

Feasibility study for a dedicated filter based polarimeter system for large telescopes: comparing two different cameras

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Abstract: We are doing a feasibility study for a dedicated filter based polarimeter system to perform 2D measurements of the scattering polarization signal of the Sr I 4607Å line at high spatial resolution (below the granular scale). For this purpose, one of the aims is to explore the different possibilities with different camera systems to achieve the required signal to noise ratio, frame rates etc. for the imaging polarimetric measurements. Hence, we performed a test 2D imaging polarimetric measurements using Zurich IMaging POLarimeter (ZIMPOL) and fast camera with an EMCCD sensor at GREGOR telescope during our recent campaign in June 2018. A broad band filter (centered at 4607Å with FWHM 1.5Å) is used for selecting the continuum band near Sr-I 4607Å spectral line.

AIM of the work

→ **Estimation of the noise measuring with two different cameras a target with zero polarization in imaging polarimetric setup.**

ZIMPOL [1]:

Camera of the fast modulation polarimeter permitting to overcome Earth atmospheric effects.



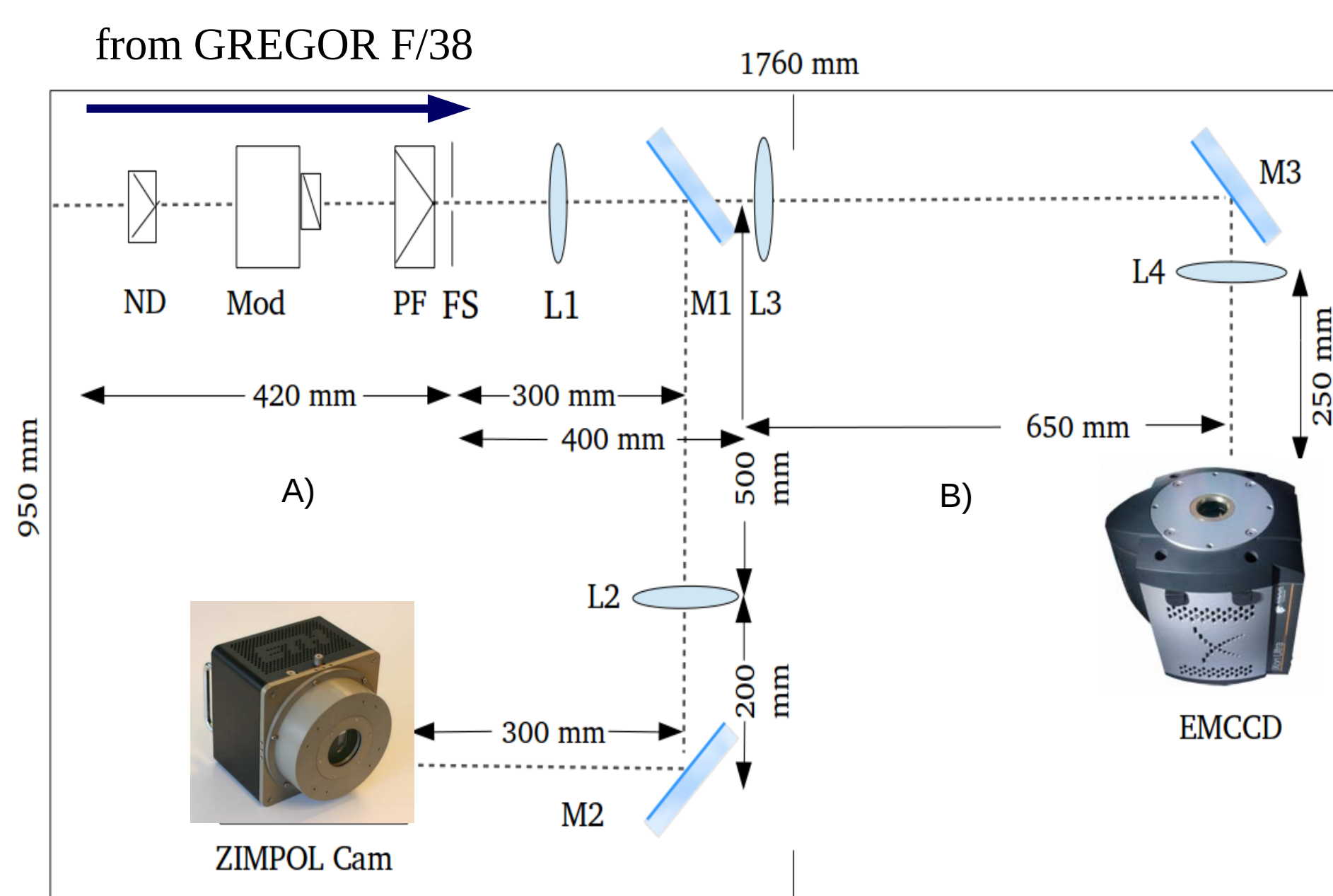
	ZIMPOL CAMERA (CCD55-30)	FAST CAMERA Andor iXon Ultra 897 (EMCCD)
sensor format	1280 x 576	512 x 512
pixel size	22.5 µm	16 µm
mask	4 pixels lenslet array	no mask
frame rate	2-3 fps	up to 200 fps
modulation rate	1-42 KHz	50 Hz

