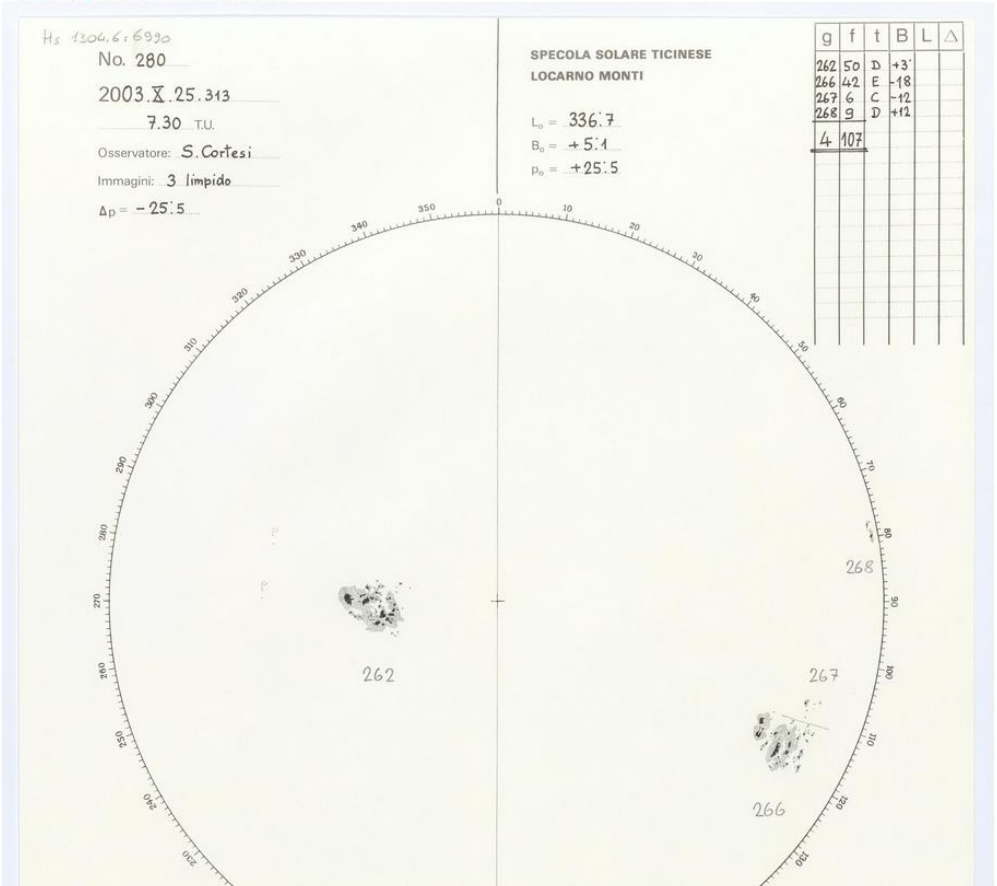
- Development of **new observing techniques** and instrumentation to **enhance precision and accuracy**
  - Improvement of **ZIMPOL polarimeter (better efficiency) -> upgrade at SUPSI**
- Goal to install a permanent ZIMPOL system at GREGOR telescope
- Identify possible evolution of ZIMPOL with new sensor technology
- Further spectropolarimetric observation programs, e.g.:
  - Joint Flares observing campaigns with STIX in collaboration with FHNW
  - Synoptic program with other spectral lines (e.g. Sr 4607)
  - New Second Solar Spectrum Atlas with CLV
- Participation in new **major international projects** for ground based solar telescopes
  (e.g. consortium for the **European Solar Telescope (EST)** project - 4m)

Sunspot group online database (1957-2023)

https://sunspots.irsol.usi.ch/

Back to years list Back to 2003 English

https://doi.org/10.7891/e-manuscripta-152218



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Observer : Sergio Cortesi
Seeing (SIDC) : 3

Group	Not Weighted	Weighted	Type	Latitude	Carrington Longit.
262	24	50	D	3	
266	60	42	E	-18	
267	7	6	C	-12	
268	4	9	D	12	
4	95	107			

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