

# SUNRISE-III STATUS + SCIENCE START



ANDREAS LAGG  
MPI FOR SOLAR SYSTEM RESEARCH, GÖTTINGEN  
SUNRISE III CONSORTIUM



# SUNRISE III - TEAM



**S.K. Solanki, A. Lagg + MPS Team**

Max Planck Institute for Solar System Research, Germany

PM, Telescope, PFI  
infrastructure, ISLiD, ICS, SUSI



**T. Berkefeld + KIS Team, Science: J. M. Borrero, aka FISTRO**

Leibniz Institut für Sonnenphysik, Germany

CWS



**P. Bernasconi + APL Team**

Applied Physics Laboratory, Johns Hopkins University, USA

Gondola, Interface to CSBF



**V. Martinez Pillet**

National Solar Observatory, Boulder, USA

DKIST, Science



**J.C. del Toro-Iniesta + TuMag Team**

Instituto de Astrofísica de Andalucía, Spain, SIII consortium

TuMag



**Y. Katsukawa + NAOJ Team**

National Astronomical Observatory of Japan

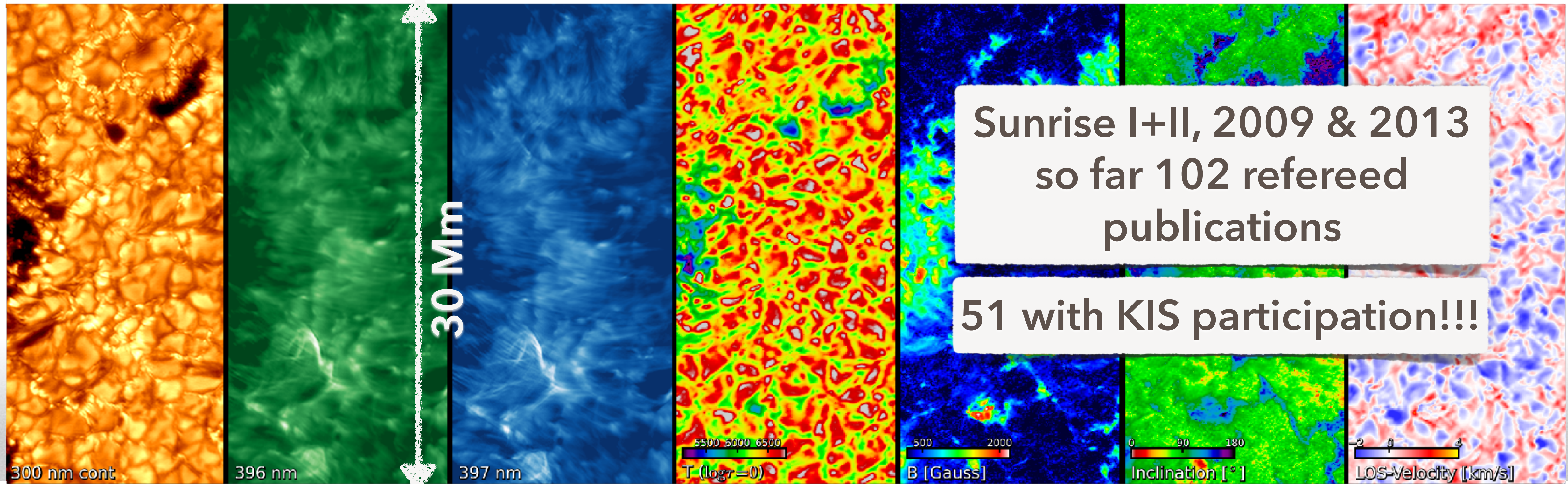
SCIP



**Amy Canfield**

Sunrise III Mission Manager at NASA BPO

Balloon



**Intensity  
image:  
photosphere**

**Narrow-band  
Ca-image:  
chromosphere**

**Temperature  
'solar surface'**

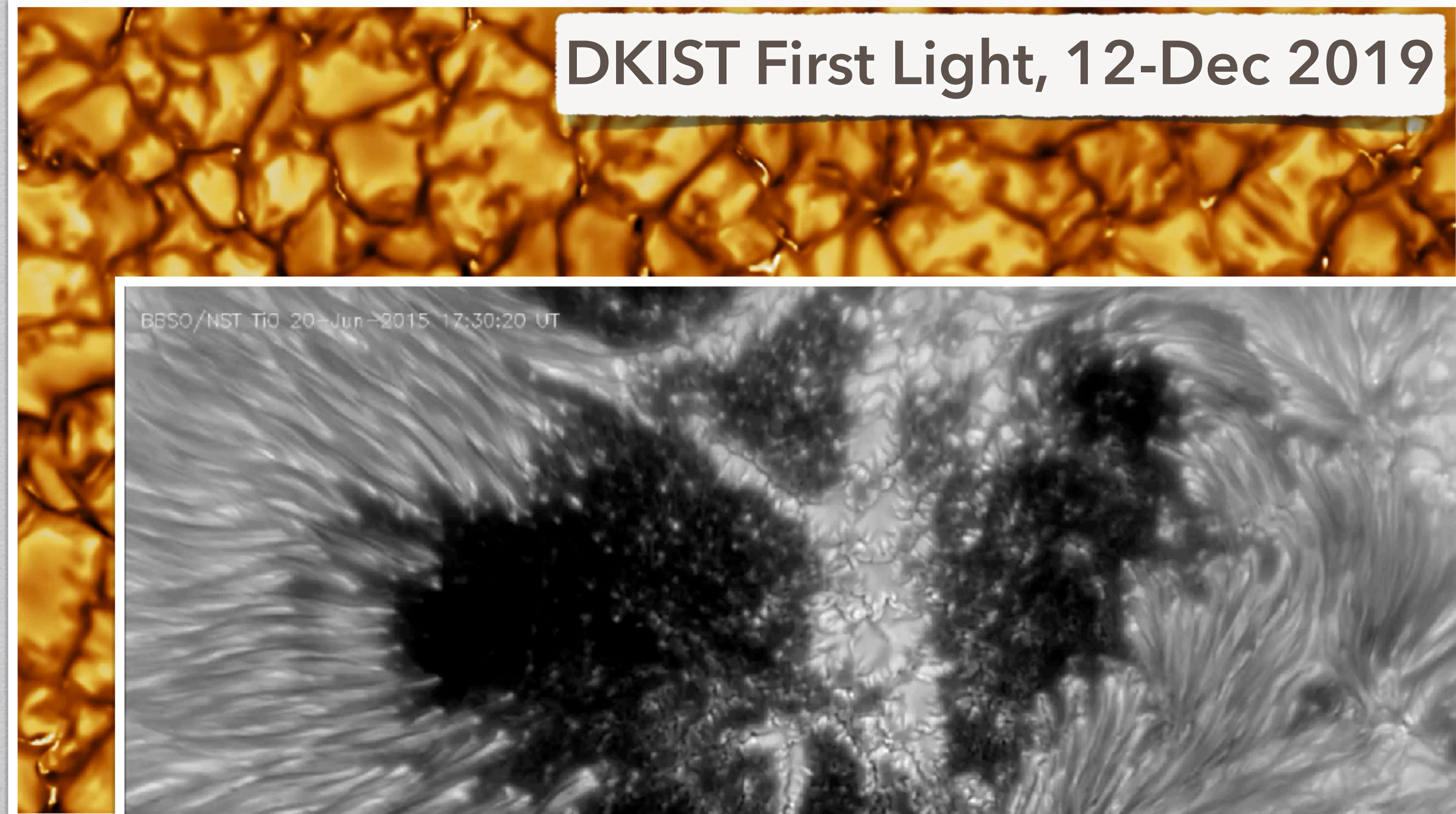
**Magnetic field  
strength**

**Magnetic field  
orientation**

**Line-of-sight  
velocity**

# WHY SUNRISE III?

- Seeing-free environment
- 24/7 sunlight
- long, constant-quality time series (>8 hr)
- access to UV
- no atmospheric dispersion  
→ combine various wavelengths
- well-known PSF (high pol. S/N ratio, no noise increase from reconstruction)
- much reduced telluric lines
- low sky brightness



DKIST First Light, 12-Dec 2019

BESO/NST TiO 20-Jun-2015 17:30:20 UT

Big Bear Goode Solar Telescope TiO

# SUNRISE III - WHAT IS NEW? WHAT IS OLD?

Gondola: now with roll compensation

Light distribution unit (ISLiD): complete redesign

New E-units and E-racks

New pointing (CWS + gondola)

New telescope mechanisms

New ICS + DSS

New telescope hardware

3 new science instruments:

- TuMag
- SCIP
- SUSI

Telescope: M1, M2, some struds, central frame, PI



# SUNRISE III - CURRENT STATUS



Follow @Sunrise\_III on twitter!

SUSI assembly, April 19 2021



ISLiD assembly done, CWS integrated (March 2021)