FAST CAMERA:

Permits a fast readout, was already used for planetary polarimetry.



EXPERIMENTAL SETUP



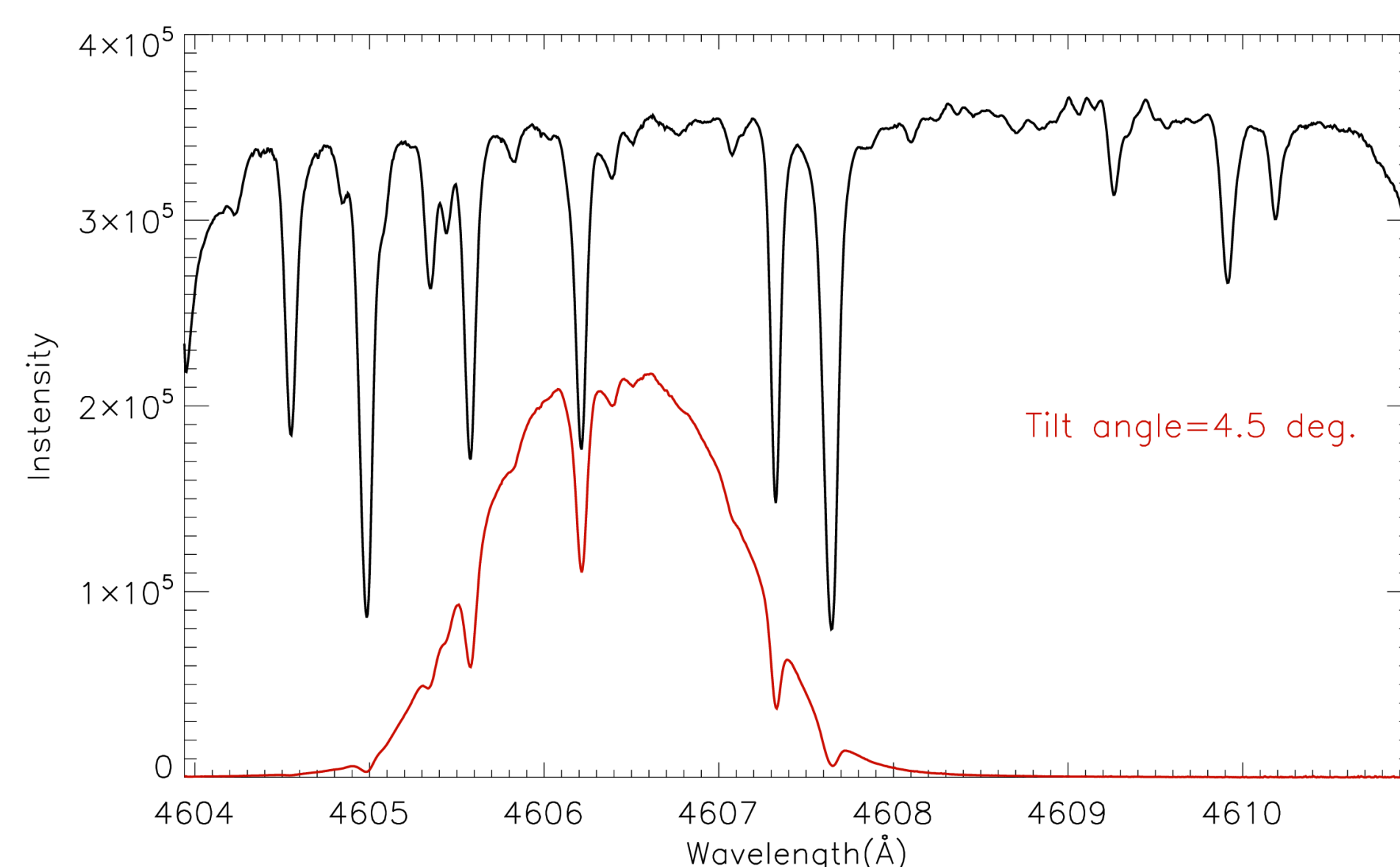
The optical setups were installed on the broad band imager table at GREGOR. The schematic layout is shown above. *FS*: science focal plane of GREGOR telescope, *Mod*: modulator based on two ferro-electric liquid crystal retarders (FLC) + a polarizing beam splitter.

