

Tor vergata Synoptic Solar Telescope: Optical Design and Preliminary Spectral Characterization

D. Calchetti¹, G. Viavattene², F. Berrilli¹, D. Del Moro¹, L. Giovannelli¹, S. Jefferies³, N. Murphy⁴ and M. Oliviero⁵

¹University of Rome Tor Vergata, ²INAF Observatory of Rome, ³Georgia State University, ⁴NASA's Jet Propulsion Laboratory, ⁵INAF Observatory of Capodimonte

16th European Space Weather Week



Synoptic Telescope

- Multi-wavelength observations of the Sun
- Monitoring solar activity
- Array of telescopes

Dopplergram

- LoS velocity in each pixel
- Dynamics of the solar atmosphere

Magnetogram

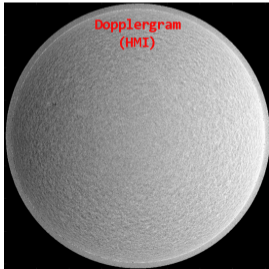
- LoS magnetic field in each pixel
- Evolution of Active Regions

H α

- Context image
- Flare observation

Synoptic Telescope

- Multi-wavelength observations of the Sun
- Monitoring solar activity
- Array of telescopes



Dopplergram

- LoS velocity in each pixel
- Dynamics of the solar atmosphere

Magnetogram

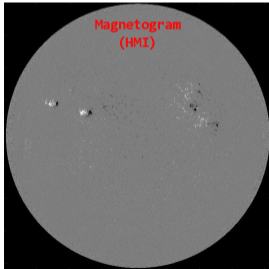
- LoS magnetic field in each pixel
- Evolution of Active Regions

H α

- Context image
- Flare observation

Synoptic Telescope

- Multi-wavelength observations of the Sun
- Monitoring solar activity
- Array of telescopes



Dopplergram

- LoS velocity in each pixel
- Dynamics of the solar atmosphere

Magnetogram

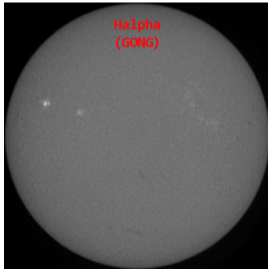
- LoS magnetic field in each pixel
- Evolution of Active Regions

H α

- Context image
- Flare observation

Synoptic Telescope

- Multi-wavelength observations of the Sun
- Monitoring solar activity
- Array of telescopes



Dopplergram

- LoS velocity in each pixel
- Dynamics of the solar atmosphere

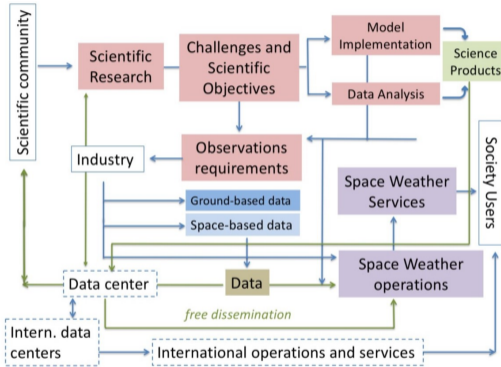
Magnetogram

- LoS magnetic field in each pixel
- Evolution of Active Regions

H α

- Context image
- Flare observation

ASPIS

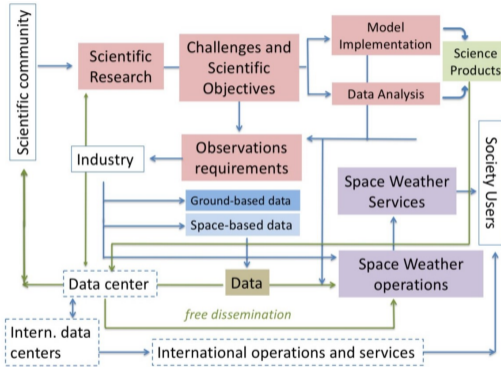


Credit: Christina Plainaki

UniTOV Solar Physics group is interested in ground-based data, data analysis and model implementation.