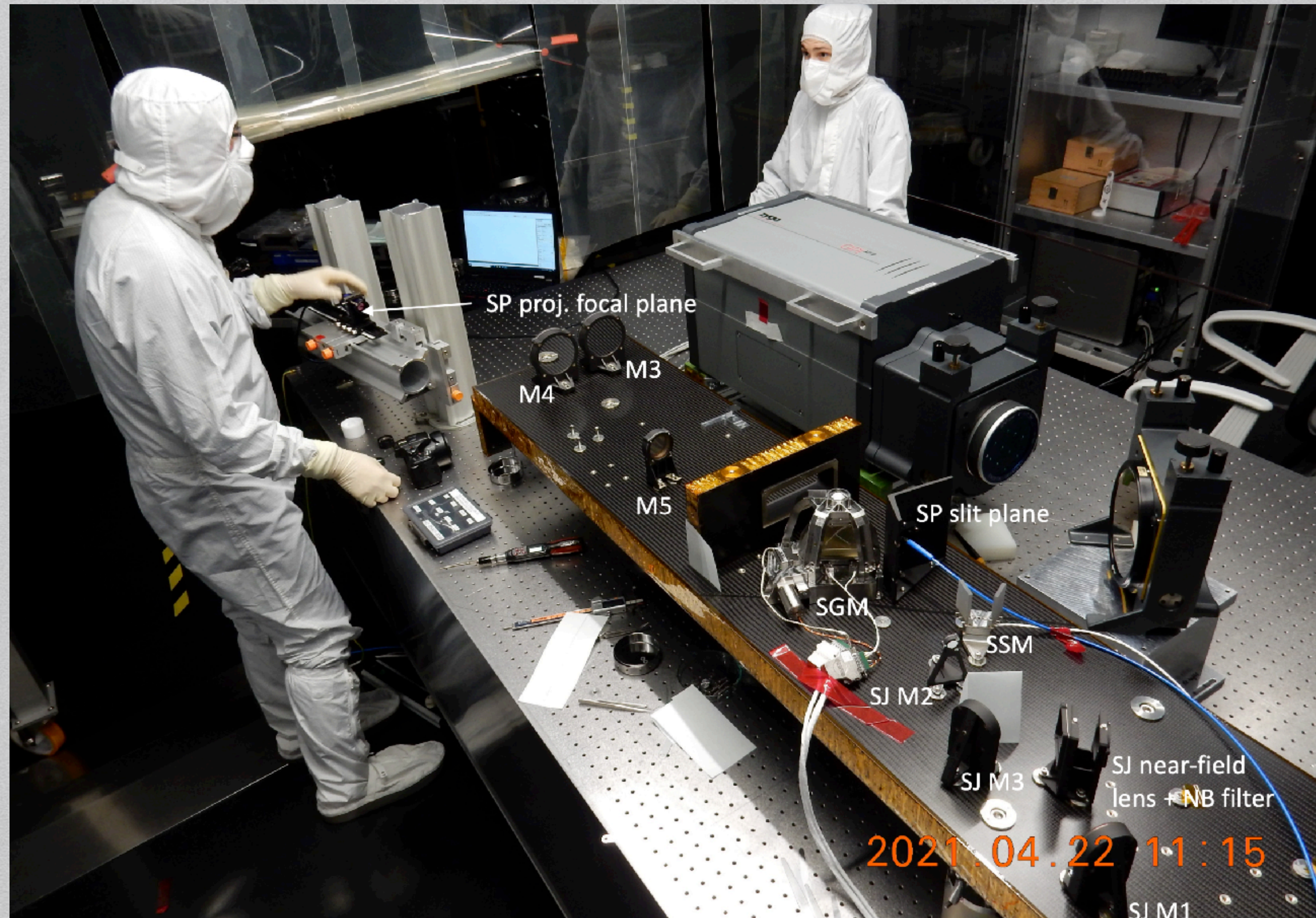
# SUSI assembly





## SUSI assembly status:

- All optics on base plate mounted and optically aligned
- Scanner and grating mechanism mounted, in operation (with EGSE), and optically aligned
- First measurements of wave front error: excellent performance



## MPS workpackages:

- ISLiD: done
- PFI
  - CWS & ISLiD integrated
  - waiting for science instruments
  - full functional test & TV test in July
- Telescope + Mechanisms + Thermal Hardware
  - mechanisms: refurbished / replaced
  - new HRW (in F1) + radiators
  - assembly & alignment: summer 2021
- E-racks & Harness:
  - baseplates ordered
  - harness in production
- ICS
  - hardware in fabrication
- SUSI
- Software
- Communication with Cols / Balloon facilities (NASA -CSBF - BPO, ESRANGE)
- PR



**UV light for dust detection**

## Partner contributions:

- SCIP
  - Ready for delivery, then HW error detected
  - refurbishment ongoing
  - delivery Sep 2021
- TuMag (Spanish SIII Consortium):
  - FM production ongoing
  - delayed delivery (Jan 2022)
- CWS
  - O-unit: integrated
  - E-unit: delivery summer 2021
- Gondola
  - on track
  - at MPS in Sep 2021



**SCIP team + FM SCIP**

# SUNRISE SCHEDULE



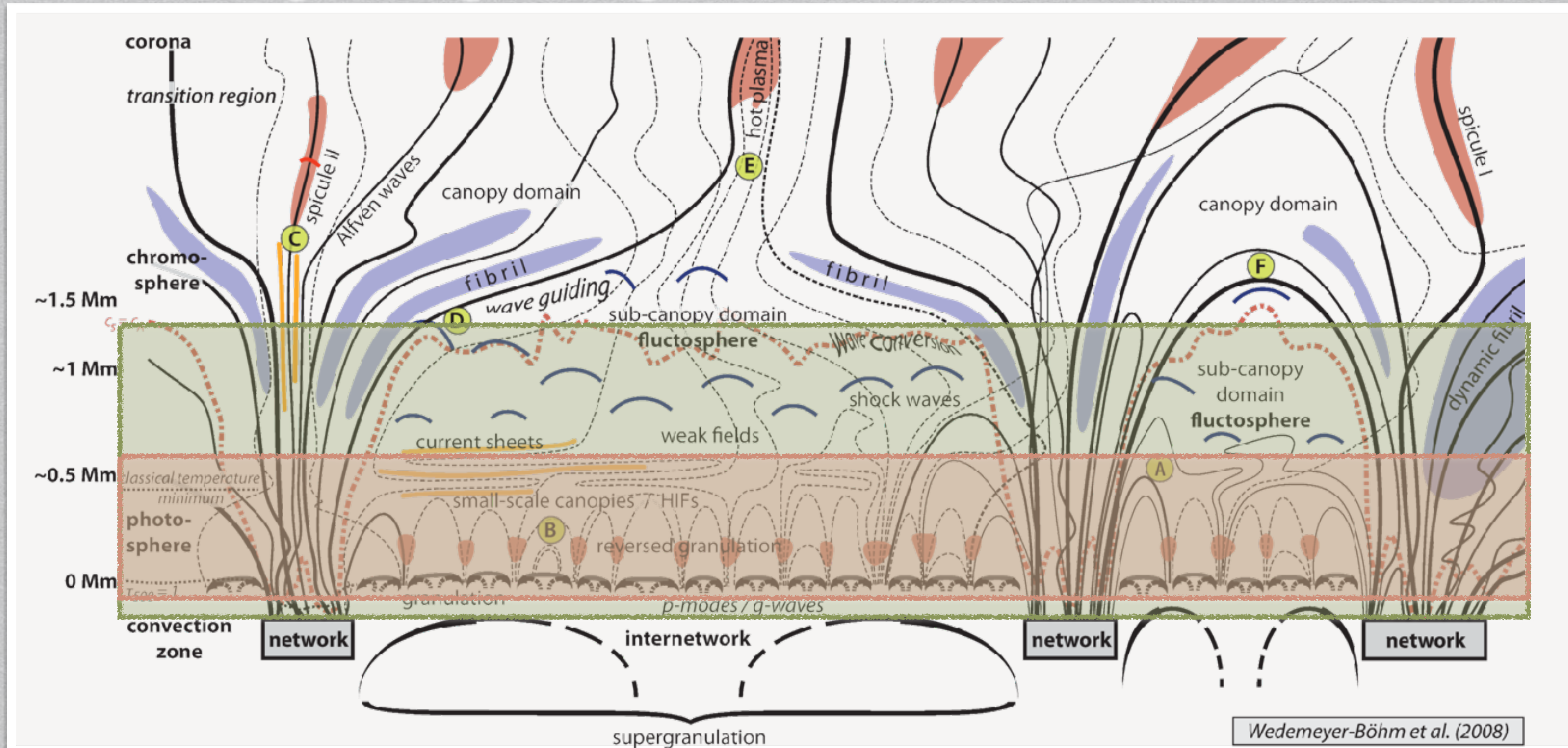
Date start	Duration	End	Activity
04/03/2021	59	02/05/2021	SUSI assembly
23/05/2021	28	20/06/2021	SUSI integration to PFI
20/06/2021	28	18/07/2021	PFI full functional test in vacuum setup (in air)
18/07/2021	14	01/08/2021	PFI into Tvac chamber
01/08/2021	28	29/08/2021	PFI Tvac
29/08/2021	5	03/09/2021	TuMAG mass dummy to PFI
03/09/2021	25	28/09/2021	SCIP integration to PFI
28/09/2021	10	08/10/2021	merging of PFI and telescope
08/10/2021	18	26/10/2021	Mating gondola & payload
26/10/2021	28	23/11/2021	Hangtest@MPS
23/11/2021	21	14/12/2021	Operation Training & Final tests
14/12/2021	31	14/01/2022	unmount gondola and payload
14/01/2022	28	11/02/2022	TuMAG integration to PFI
11/02/2022	7	18/02/2022	PFI Pol. calibration from F1 (all instruments)
18/02/2022	21	11/03/2022	PFI 2nd TVac with Sun
11/03/2022	21	01/04/2022	packing + transport to Kiruna
01/04/2022	61	01/06/2022	Assembly & Verification @ ESRANGE
01/06/2022	0	01/06/2022	ready for launch

- 3D structure of photospheric and chromospheric field in different regions: how force-free is the field?
- How different is the quiet Sun (coronal hole vs. normal)?
- How efficient is field-line braiding (campfires)?
- How high is the wave flux travelling into chromosphere and corona?
- How common are small scale jets?
- How does magnetic flux emerge and how is it removed?

# SUNRISE III - PROBING DEEPER AND HIGHER

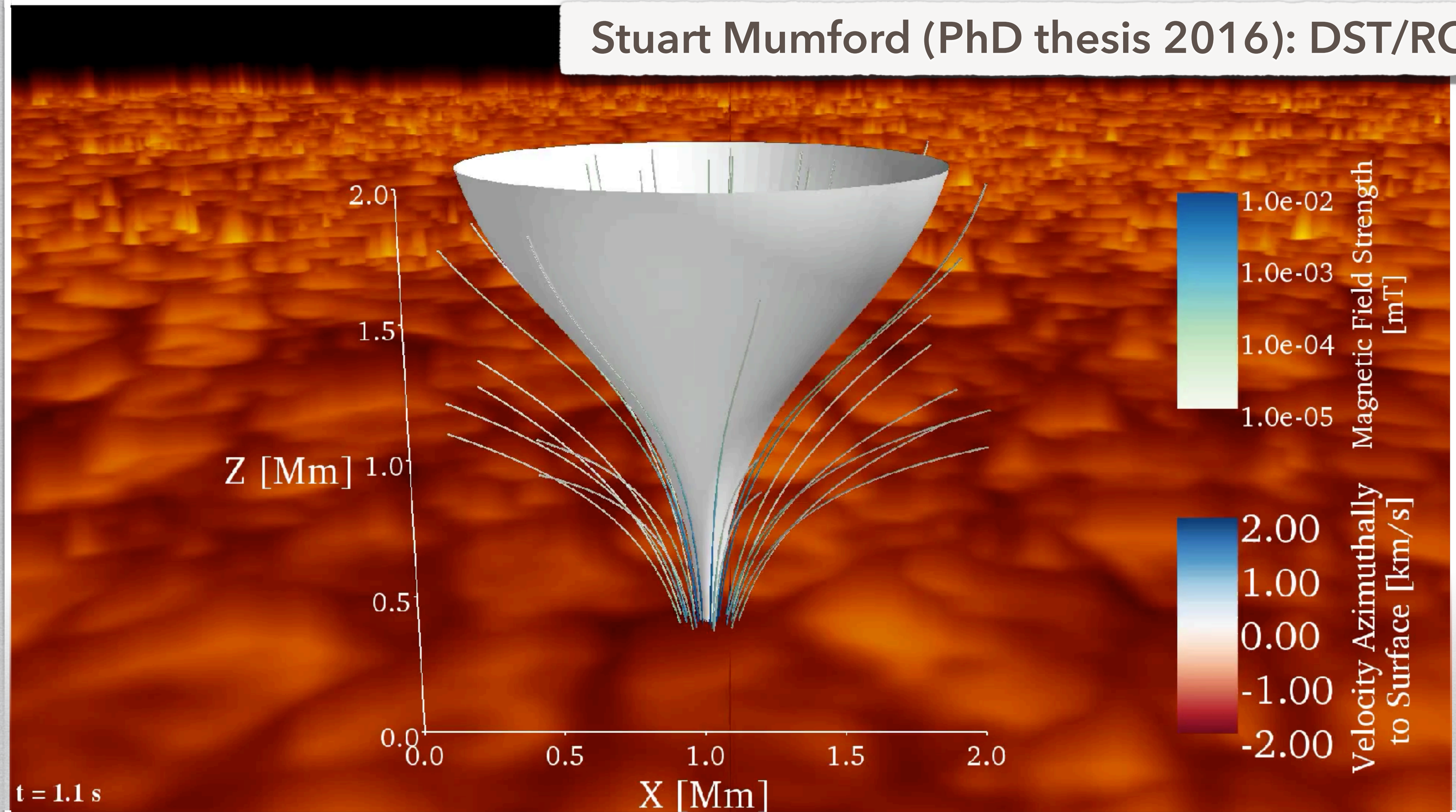
- Sunrise I & II resolved elementary magnetic structures, uncovered chromospheric waves & a possible new way to heat the corona
- Sunrise III will use a new gondola with significantly enhanced stability
- improved science instruments and to probe the magnetic field & its influence on the plasma over larger height range