PF: broad band filter (FWHM 1.5Å, centered at 4607.3Å).

Two optical setup (M1 & L1 are removable) for:
A) ZIMPOL camera: *L1* (f1 150 mm) collimating lens, *L2* (f1 500 mm) reimaging lens.

B) fast camera: *L3* (f1 250 mm) collimating lens, *L4* (f1 400 mm) reimaging lens.

BROAD BAND FILTER PROFILE

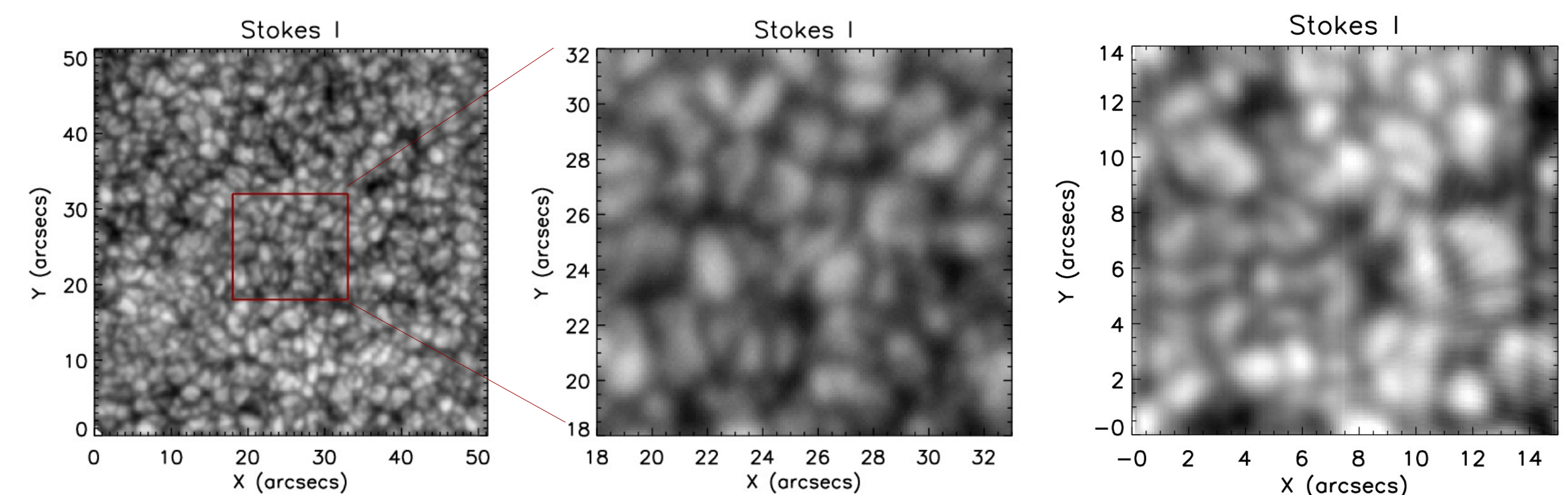


SUMMARY

→ We obtained similar Stokes images with the both cameras.
→ The origin of the unwanted structures present in the Stokes images are needed to be understood clearly.
→ This work is also intended to be improved using a small band Fabry Perot filter centered on the Sr 4607Å spectral line.

