Broad Band Imager at GREGOR 2016

Oskar von der Lühe, Sebastian Hoch, Lars Bielak,
Markus Knobloch, Felix Krämer, Alexander Schäfer, Olivier Grassin

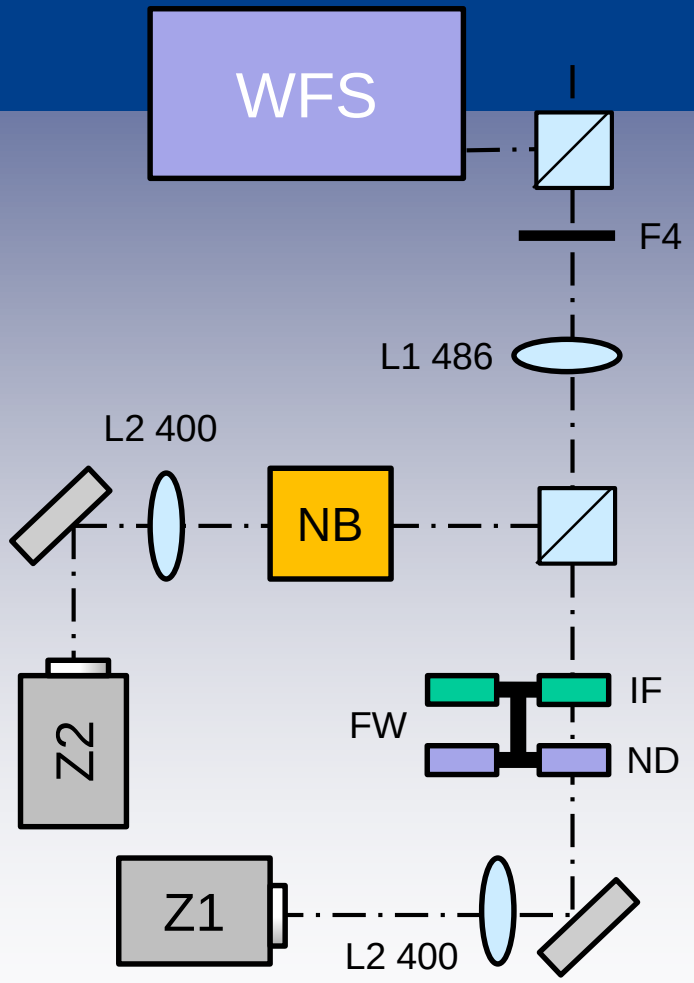
KIS

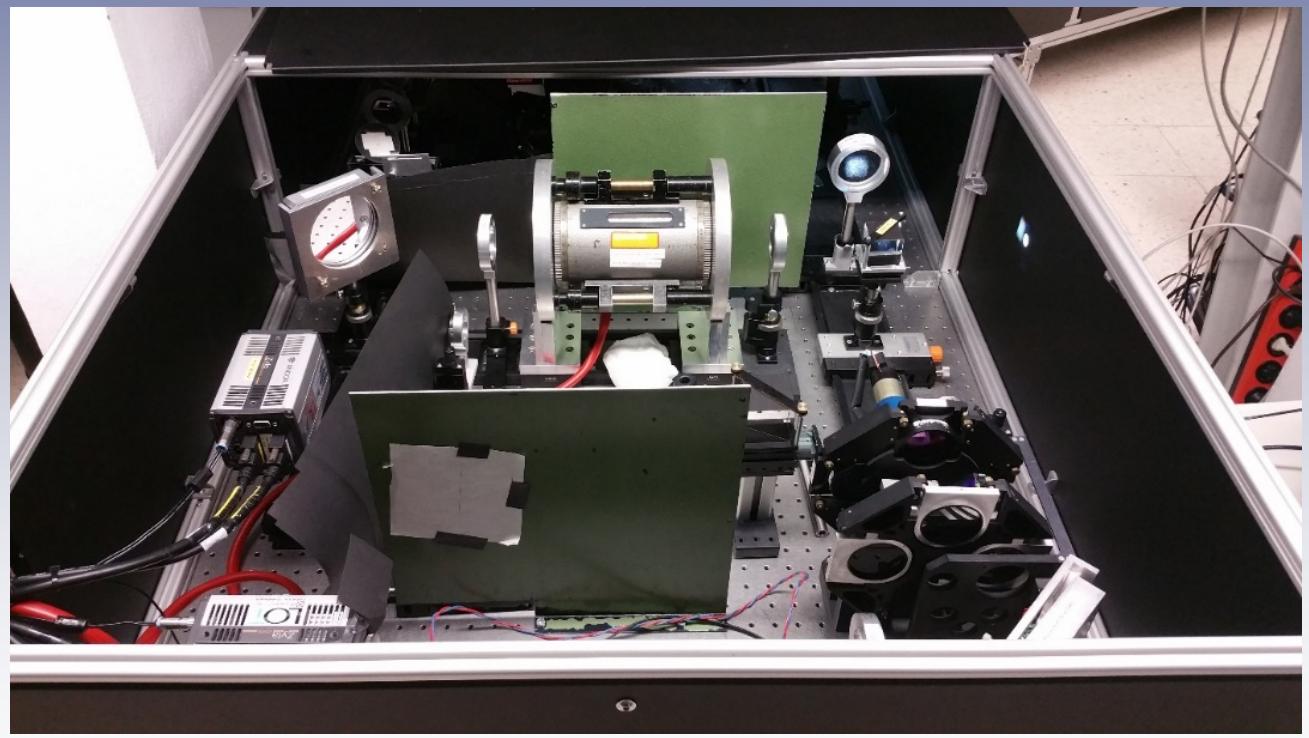
Kiepenheuer-Institut
für Sonnenphysik

What is BBI?

- BBI is a Two Channel Multi Spectral Photometer for
  - highest spatial resolution (diffraction limit)
  - very high time resolution (seconds)
- Science target: study rapid evolution of very small scale phenomena simultaneously in several layers of the solar atmosphere

BBI Configuration





BBI Configuration

- Two channels for simultaneous imaging
- „broadband channel“
  - filter wheel with four positions for standard 50 mm interference filters and ND filters, motorized
  - set of high quality ND filters
  - motorized camera focusing
- „narrow band channel“
  - single interference or Lyot filter
  - flexible setups

Cameras

- Andor Zyla sCMOS 5.5
  - 2560 x 2160 pixels, 6.5 µm, 0”03 / pixel
  - true global shutter
  - 50 fps (100 fps)
  - 16 bit
  - Camera Link
- Two – nearly – identical cameras purchased in 2014 and 2015
- In-house development of server and client SW

Operation

- A set of conductor scripts handle
  - data collection (filter setting and focusing, burst sequencer)
  - flatfields (GAOS handling, telescope FF mode, pointing)
  - darks and targets (F3 wheel)
- Hardware camera synchronization not yet implemented
- Operation from control room

KIS Customers

- S. Hoch, O. von der Lühe: „Dynamics of Active Regions“
- R. Schlichenmaier, et al., „Magneto-convection in Sunspots“
- A. Gorobets, S. Berdyugina: „Statistics of small magnetic elements in the Quiet Sun“

