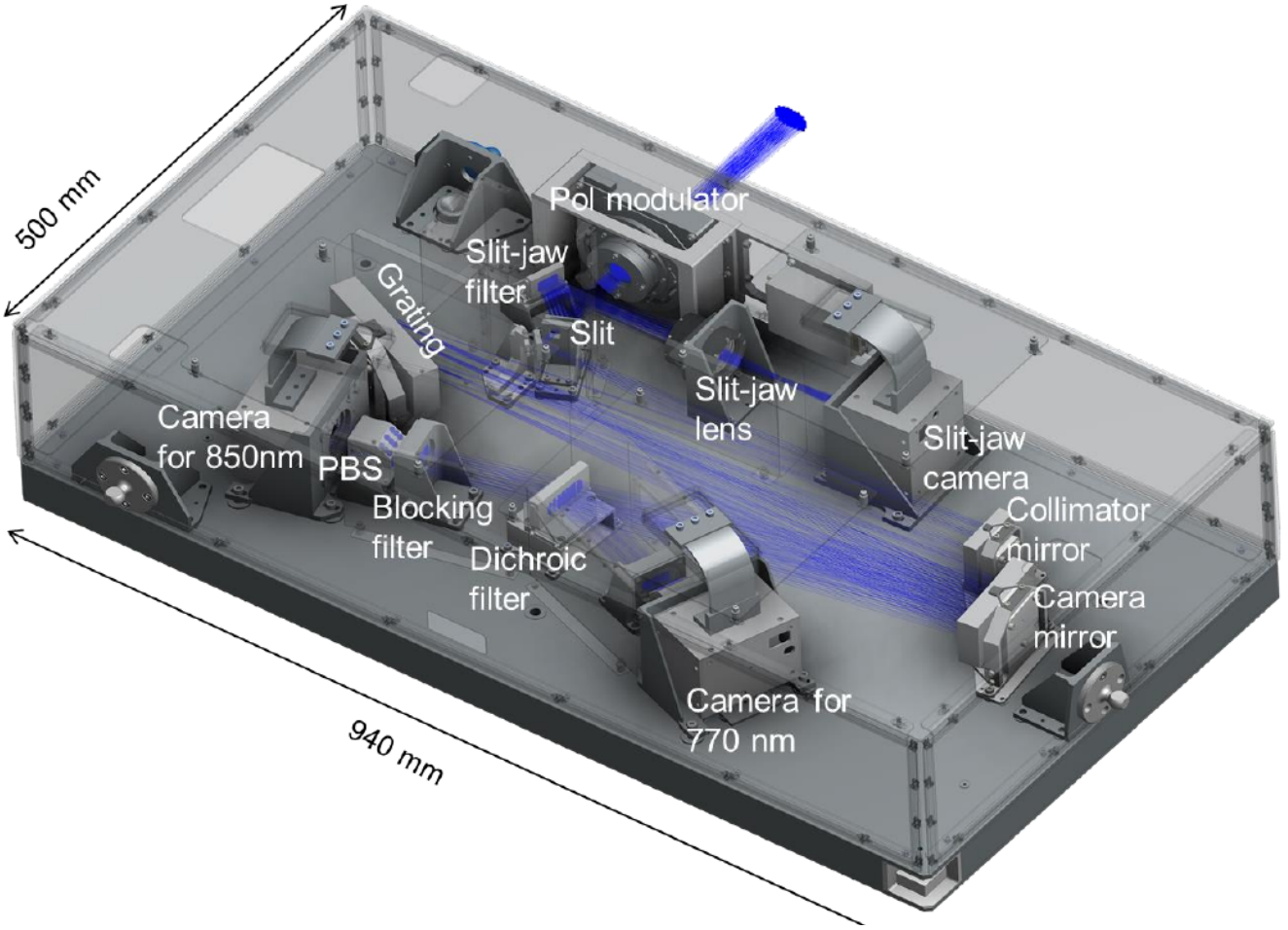
Sunrise Chromospheric Infrared spectropolarimeter (SCIP)

Basic specifications

	requirement	specification
wave length	To seamlessly cover the photosphere and the chromosphere simultaneously	1 . Ca II line, 850nm band (846.6-854.9 nm) 2. K I line, 770nm band (765.5-771.6nm) (Simultaneous observation of the 2 bands)
spatial resolution	To resolve dynamic MHD events in the chromosphere	0.2" (diffraction limit@854nm, = Hinode/SOT's imaging resolution), 0.094"/pixel
cadence		Stokes IQUV mode: 1-10 s per slit position Stokes I only: 45s / Full FOV
spectral resolution	To observe magnetic field in the chromosphere	$\lambda/\Delta\lambda = 2 \times 10^5$
polarimetric accuracy		requirement: 0.05% of Ic (B_{LOS}=10G@Ca II 854nm) objective: 0.03% of Ic (B_{LOS}=5G@Ca II 854nm)
FOV	To cover dynamical activity (> supergranular size)	58" (slit) x 58" (scan)