SUNRISE I+II

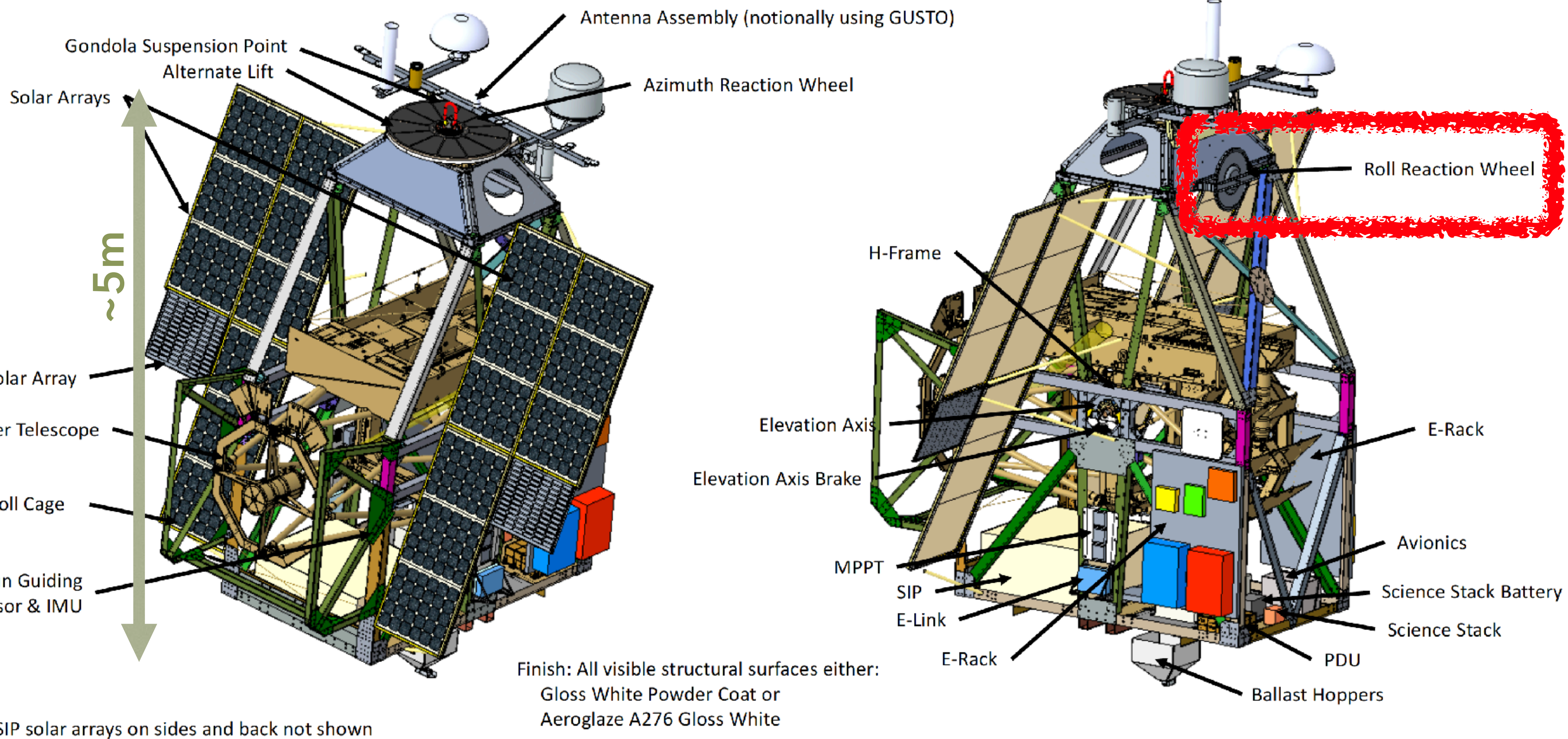


SUNRISE III

Stuart Mumford (PhD thesis 2016): DST/ROSA



# SUNRISE III WITH A COMPLETELY NEW GONDOLA





# SUNRISE III: 3 SCIENTIFIC INSTRUMENTS

## SUSI (UV spectropolarimeter)

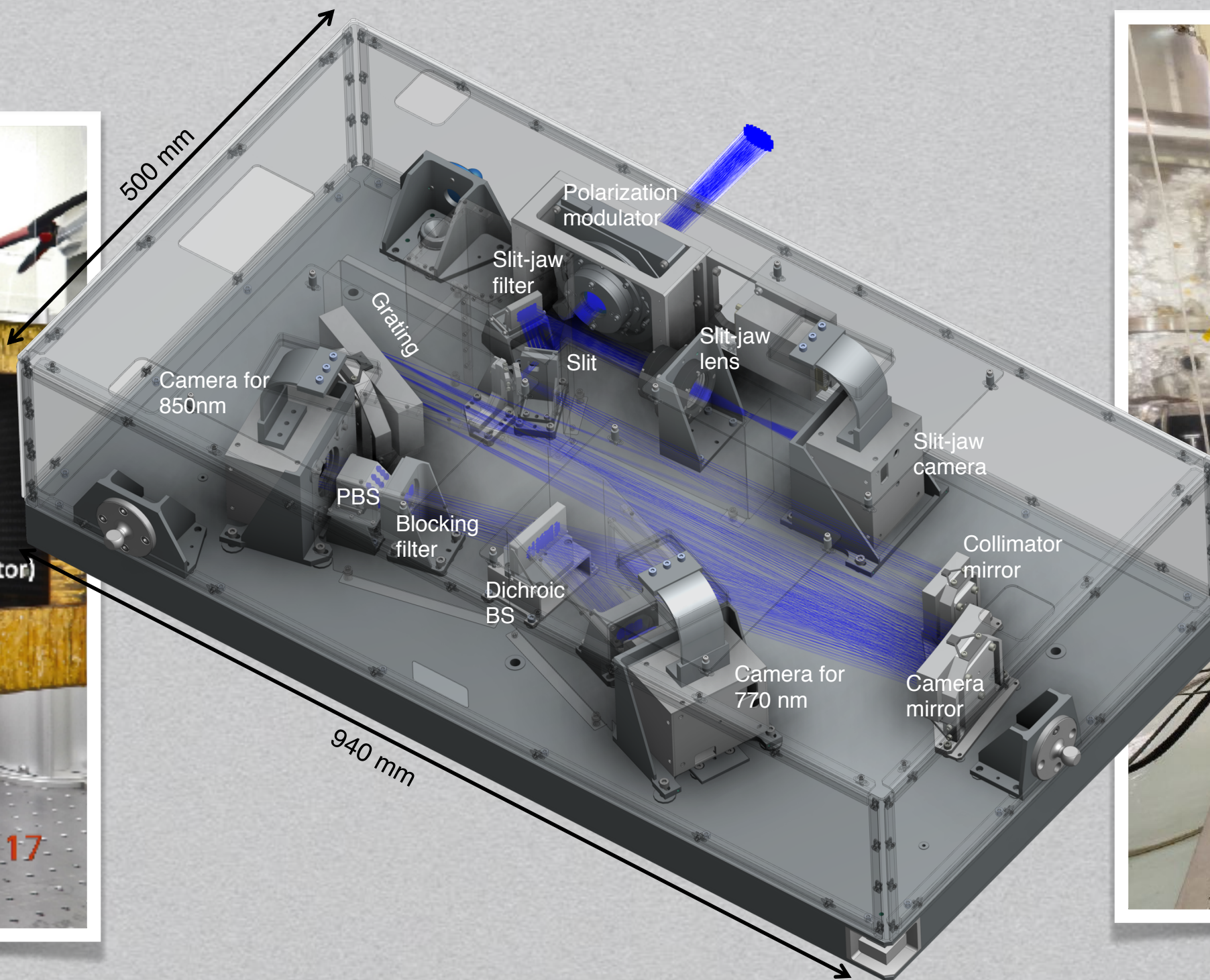
- slit spectrograph
- full stokes from 314-410nm
- unprecedented height & spatial resolution