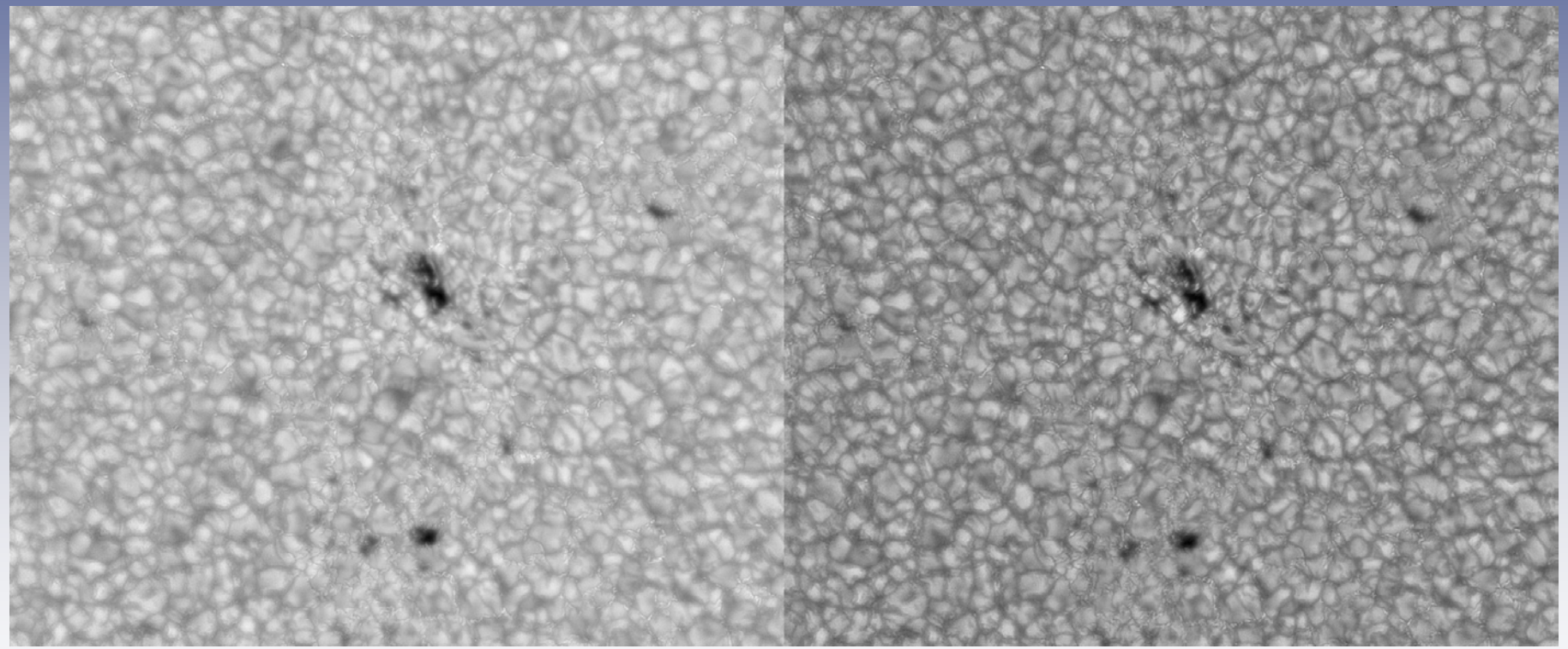
2016 Campaigns

- Technical time 16-24 March
- Science time 24 July – 6 August
  - BB: 656, 486, 430, 395, 865 (thanks, Carsten!), exp. 2 … 4 ms
  - NB: Ca II H (MPS), Hα, exp. 100 … 500 ms
- Science time 10 – 18 September
  - BB: 656, 486, 430, 422
  - NB: Hα (SolarSpectrum), Hα Lyot

Performances and Limitations

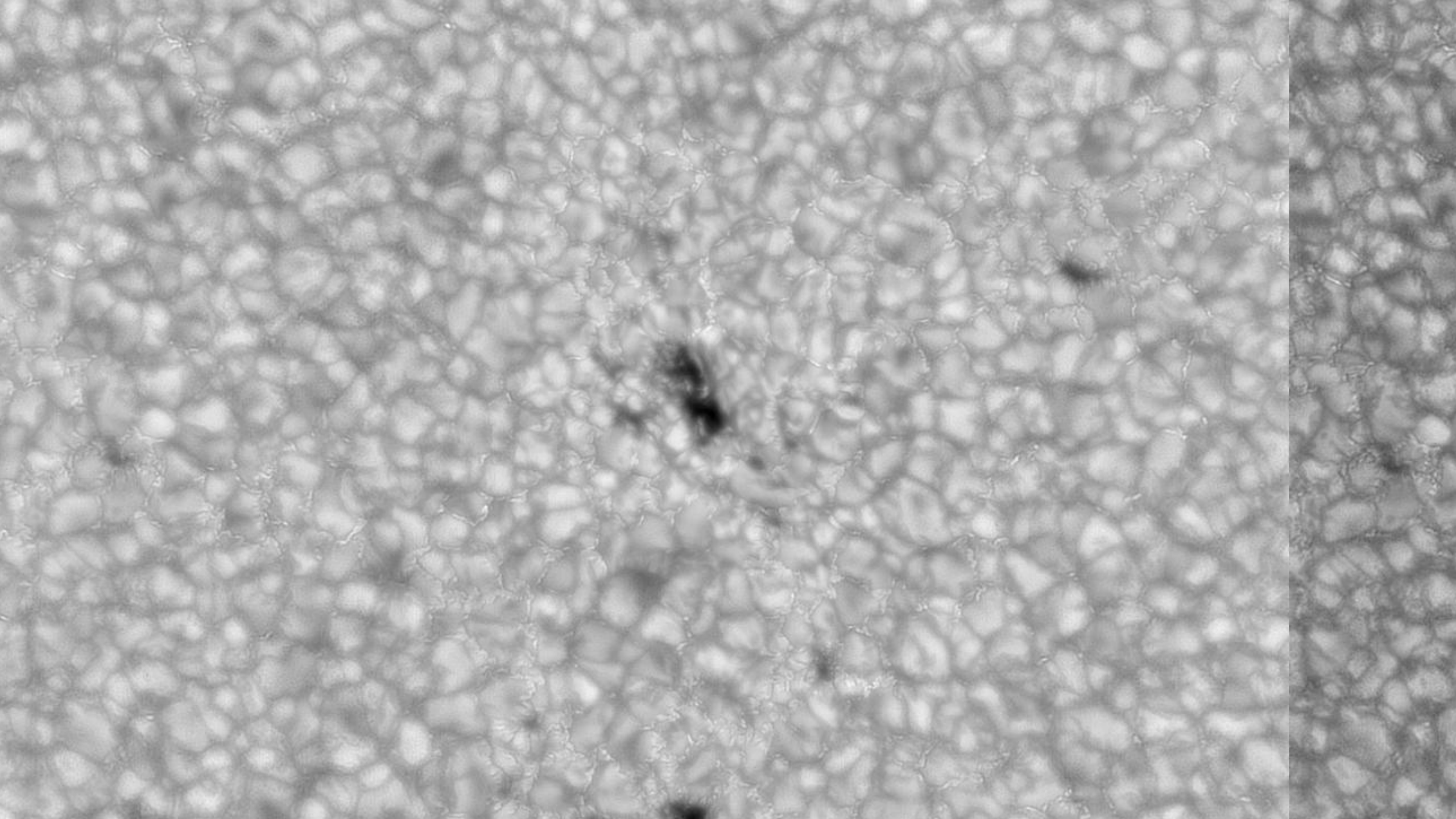
- Several days with acceptable seeing, never very good
  - mostly locking on active regions, occasionally on granulation
- 3 … 5 s cadence for 100 frame bursts at single wavelength sustained
- 30 s cadence for four wavelengths in the BB channel
  - 3 s to rotate filter wheel by one position, 9 s to “rotate back”
- 1 TB data storage per camera limits observing time to typically 2 hours
  - morning and afternoon sessions