Optical layout



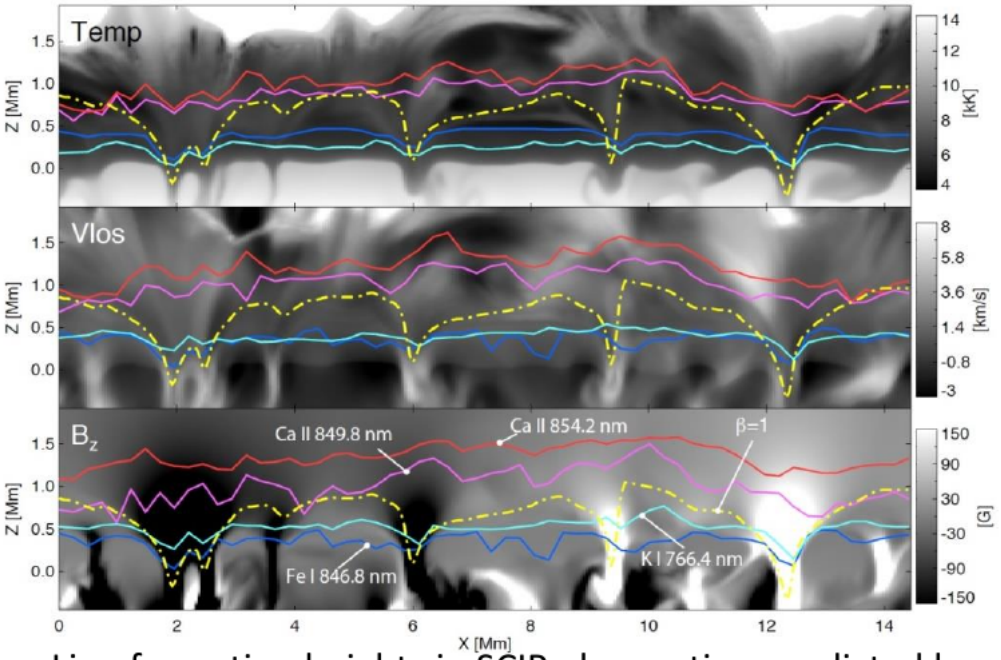
Properties of spectral lines

Properties of the main spectral lines in SCIP observation

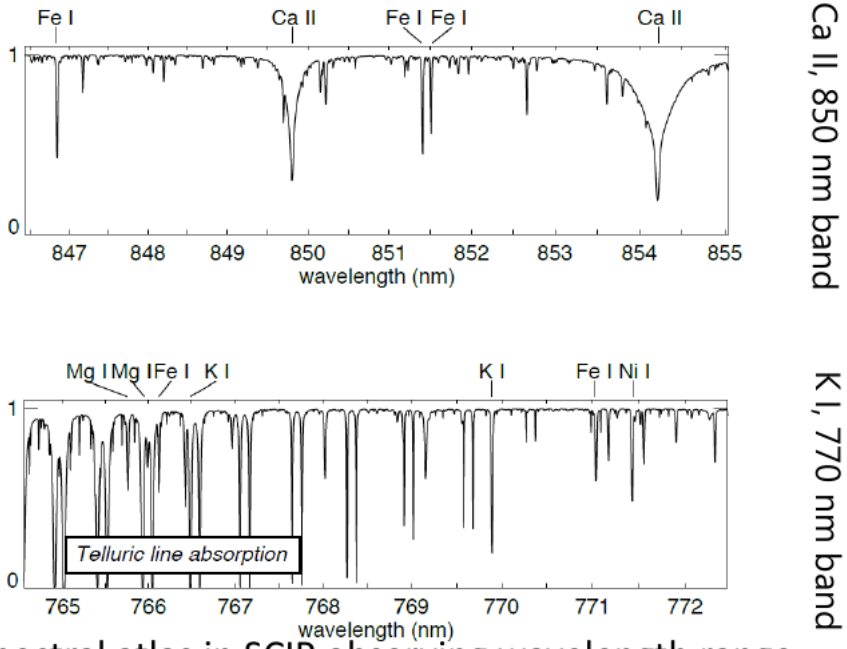
ph: photosphere, ch: chromosphere

line	FeI	Ca II	FeI	FeI	Ca II	Mg I	Mg I	Fe I	K I	K I	Fe I	Fe I
λ (nm)	846.84	849.80	851.41	851.51	854.21	765.76	765.92	766.12	766.49	769.90	771.04	771.43
g_{eff}	2.50	1.07	1.83	0.75	1.10	1.25	1.75	1.60	1.16	1.33	1.50	1.50
layer	ph	ch	ph	ph	ch	ph	ph	ph	upper ph	upper ph	ph	ph