MEASUREMENT AND RESULTS

STOKES I

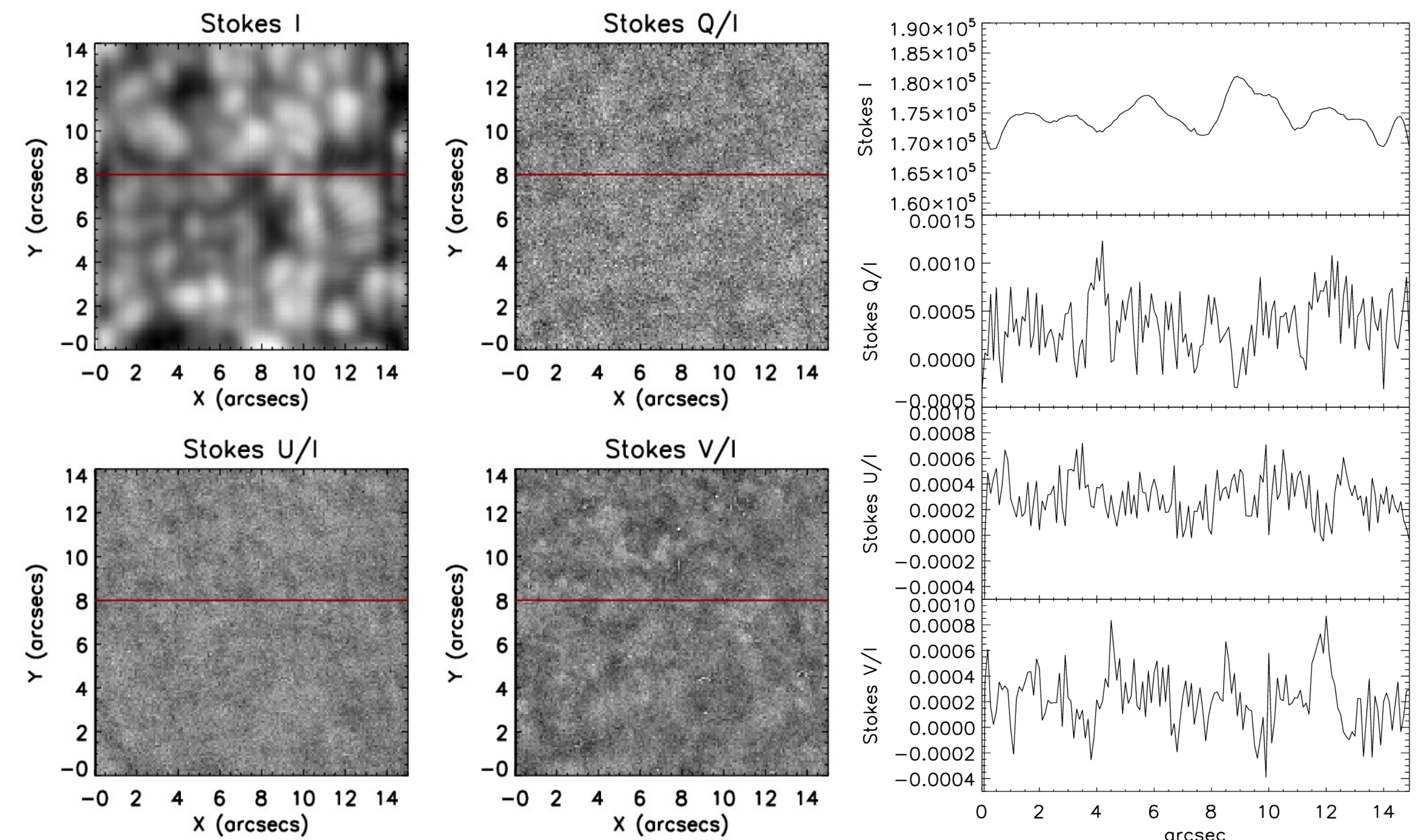


Stokes I images obtained with the fast camera setup at disk center with FOV 51.2"×51.2" near the Sr 4607Å continuum, observed on 20 June, 2018. The zoomed image of the red box (FOV 15"×14") is shown separately in the middle panel. In the right panel: Stokes I images obtained with the ZIMPOL setup at disk center with FOV 15"×14", observed on 22 June, 2018.