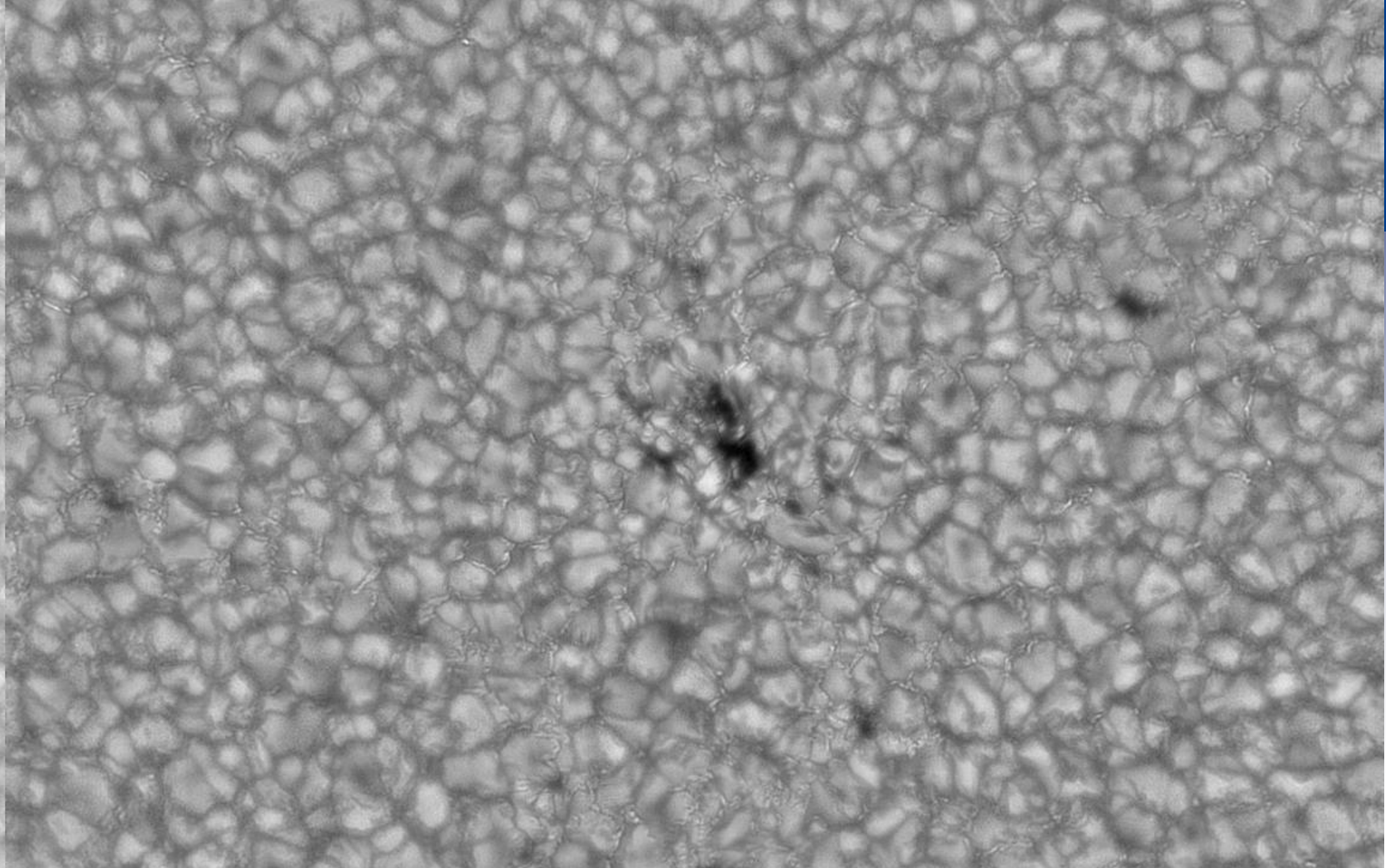
1. August 2016



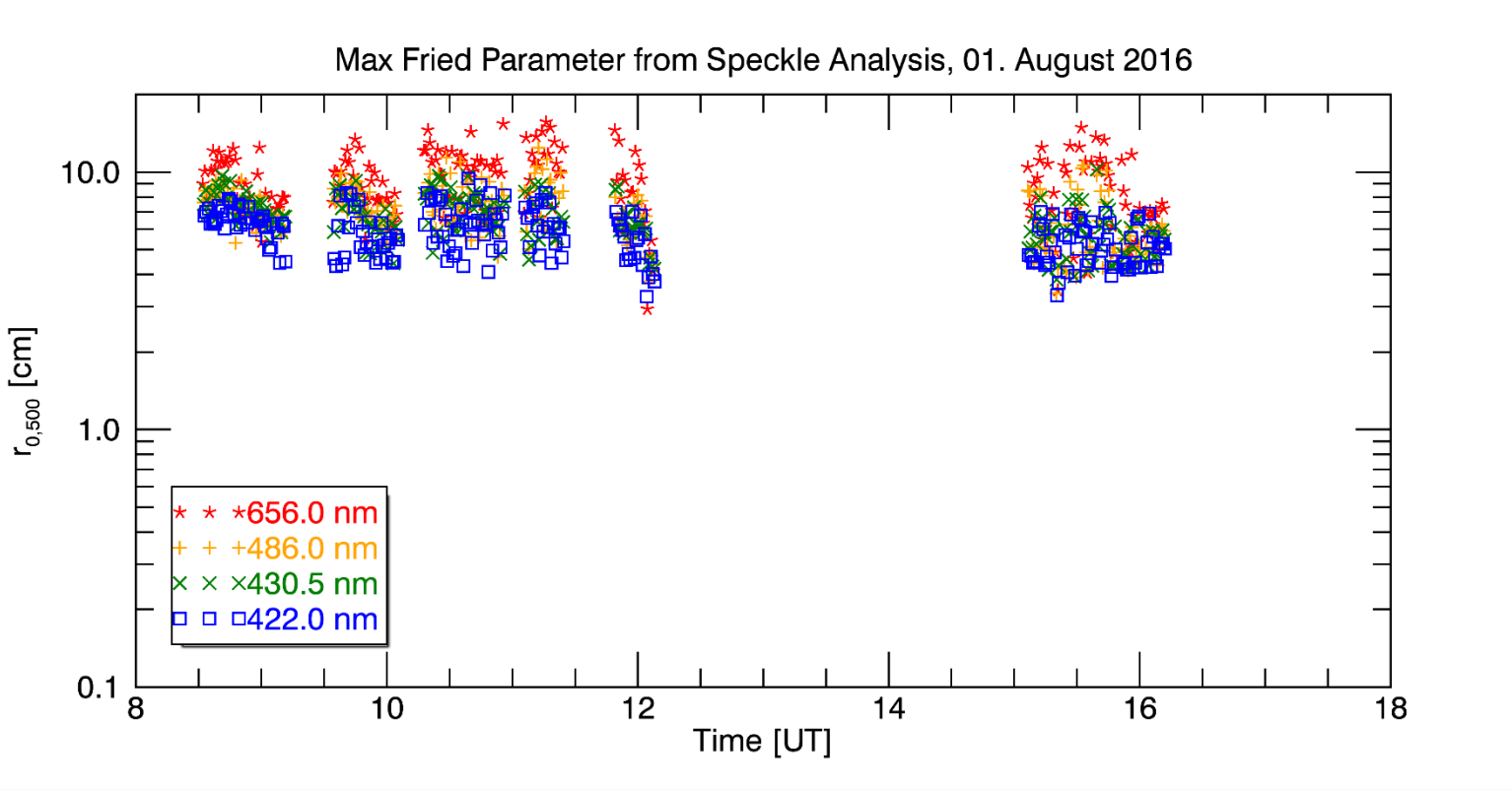
H alpha continuum

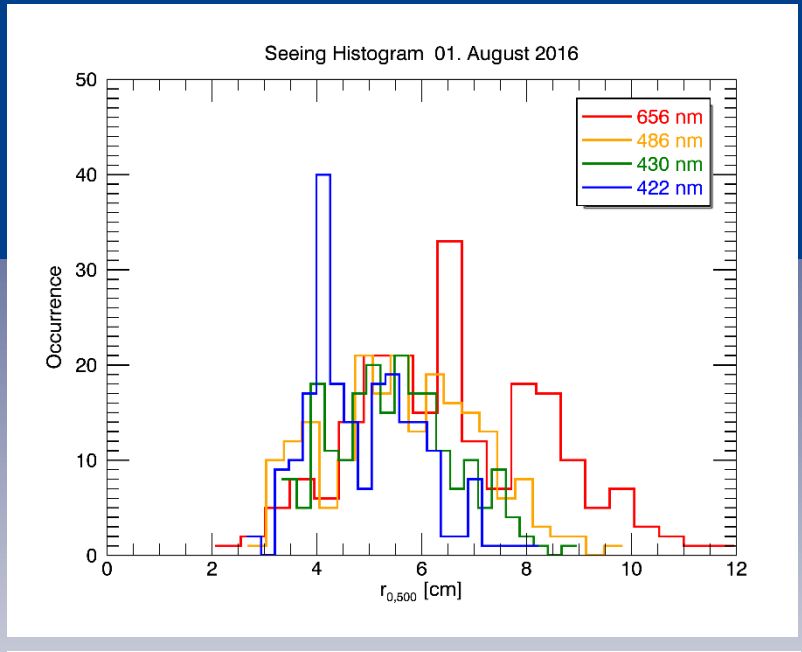
H beta continuum

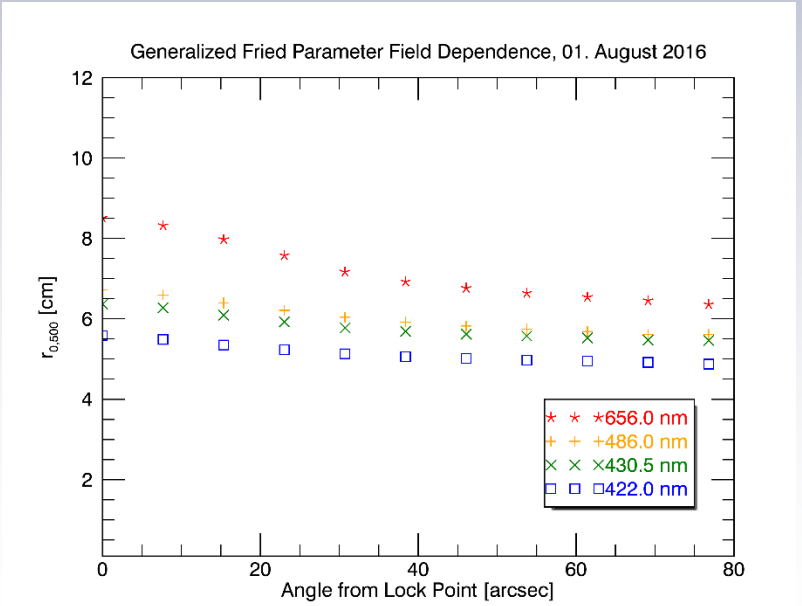