Properties of spectral lines



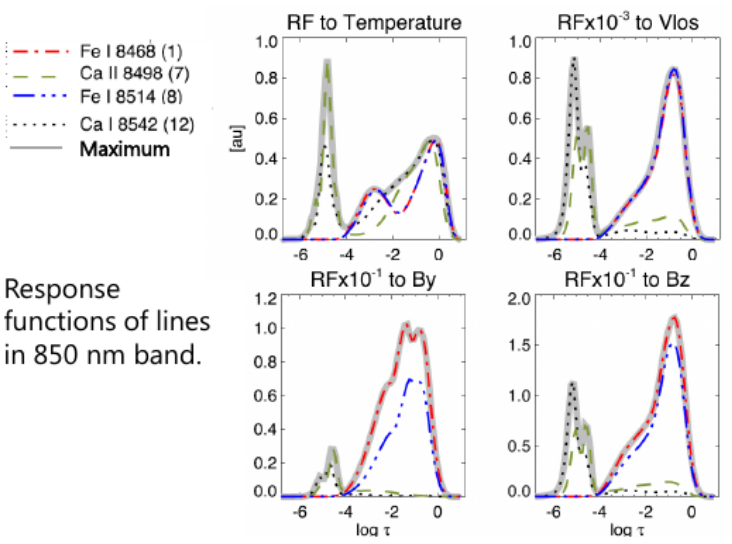
Line formation heights in SCIP observation predicted by 3D MHD simulation & NLTE line synthesis.



Spectral atlas in SCIP observing wavelength range.

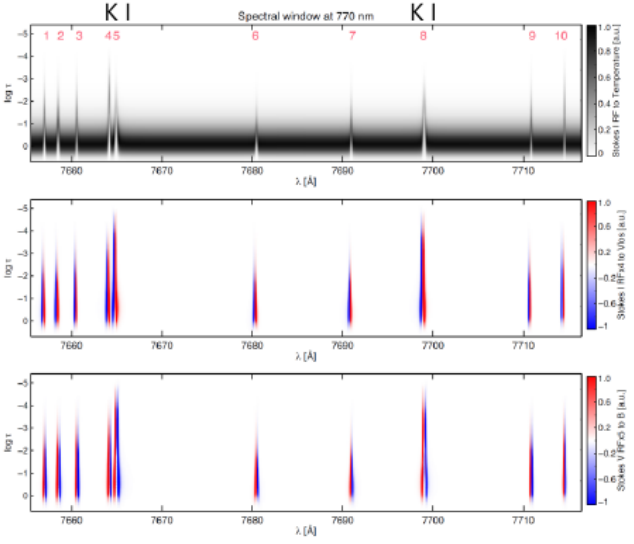
Properties of spectral lines

- **Ca II line, 850 nm band**
  (Quintero Noda+2016,2017)
  - Ca II lines :
    sensitive to T & V_{LOS} from the photosphere to the middle chromosphere
  - Fe I lines:
    increase sensitivity at the photosphere



Response functions of lines in 850 nm band.

- **K I line, 770 nm band**
  (Quintero Noda+2017, 2018)
  - K I lines :
    sensitive to V_{LOS} & B
    around the upper photosphere
    →complement 850nm band
  - Telluric line contamination in K I D_2 becomes weak in stratosphere



Response functions of lines in 770 nm band.

Observing modes

SP			
		Normal mode (Stokes IQUV)	Rapid mode (Stokes I only)
FoV along the slit		58” (0.0936”/pix)	
FoV in the scanning direction		N_{step} steps (N=1 to 620, 1 step = 0.0936”)	
Wavelength range (nm, in air)	CH1	846.6 - 854.7	
	CH2	765.5 - 771.6	769.7 to 770.1 (K I D1 only)
Integration time (*) total integration time = 512 ms x N_{pmu}xN_{slit}		N_{pmu} cycles (N_{pmu}=2 to 20, 1 cycle = 0.512 ms) N_{slit} repeats (N_{slit} =1 to 100)	10 msec
Scan duration (sec, including overhead)		(0.512 x N_{pmu} x N_{slit} + 0.128) x N_{step}	0.064 x N_{step}
SJ			
FoV		60” x 60” (0.0936”/pix)	
Filter pass-band (in air)		770.5 ± 0.5 nm	
Exposure time		10 msec (TBD)	
Cadence		64 msec	

Black: fixed
Red: selectable/adjustable

Polarization sensitivity

(1σ sensitivity)

Integration time	Spatial summing	SP-CH1 (850 nm)	SP-CH2 (770 nm)
1.024 sec	no sum	1.4×10^{-3}	1.0×10^{-3}
	2 pix sum	1.0×10^{-3}	7×10^{-4}
5.12 sec	no sum	6×10^{-4}	4×10^{-4}
	2 pix sum	4×10^{-4}	3×10^{-4}
10.24 sec	no sum	4×10^{-4}	3×10^{-4}
	2 pix sum	3×10^{-4}	2×10^{-4}

Note:

- Disk-center observation
- Spatial sampling: 0.0936” x 0.0936” (no sum), 0.0936”x0.187” (2 pix sum)
- Wavelength sampling: $\lambda/\Delta\lambda = 2 \times 10^5$
- Photon budget (single beam)
  - CH1: 1.1×10^6 e^-/pix·sec
  - CH2: 2.3×10^6 e^-/pix·sec

- Dual-beam combined
- Polarization efficiency: 0.5 for QUV