## TuMaG (imaging spectropol.)

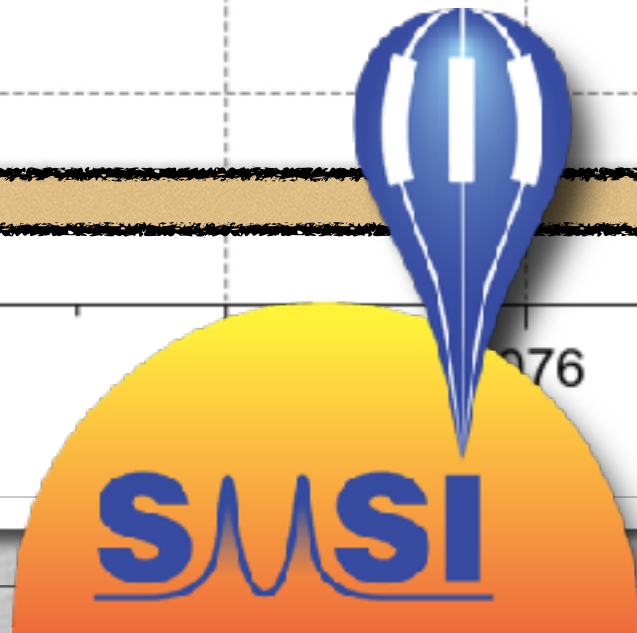
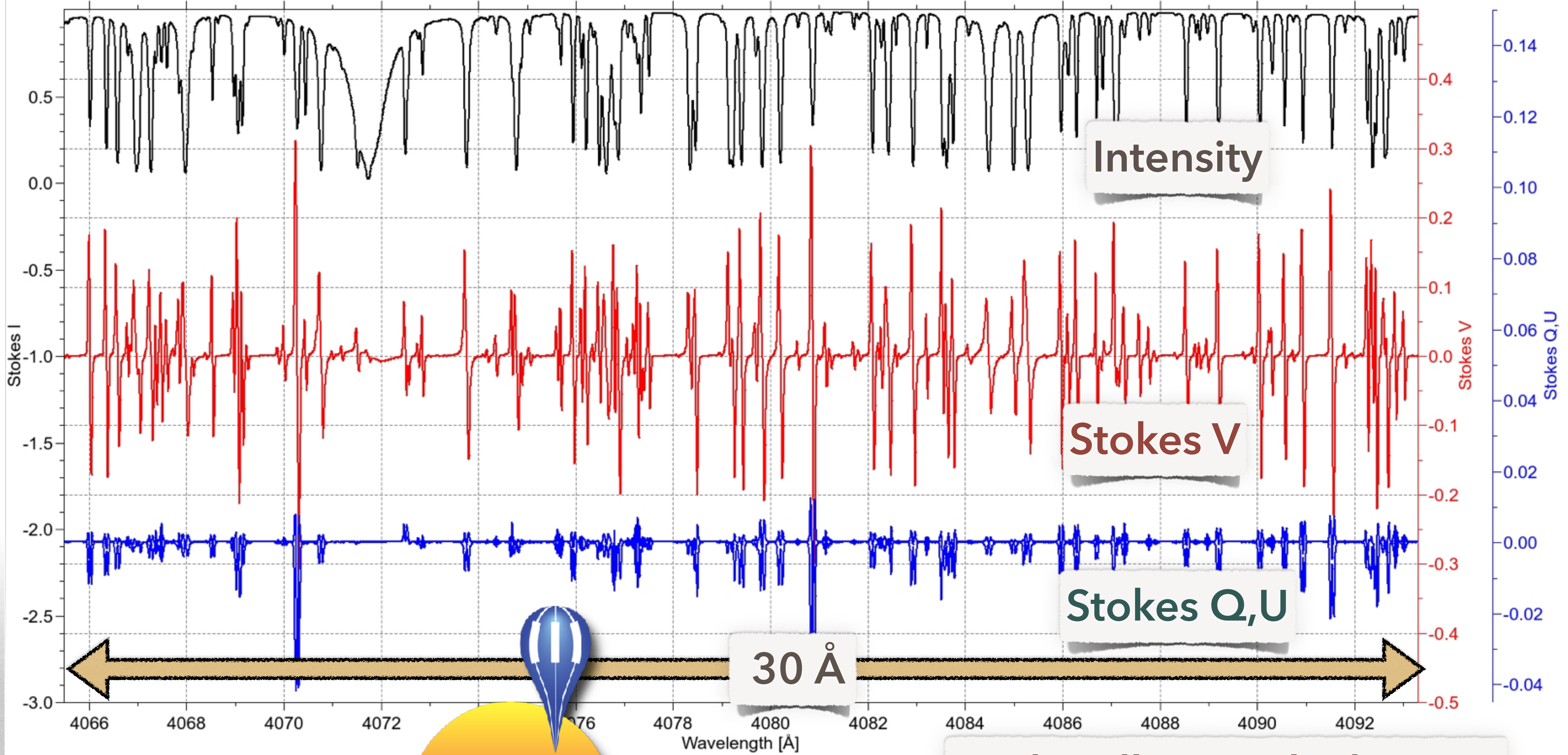
- 2D imaging Full Stokes
- photosphere: Fe 5250
- chromosphere: Mg Ib

## SCIP (IR sepctropolarimeter)

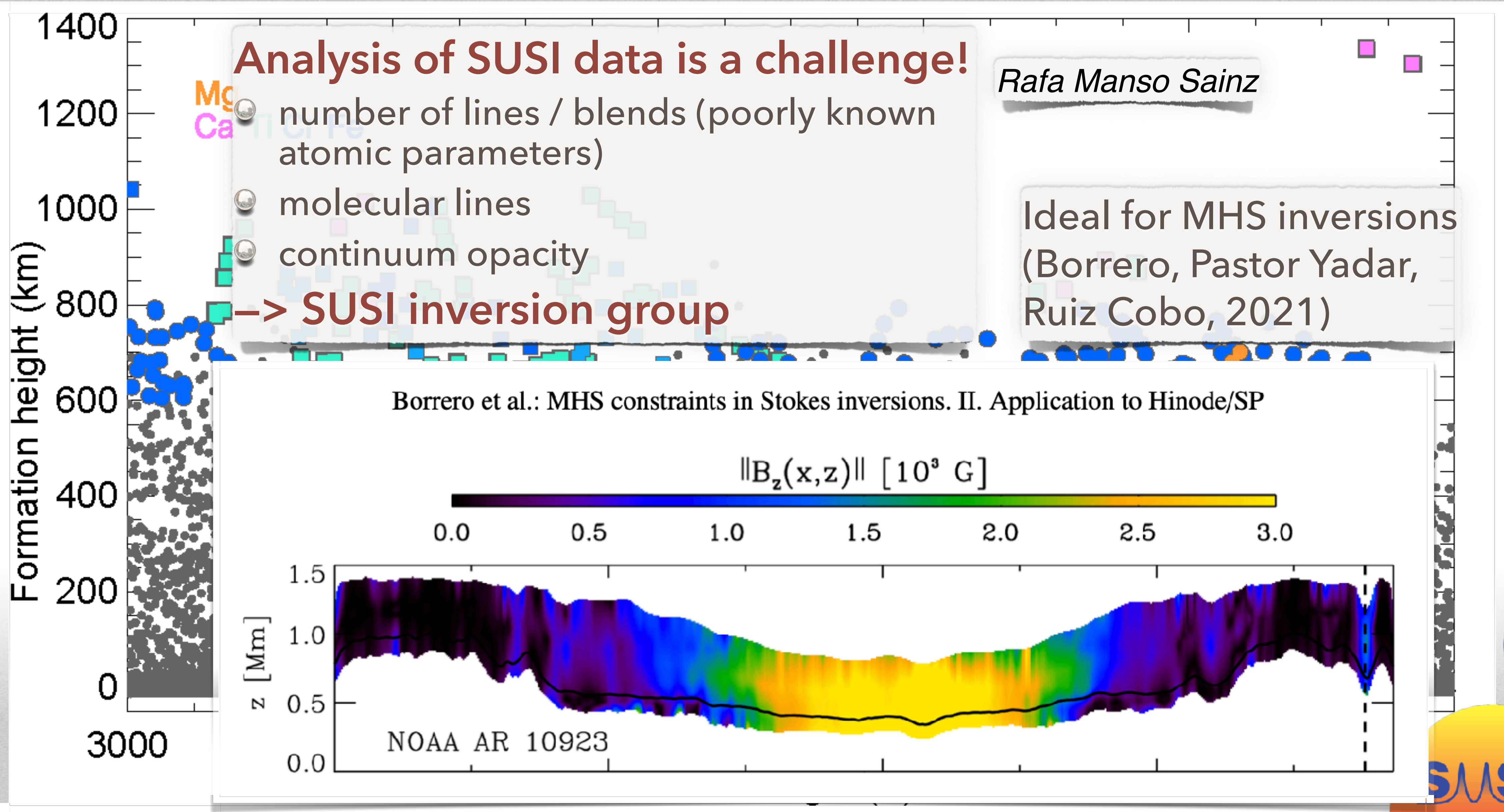
- slit spectrograph
- full Stokes 765-855nm
- incl. Ca IR, K, Fe