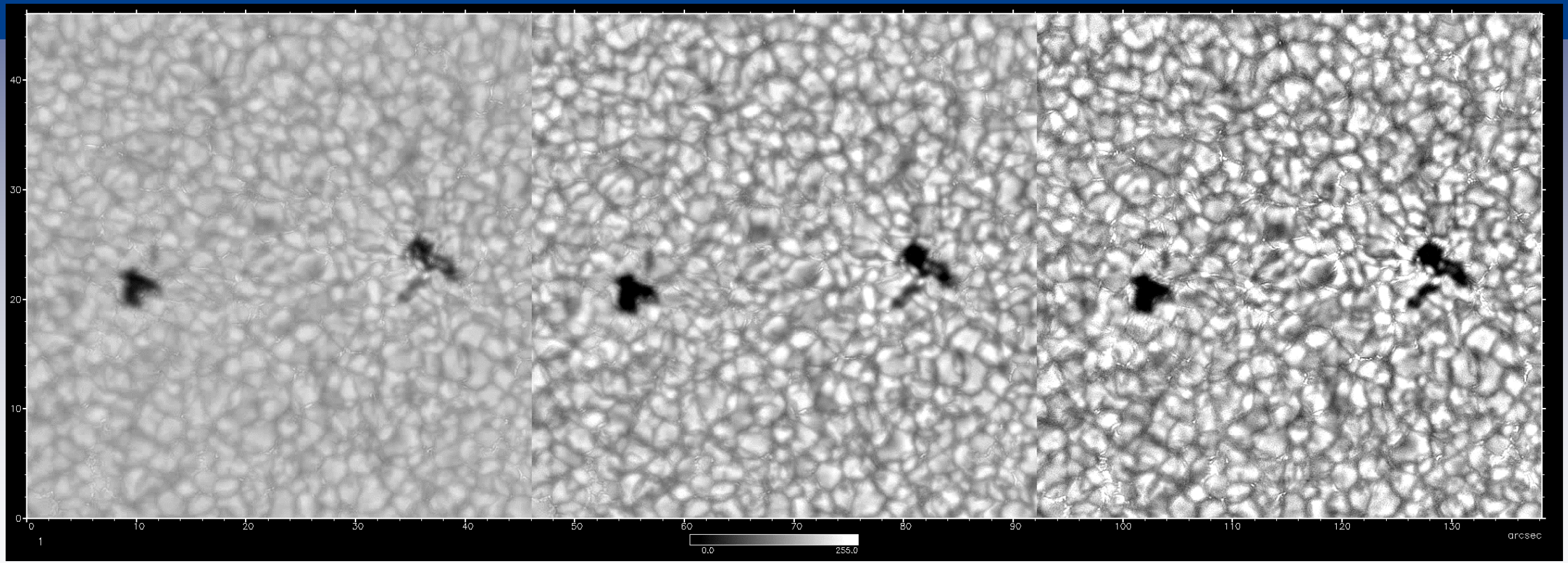
Seeing Diagnostics



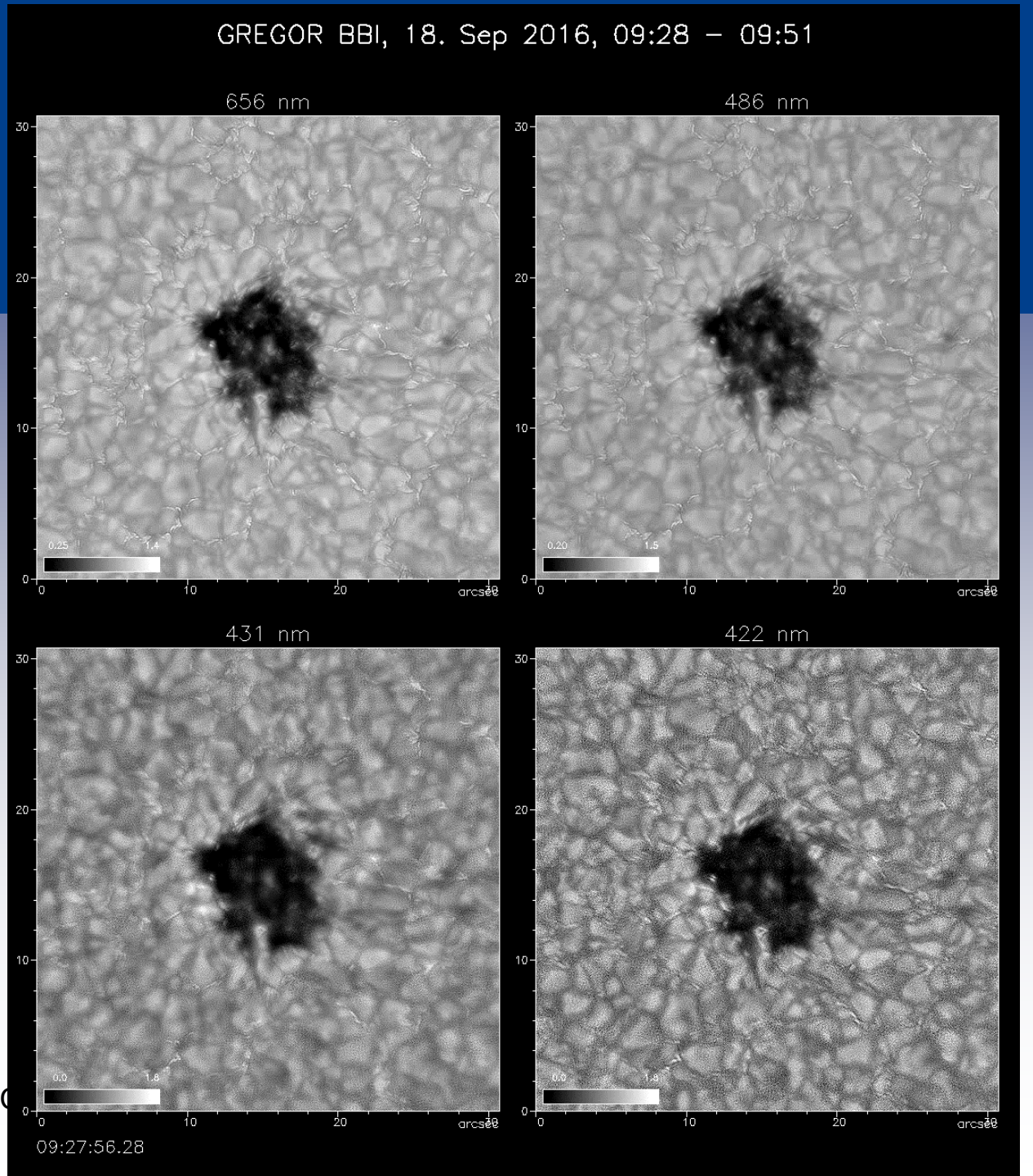




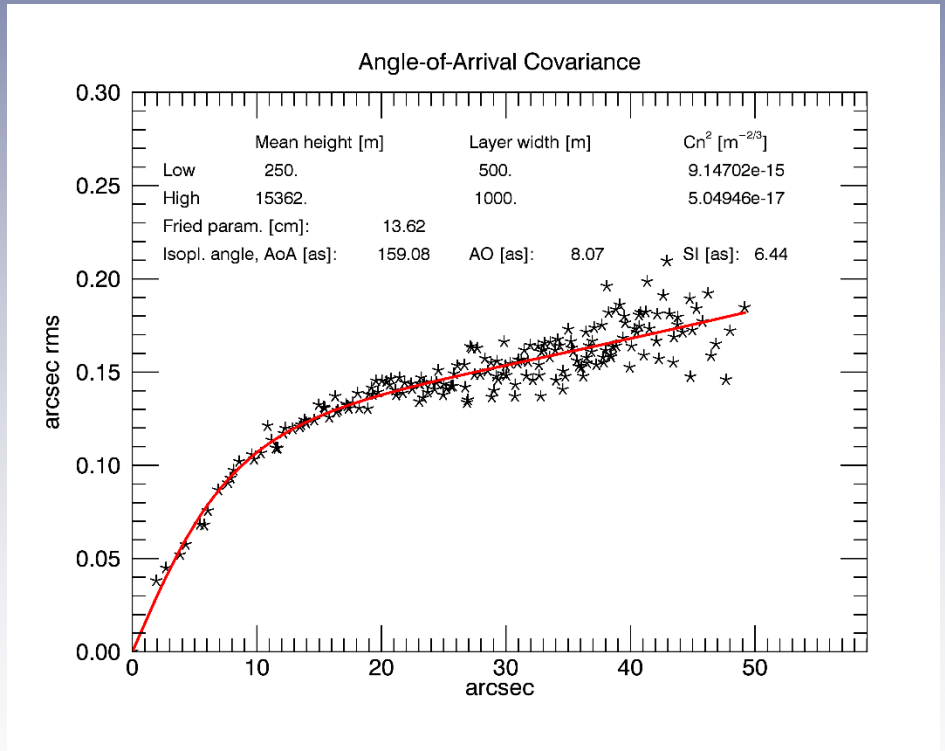
2. August 2016

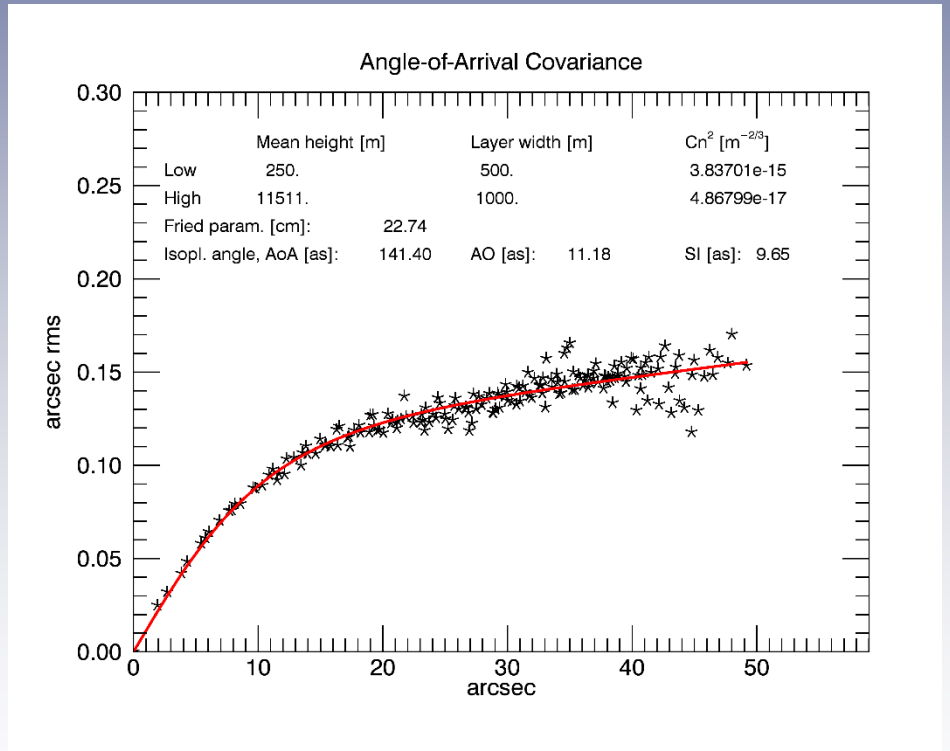


656 486 430