ZIMPOL

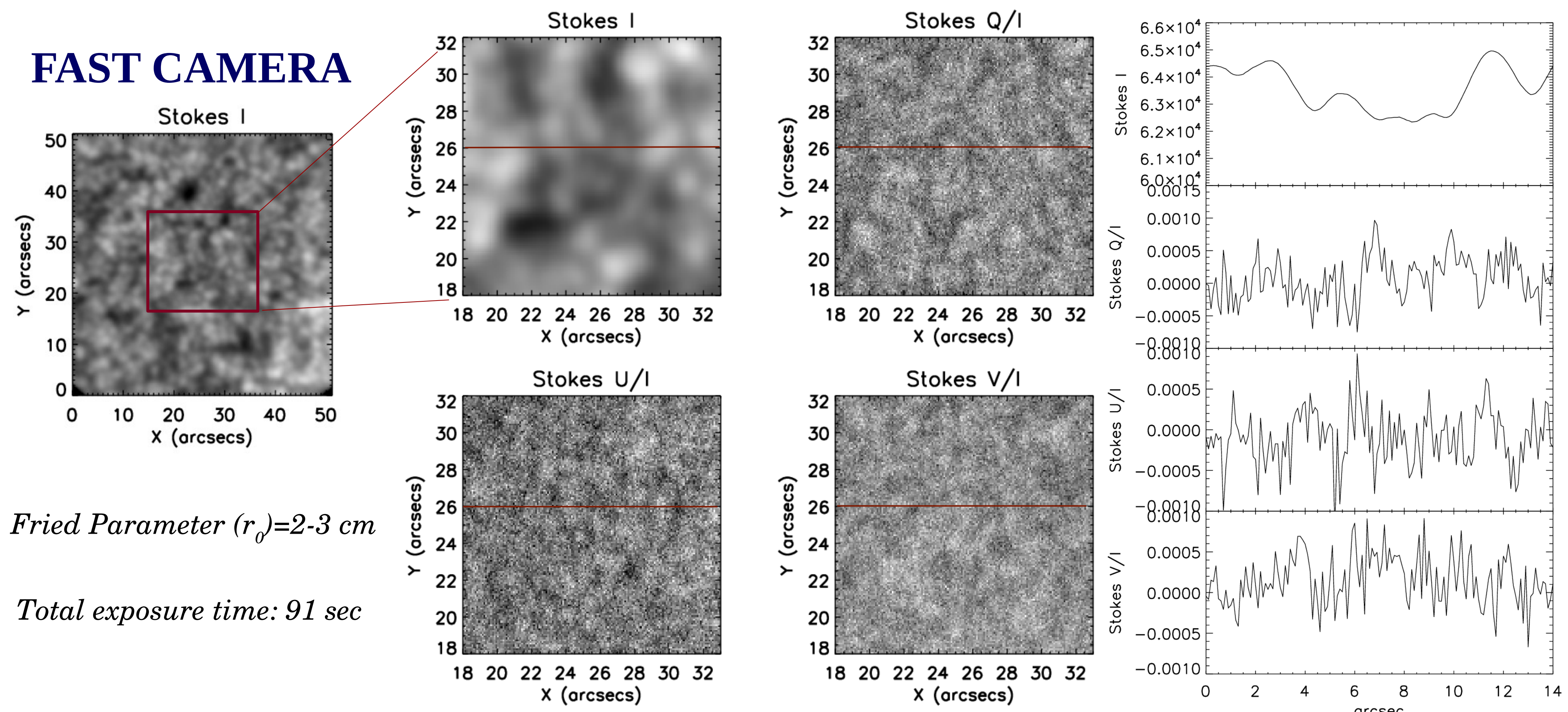
Fried Parameter (r_0)=4-5 cm

Total exposure time: 43 sec



Stokes images obtained with the ZIMPOL setup at disk center. In the continuum zero polarization is expected: signals are due to the instrumental effect. In the right panel, Stokes profiles are shown along the red lines.

FAST CAMERA



Fried Parameter (r_0)=2-3 cm

Total exposure time: 91 sec

Stokes images obtained with the fast camera setup at disk center with FOV 15"×14" near Sr continuum region. In the right panel, Stokes profiles are shown along the red lines.