# MANY-LINE ANALYSIS WITH SUNRISE III

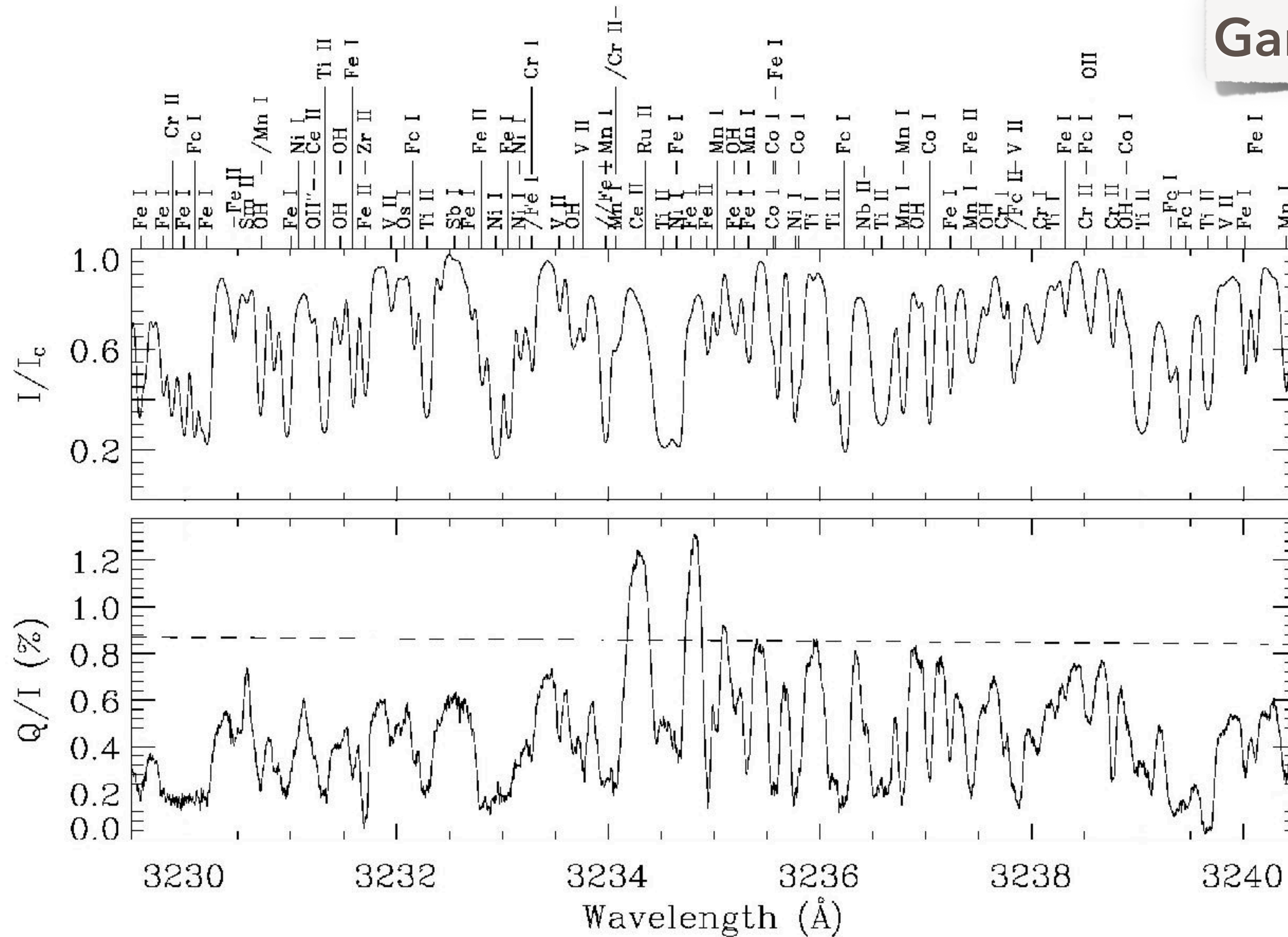


Riethmüller & Solanki 2018

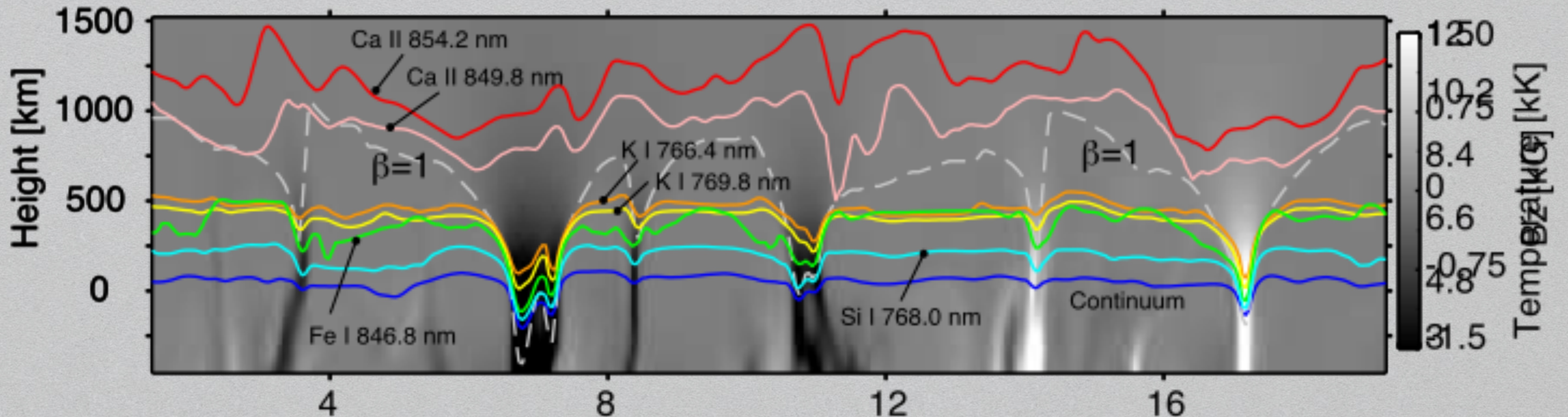
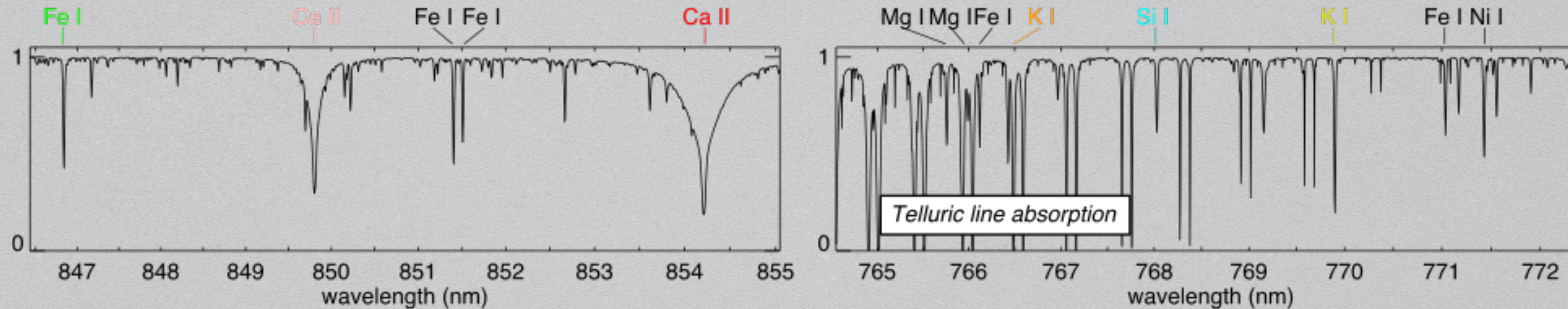