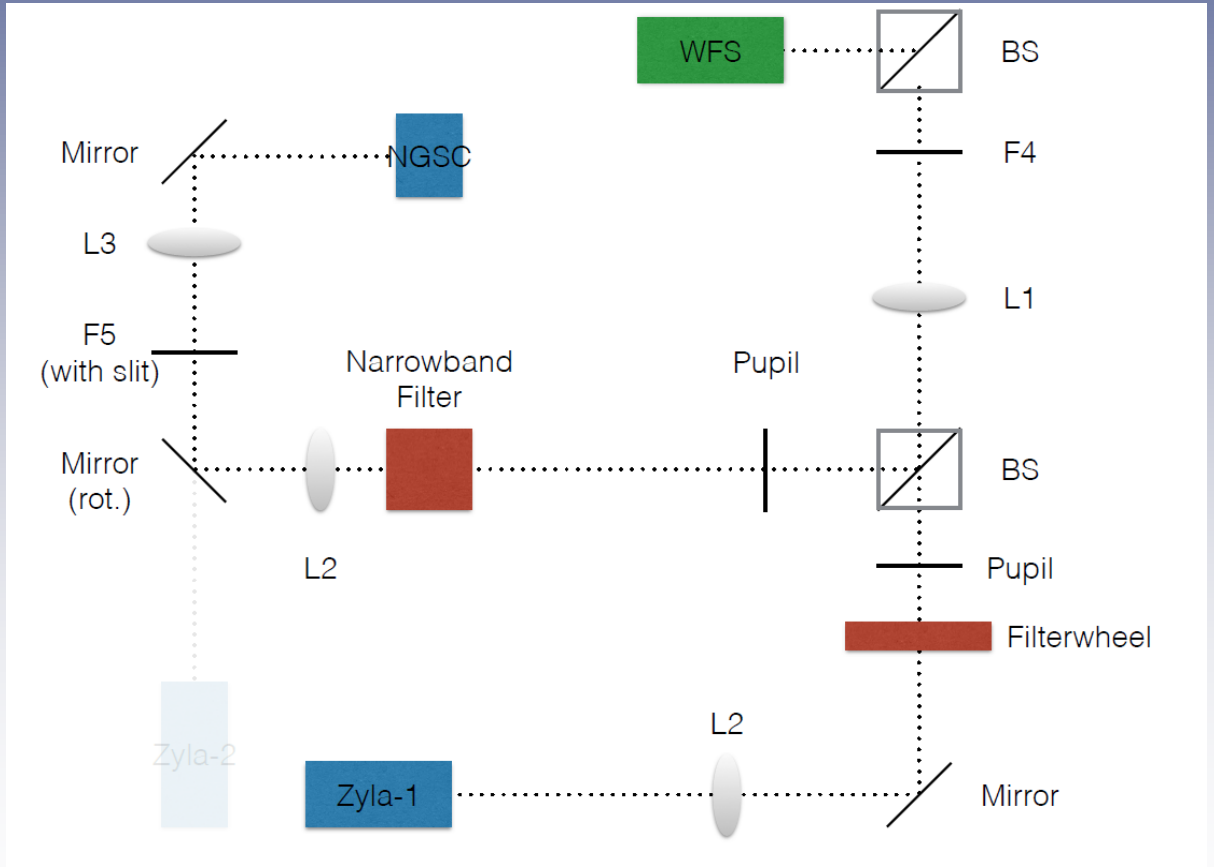

GREGOR BBI, 18. Sep 2016, 09:28 – 09:51
656 nm
486 nm
431 nm
422 nm
09:27:56.28

More Seeing Diagnostics

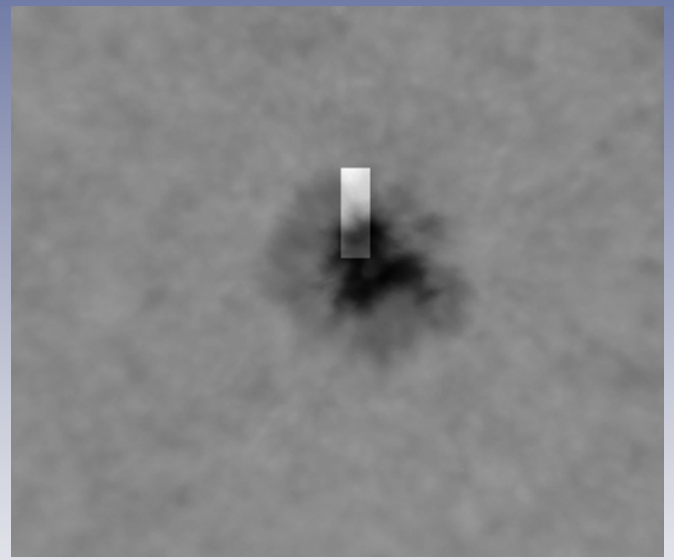


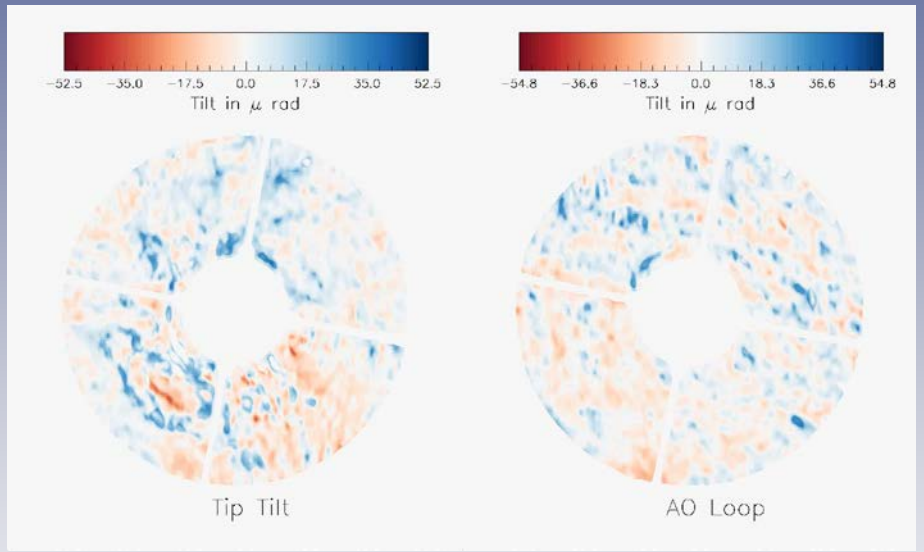