- Asi Space weather InfraStructure
- Aims to disseminate interdisciplinary SW data to support scientific research
- National scientific SW data center
- Test-beds for forecasting models

ASPIS



Credit: Christina Plainaki

UniTOV Solar Physics group is interested in ground-based data, data analysis and model implementation.

- Asi Space weather InfraStructure
- Aims to disseminate interdisciplinary SW data to support scientific research
- National scientific SW data center
- Test-beds for forecasting models

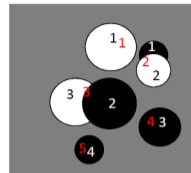
Flare Forecasting Algorithm

D UniTOV Value

- Number of Polarity Inversion Lines
- Simple algorithm
- Computationally inexpensive

The Algorithm

- Binary mask of LoS magnetograms
- f_t is the total number of positive and negative fragments
- f_u is the total number of unsigned fragments
- $D = f_t - f_u$



$$f_t = 3 + 4 = 7$$

$$f_u = 5$$

$$D = f_t - f_u$$

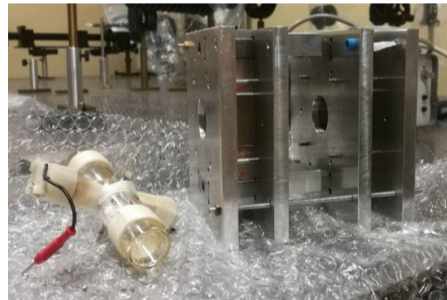
$$D = 7 - 5 = 2$$

**More information during
Berrilli et al. talk,
Session 16 (Rogier),
11:45!**

MOF

- Magneto Optical Filters (Cimino et al., 1967) provide two very stable and narrow bands (~ 50 mÅ at transmission peaks).
- Vapour cell, usually Na or K, with longitudinal magnetic field inside.
- The magnetic field induces an inverse Zeeman effect in the vapour and a Macaluso-Corbino effect (Faraday rotation near absorption line) in the linearly polarized light.

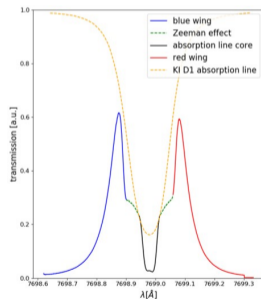
Line	λ [nm]	Height [km]
K I	770	300-400
Na I D2	589	600-700
Fe I (HMI)	617	100
Ni I (MDI)	677	125



MOF

- Magneto Optical Filters (Cimino et al., 1967) provide two very stable and narrow bands (~ 50 mÅ at transmission peaks).
- Vapour cell, usually Na or K, with longitudinal magnetic field inside.
- The magnetic field induces an inverse Zeeman effect in the vapour and a Macaluso-Corbino effect (Faraday rotation near absorption line) in the linearly polarized light.

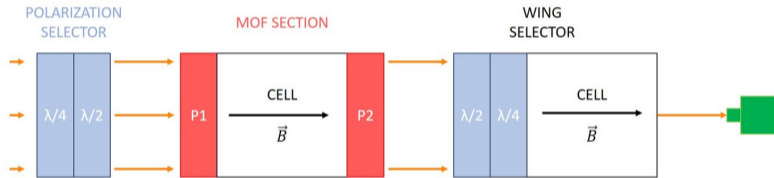
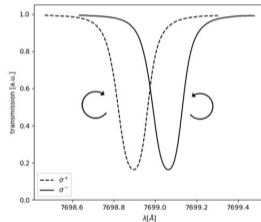
Line	λ [nm]	Height [km]
K I	770	300-400
Na I D2	589	600-700
Fe I (HMI)	617	100
Ni I (MDI)	677	125



(Calchetti et al., accepted)

MOF Optical Line

Incoming light is a σ^+ and σ^- absorption line circularly polarized.