# SCATTERING POLARIZATION WITH SUNRISE III

Gandorfer 2005



# CHROMOSPHERIC 3D OBSERVATIONS IN THE NEAR-IR

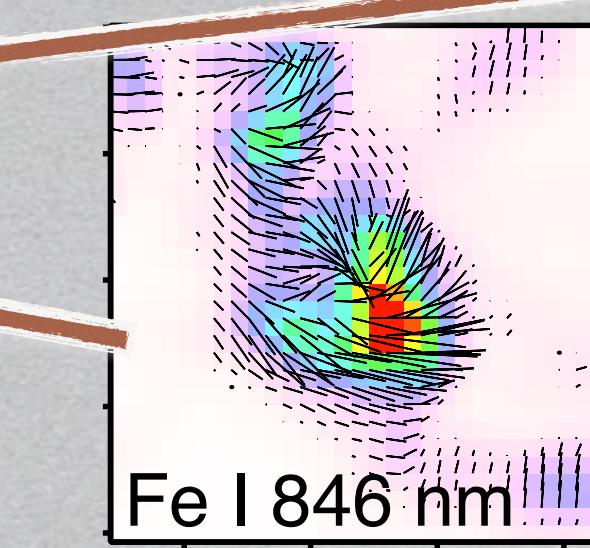
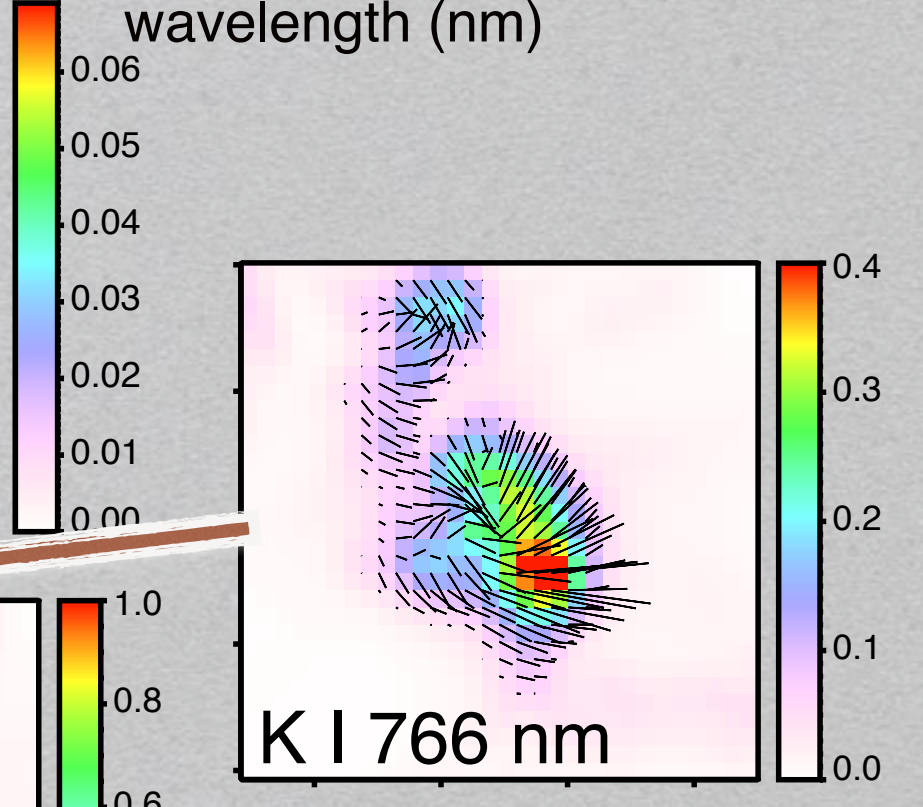
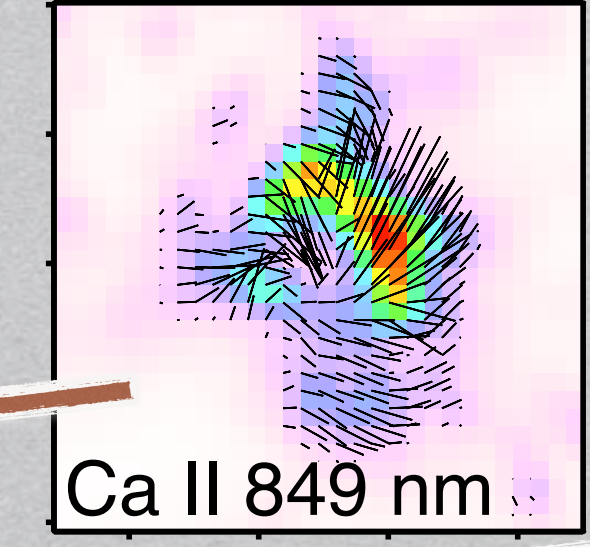
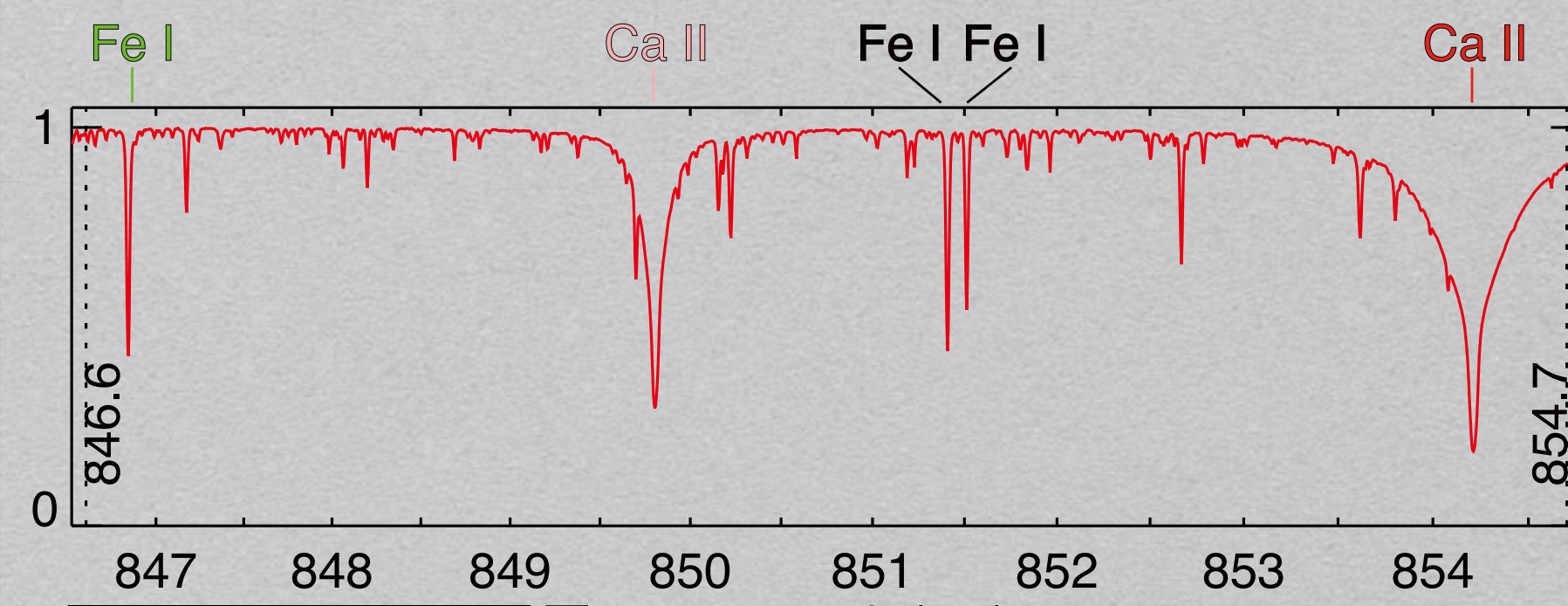
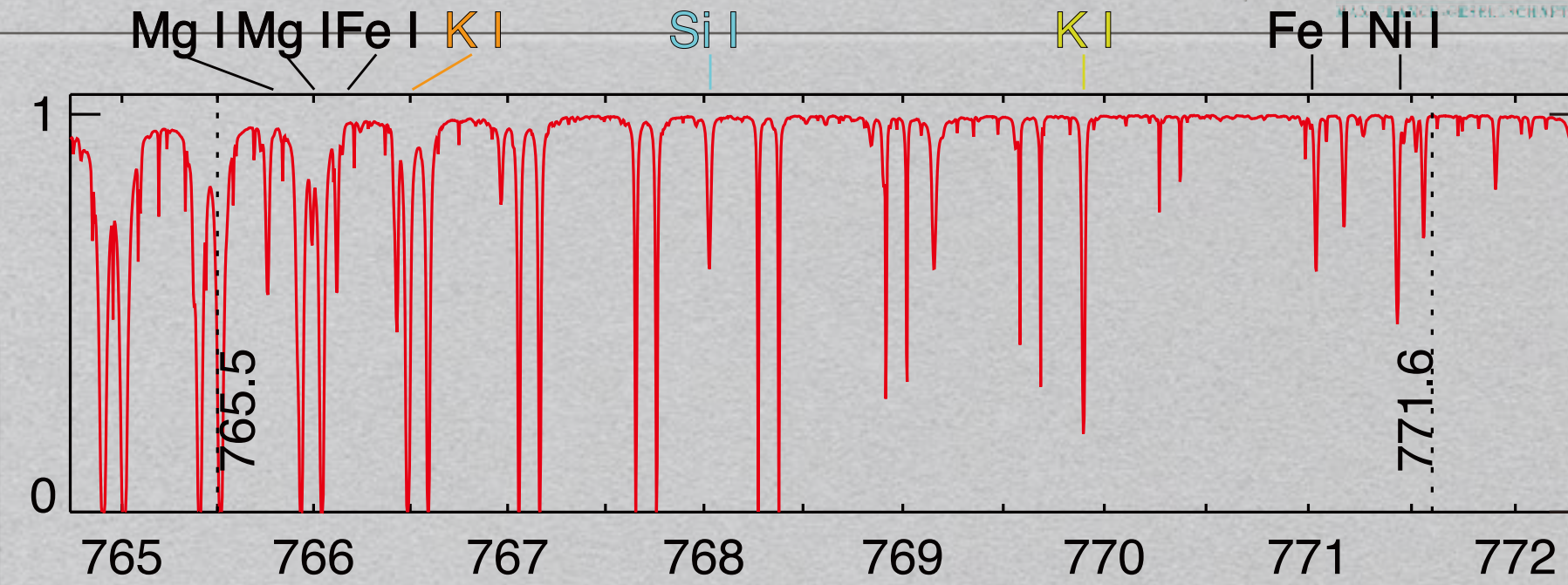
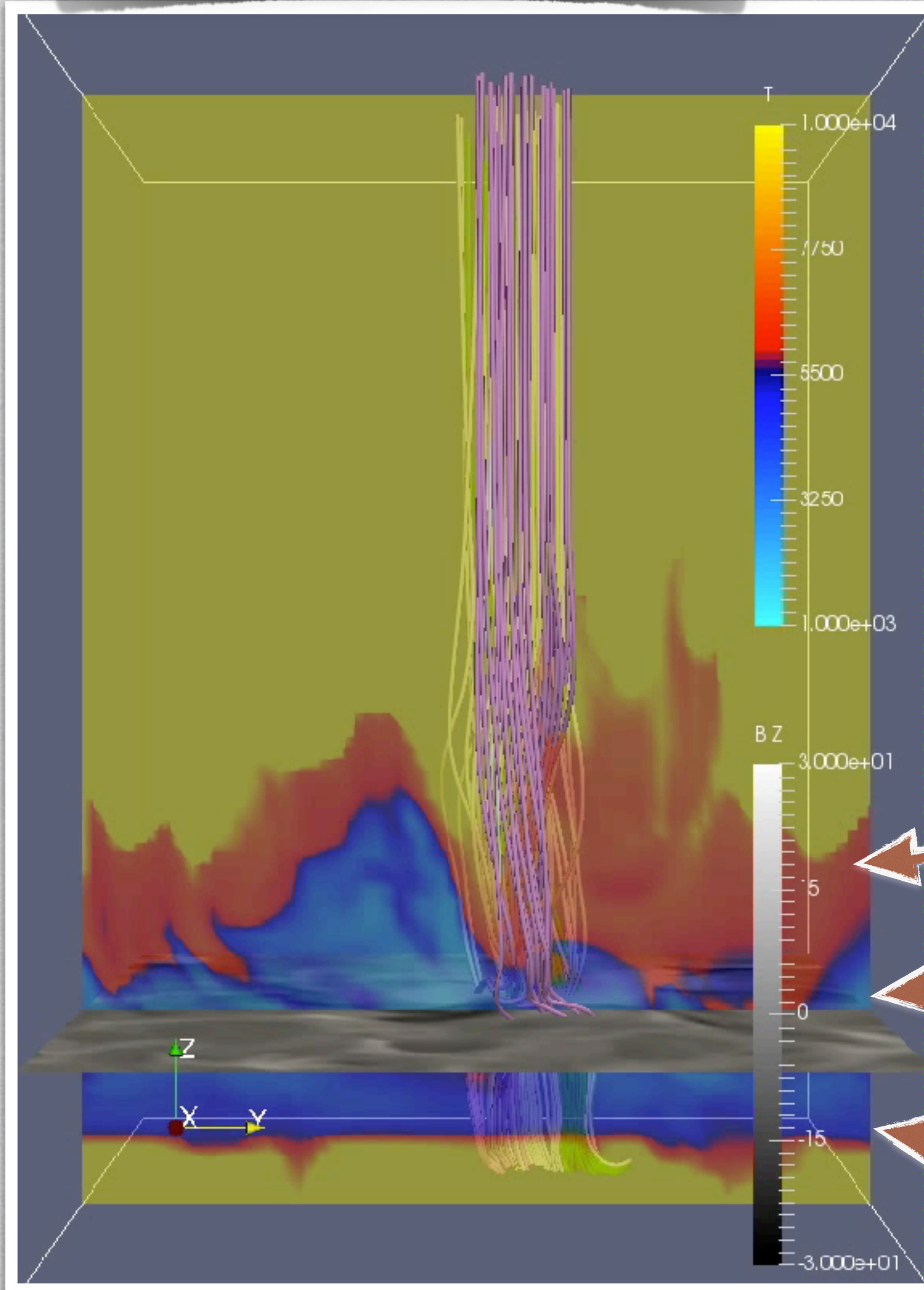


# SUNRISE CHROMOSPHERIC INFRARED SPECTRIPOL (SCIP)

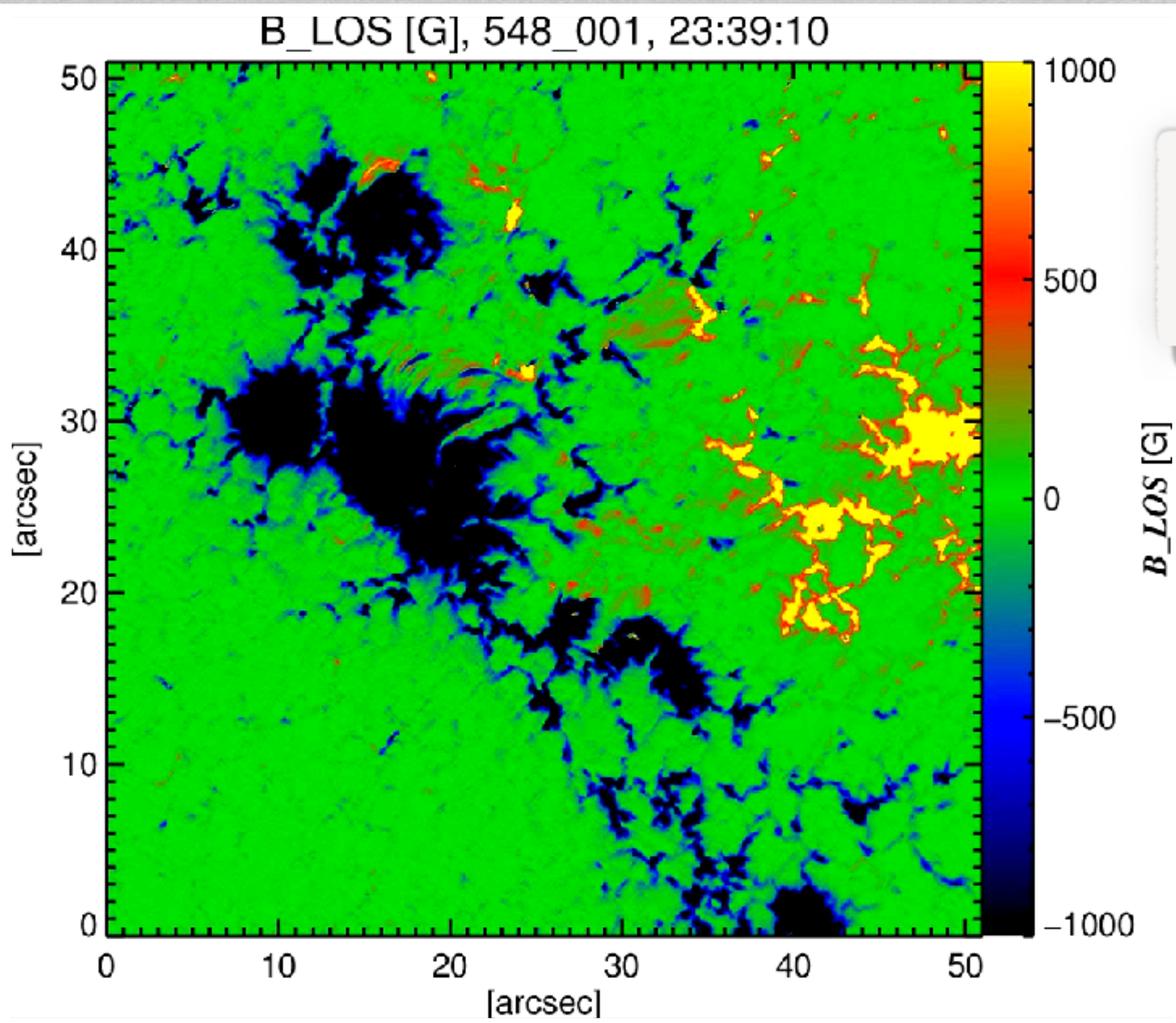


Spectral range	765 - 855 nm
Scientific target, wavelength bands	Photosphere: Fe I 846.8 nm, Fe I 851.4 nm
	Upper photosphere: K I 766.5 nm, K I 769.9 nm
	Chromosphere: Ca II 849.8 nm, Ca II 854.2 nm
FOV	58" x (61 - 83) Å
resolution	0.21" (diff. limit), sampling: 0.094" x (39 - 42) mÅ/px
Cadence	1 - 10 s
Max. pol. accuracy	0.03% ( $1\sigma$ ) sensitivity in 10 sec at Ca II line to measure ~ 5 G magnetic fields