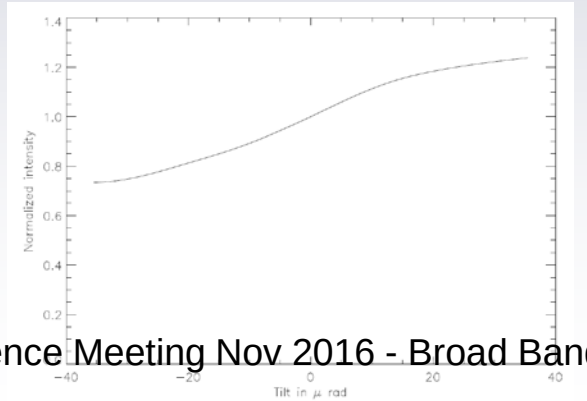
Foucault Tests



M2 Ripple and AO performance

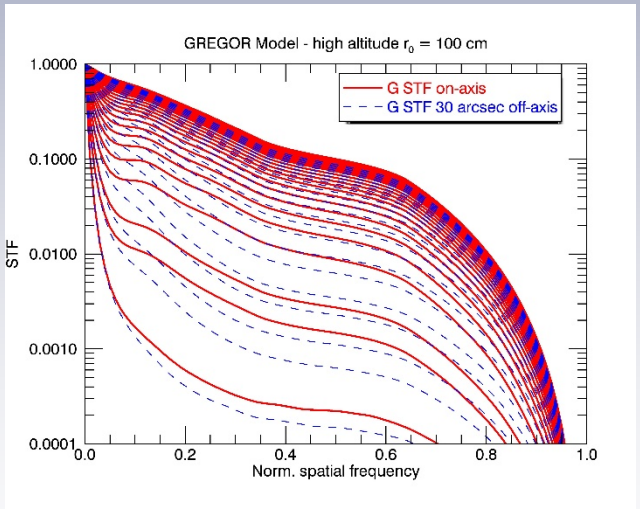


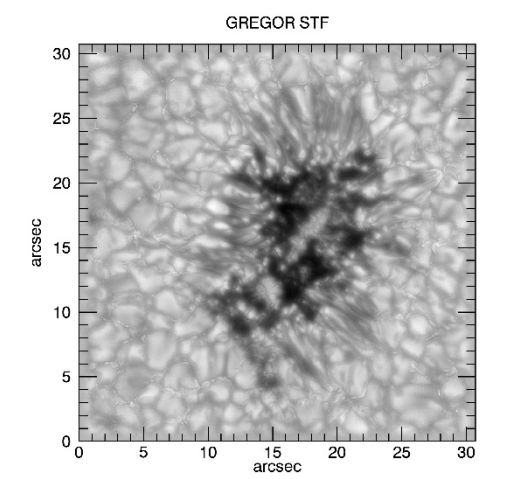


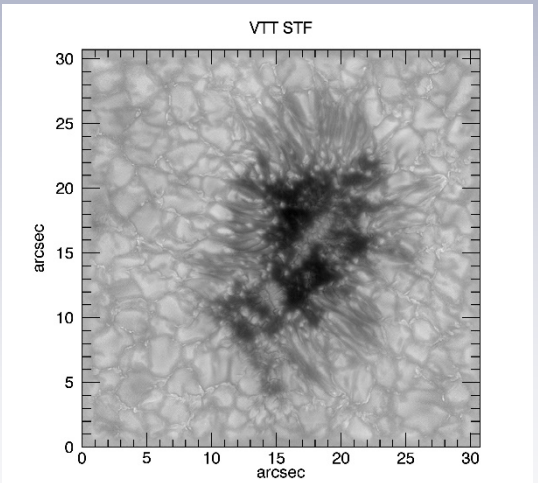


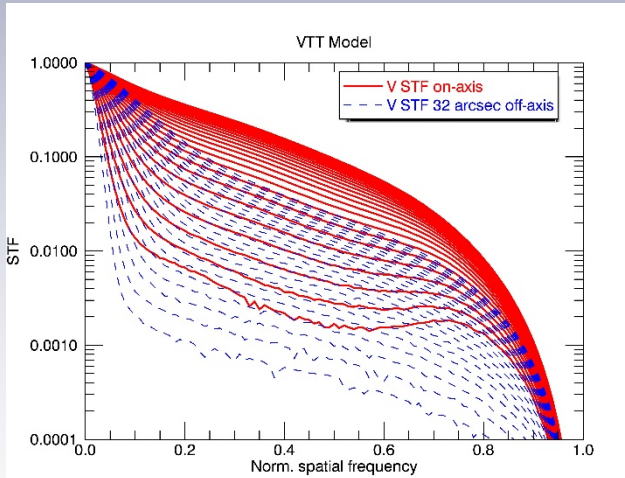
KISIP and GREGOR

- If you use KISIP with data from GREGOR, you are likely to use the wrong Fourier amplitude calibration
- Models for GREGOR account for the central obscuration in the STF