The two cells can separate blue and red wings.

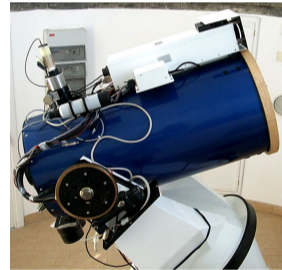
VAMOS and MOTH

VAMOS

- INAF Observatory of Capodimonte
- Potassium MOF
- New optical design, High resolution

MOTH

- GSU Hard Labor Creek Observatory
- Potassium and Sodium MOF
- Antarctic campaigns, 1.8" resolution, 5 s cadence



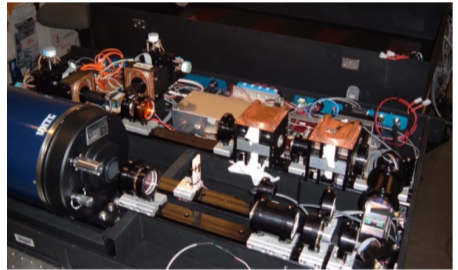
VAMOS and MOTH

VAMOS

- INAF Observatory of Capodimonte
- Potassium MOF
- New optical design, High resolution

MOTH

- GSU Hard Labor Creek Observatory
- Potassium and Sodium MOF
- Antarctic campaigns, 1.8" resolution, 5 s cadence



Tor vergata Synoptic Solar Telescope (TSST)

- 2 channels: $H\alpha$ and K-MOF
- Collaboration with MOTH (GSU and IfA) and VAMOS (INAF-OAC)
- Test @ UniTOV, Observations @ La Palma (Canary Islands)

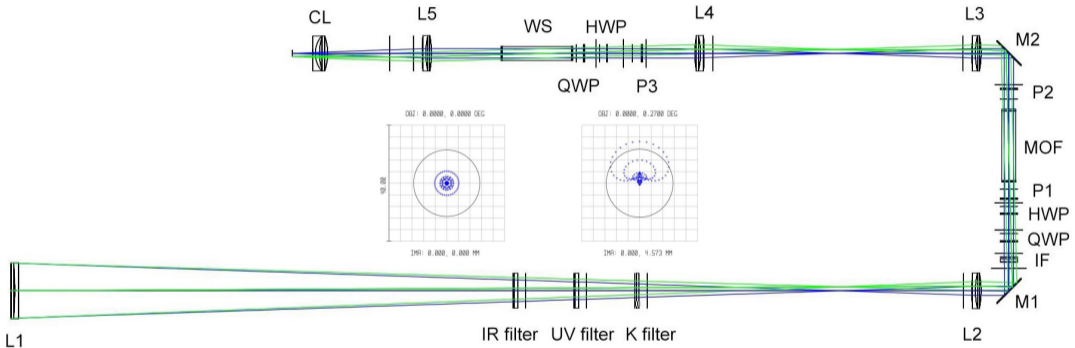
Refractor $H\alpha$ telescope 0.4 Å

- Real time flare and structure regions detection
- $H\alpha$ filter compatible with INAF Observatory of Catania and Capodimonte

MOF-based telescope with 80mm aperture f/12.5

- Simultaneous dopplergram and magnetogram every 15s (TBC)
- Dynamic of the solar atmosphere
- Evolution of the active regions