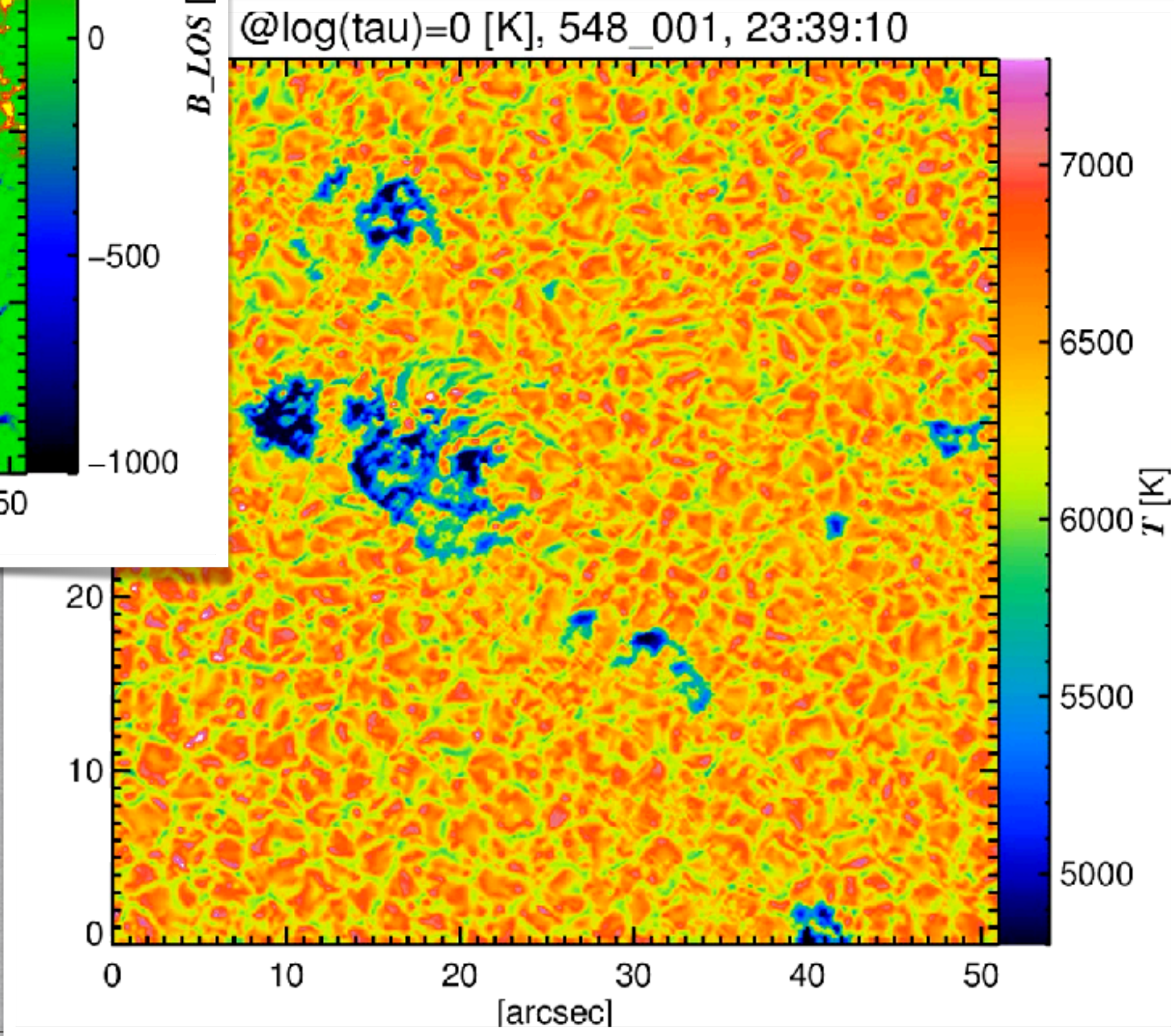
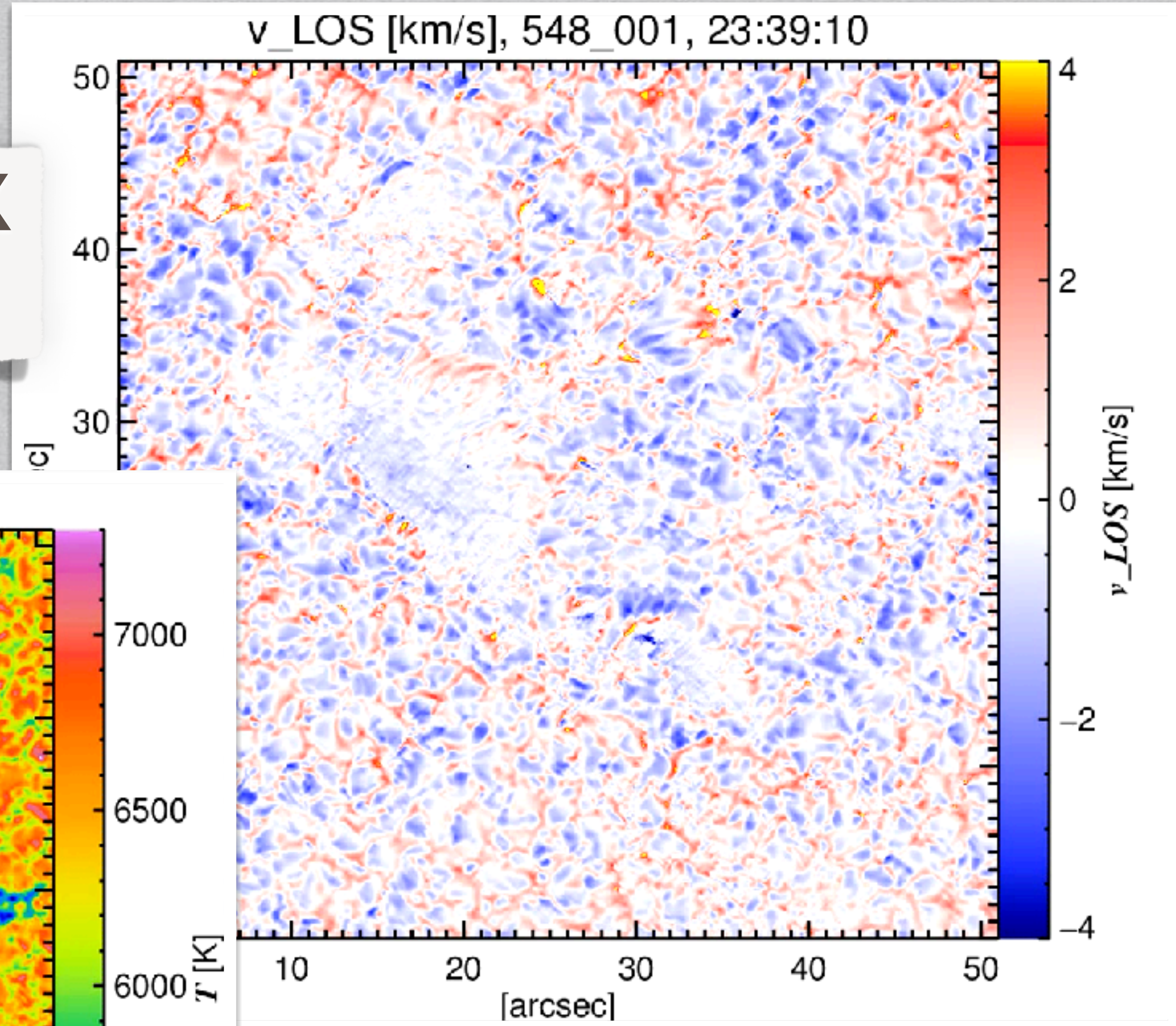
*Iijima and Yokoyama (2017)*



# TUMAG: 2D MAPS IN PHOTO- AND CHROMOSPHERE



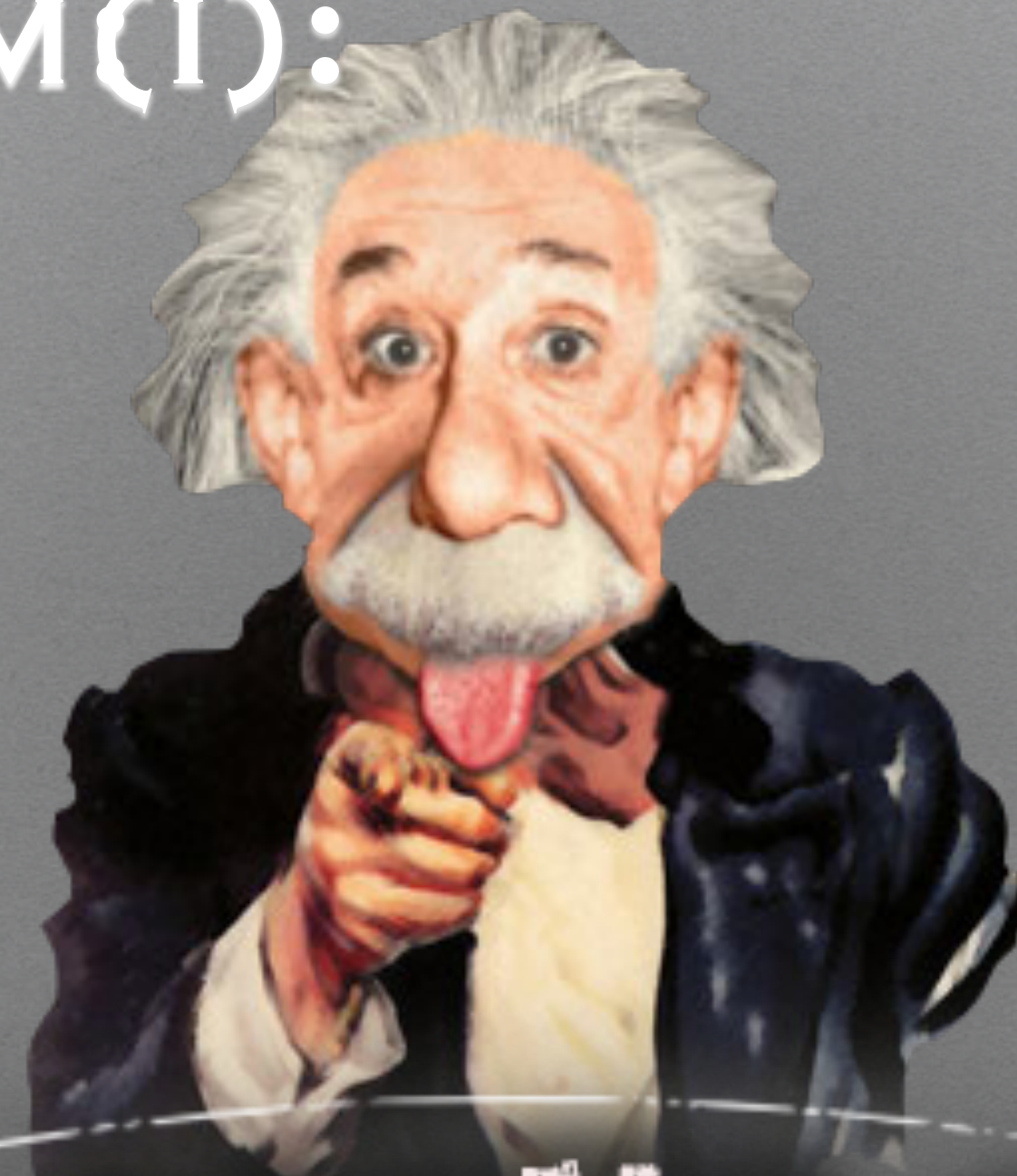
2009 + 2013: IMaX  
(photosphere)