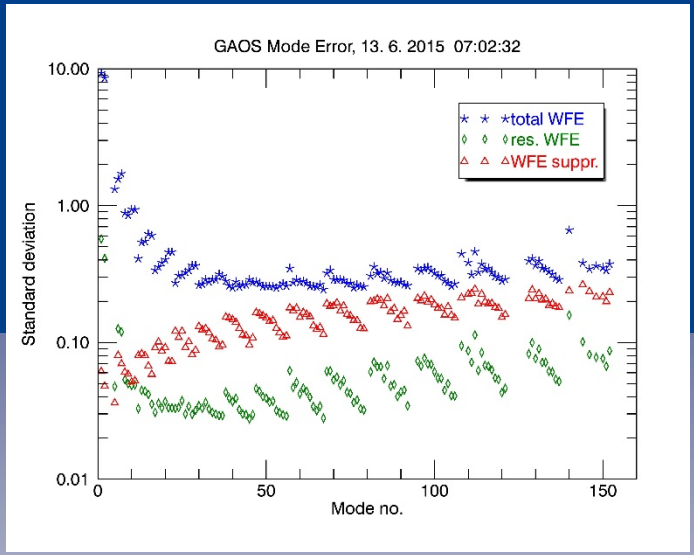


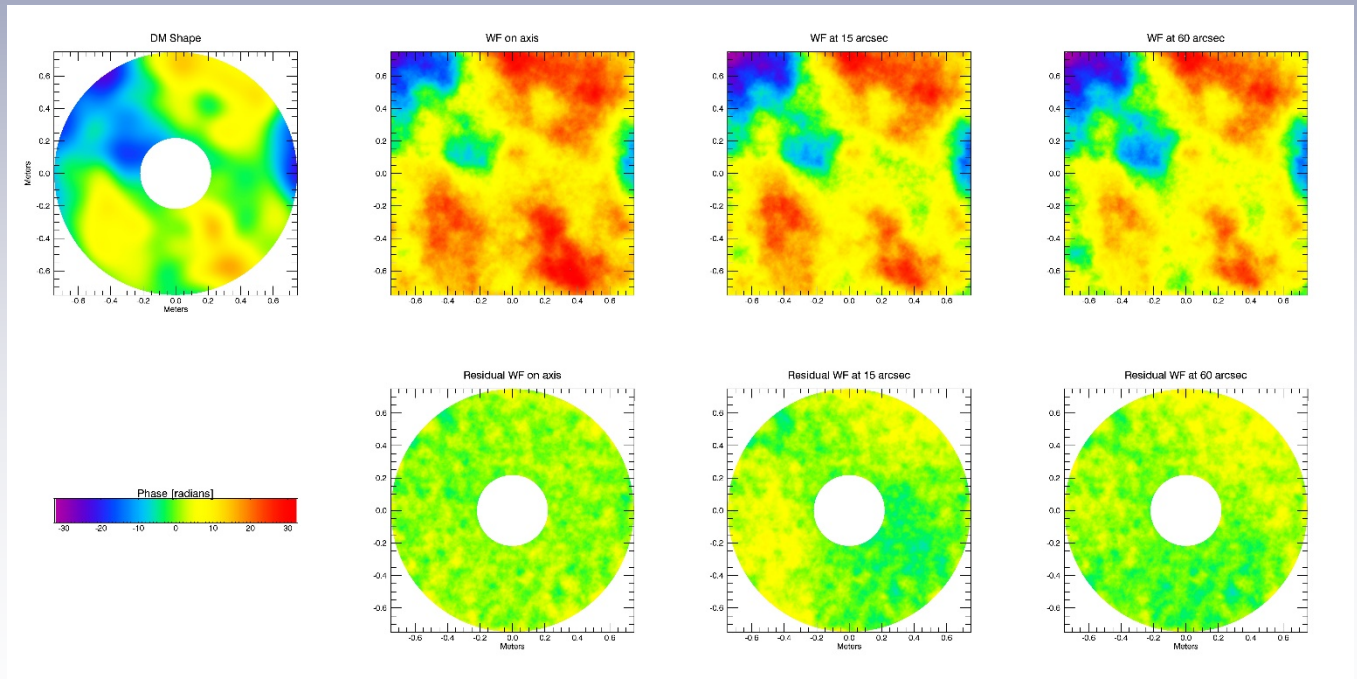


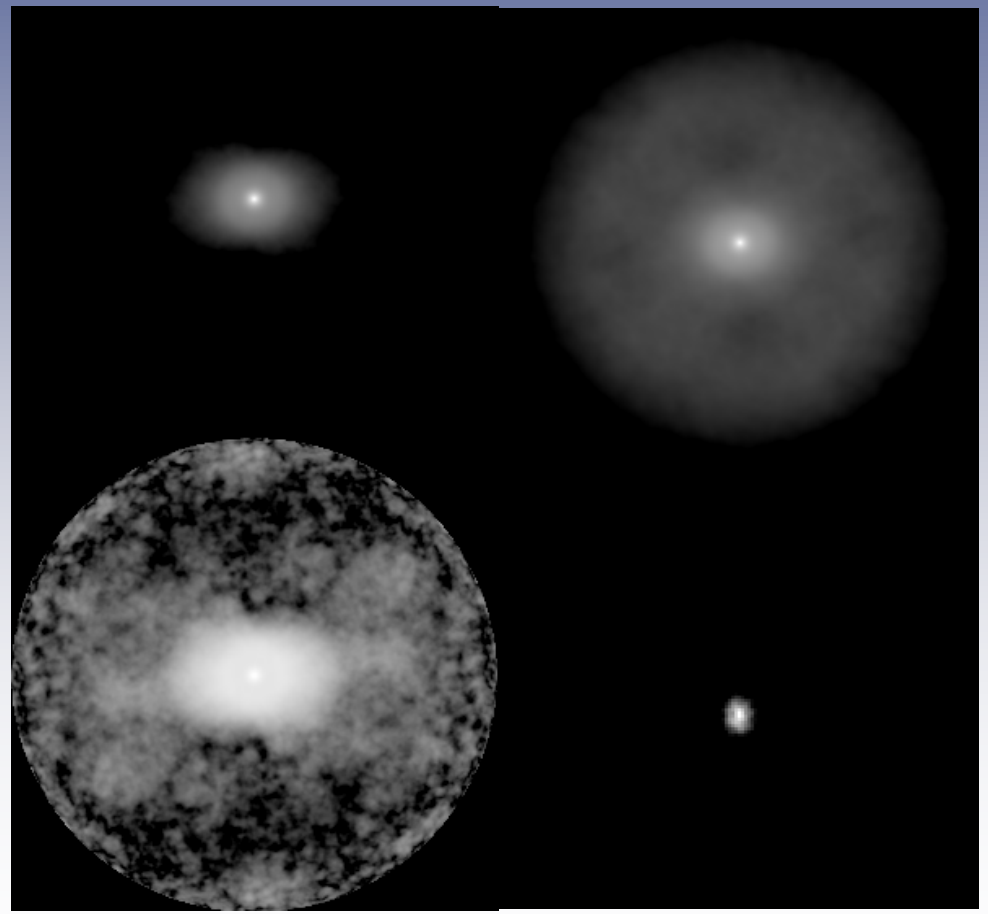




STF Modeling







Conclusions

- BBI received an upgrade
- Fairly successful season, ~ 20 TB of data, still crunching them (KISIP and MFBD)
  - KIS archive
- We have a consistent problem achieving the diffraction limit in the blue, expecting this to improve with the new M2
- Diagnostics for seeing and performance from data