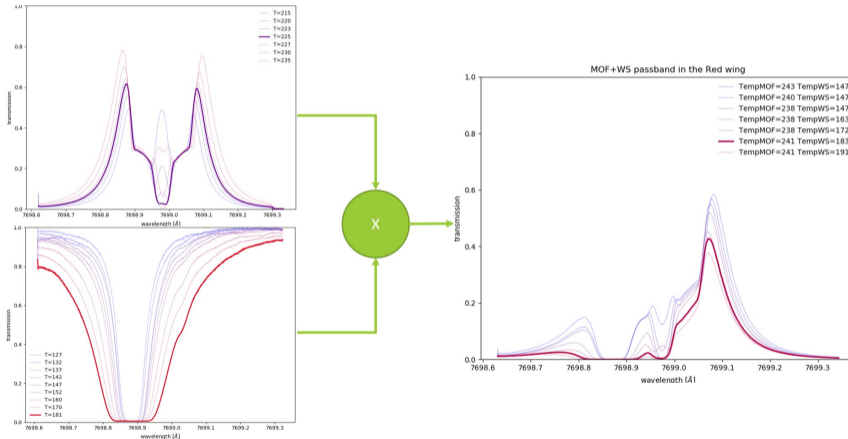
Optical Scheme



(Courtesy of G. Viavattene)

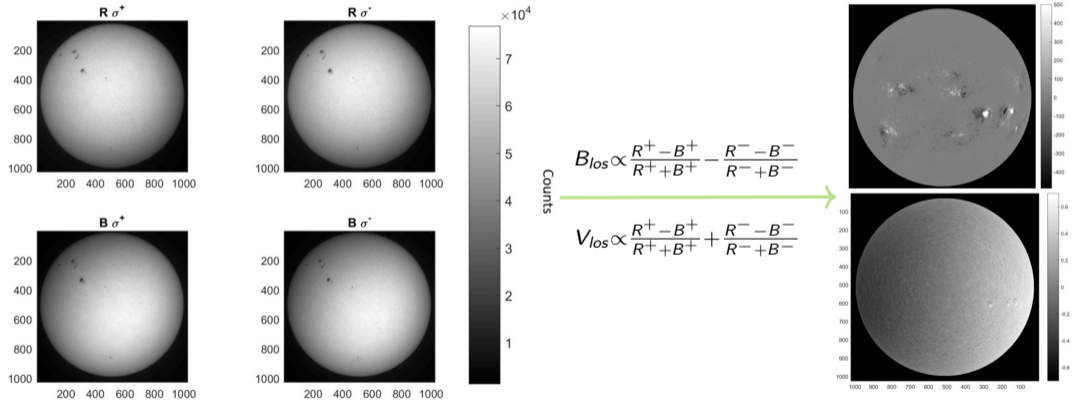
Spectral Characterization

Test at INAF-OAC (Calchetti et al., accepted)

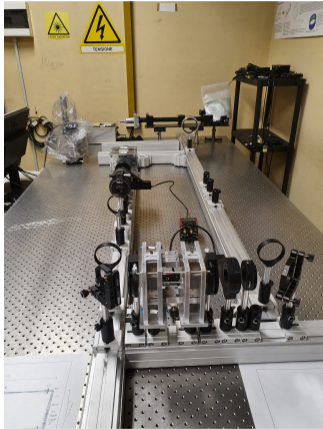


Observations with MOF

Mees Solar Observatory,
Maui, Hawaii, USA
Courtesy of Prof. S.
Jefferies



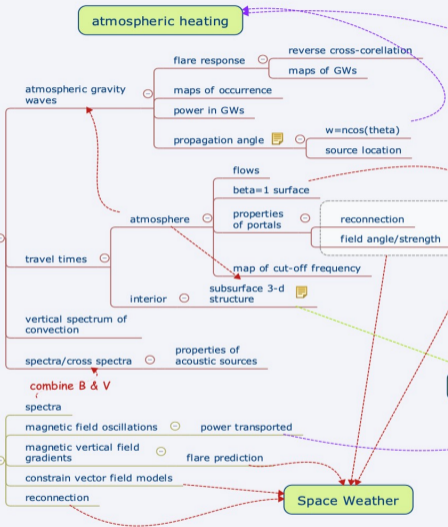
Work in Progress...



MOTH science

multi-height velocity

multi-height magnetic



interior/dynamo

Space Weather

Courtesy of S. Jefferies