2022: TuMag  
+ chromosphere

## UNCLE SAM(I):

- Phase I: Collecting Ideas (now)
- Phase II: Combine ideas to develop observing plan:
  - prioritisation
  - feasibility
  - constraints
- Phase III: Develop timeline

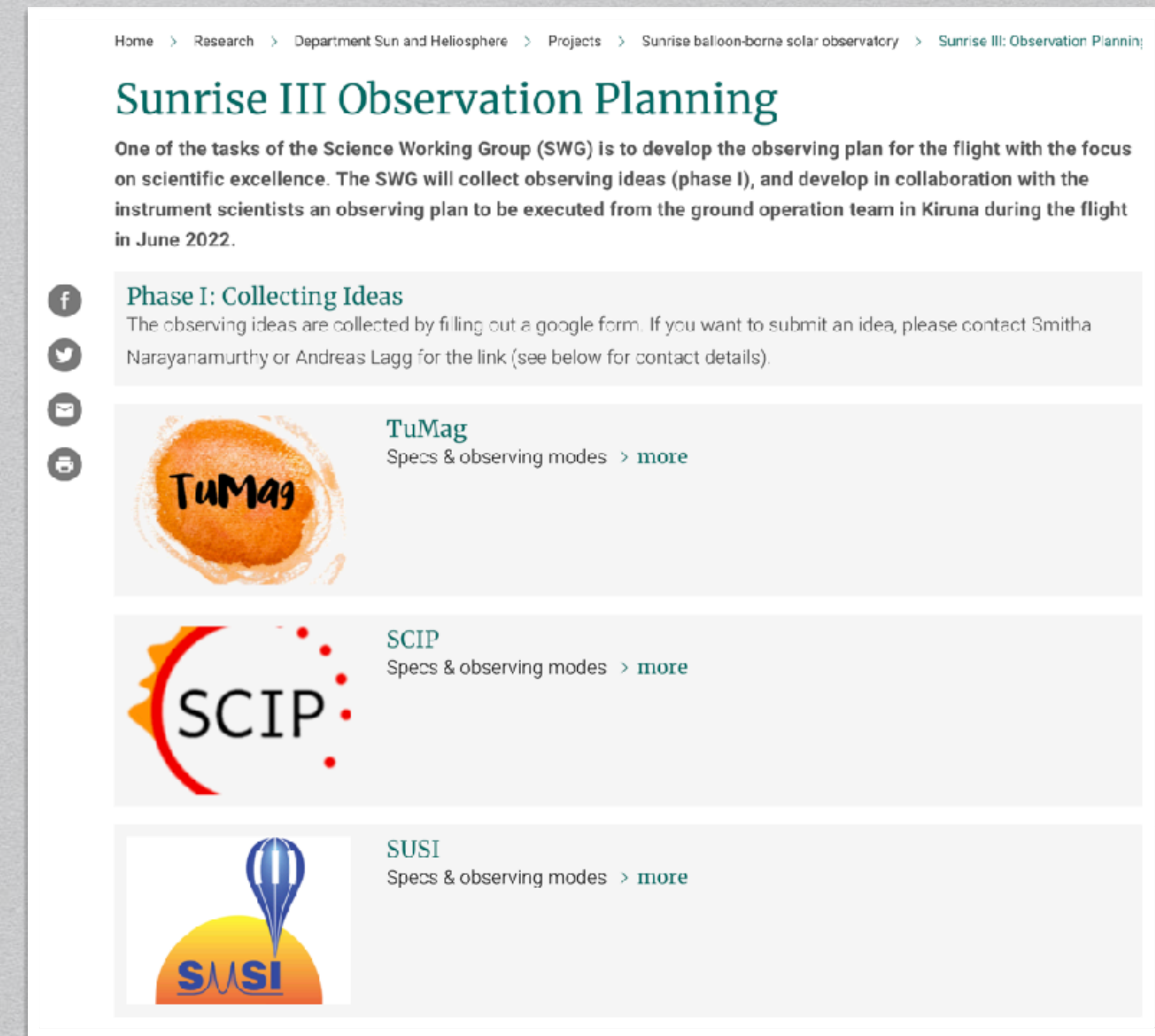


WE WANT YOU

... to participate in SUNRISE III !!!



- To create an observing plan for Sunrise III, we have formed a Science Working Group (SWG) with members from the PI and Col institutes.
- Currently we are in the process of collecting scientific ideas
- **We invite you all to submit ideas (submission deadline: May 15 2021)**
  - Fill in a google form:
  - short description of the idea
  - clickable selection of key instrument parameters
  - link to form: write mail to me [lagg@mps.mpg.de](mailto:lagg@mps.mpg.de); or write your e-mail address into the chat
- All the collected ideas will be discussed in the SWG and we will come up with a consolidated observing plan.






Home > Research > Department Sun and Heliosphere > Projects > Sunrise balloon-borne solar observatory > Sunrise III: Observation Planning

## Sunrise III Observation Planning

One of the tasks of the Science Working Group (SWG) is to develop the observing plan for the flight with the focus on scientific excellence. The SWG will collect observing ideas (phase I), and develop in collaboration with the instrument scientists an observing plan to be executed from the ground operation team in Kiruna during the flight in June 2022.

**Phase I: Collecting Ideas**  
The observing ideas are collected by filling out a google form. If you want to submit an idea, please contact Smitha Narayanamurthy or Andreas Lagg for the link (see below for contact details).

-  **TuMag**  
Specs & observing modes > [more](#)
-  **SCIP**  
Specs & observing modes > [more](#)
-  **SUSI**  
Specs & observing modes > [more](#)

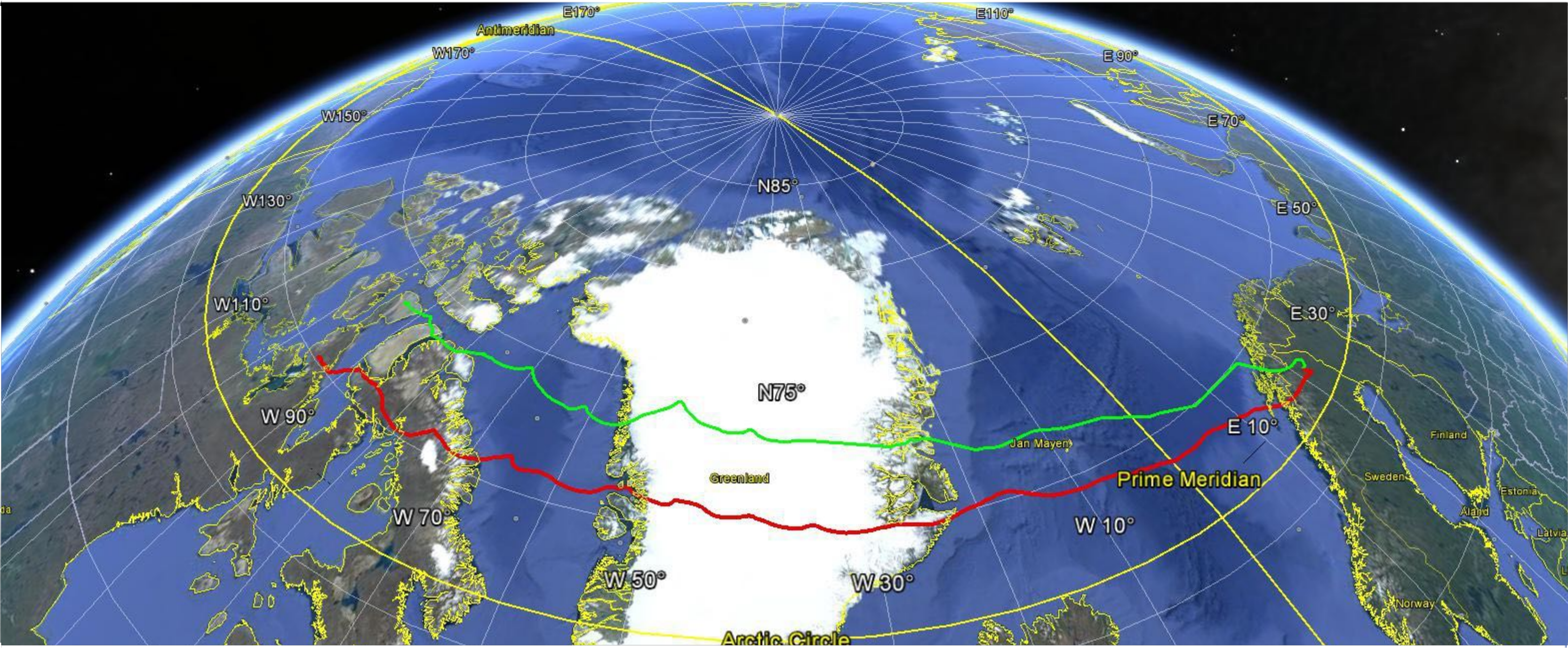
Visit MPS homepage:

<https://www.mps.mpg.de/sunrise-obs-plan>





# SUNRISE I+II FLIGHT



**Balloon-Borne Solar Telescope "Sunrise"  
Launch Preparations**

**Esrange Space Center, Northern Sweden  
May/June 2013**

**Video courtesy: HP Doerr**