Leibniz-Institut für
Astrophysik Potsdam

First results from 

the Potsdam Echelle Polarimetric and Spectroscopic Instrument for the LBT

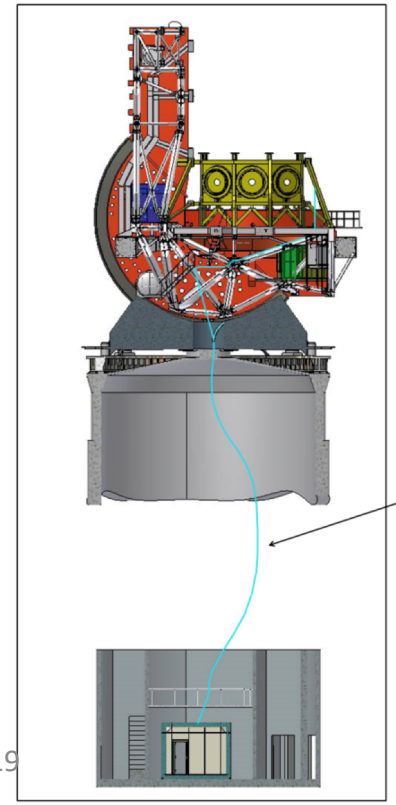
Klaus G. Strassmeier w/

Ilya Ilyin, Michi Weber, Arto & Silva Järvinen, Manfred Woche, Thorsten Carroll,
Engin Keles, Matthias Mallonn, et al.

Leibniz-Institute for Astrophysics Potsdam (AIP), Germany

LBT:

(two-bedroom condominium good to $\lambda/8$)



PFU SX

PFU DX

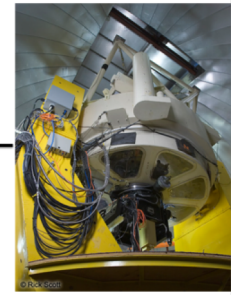
Polarimeter SX

Polarimeter DX

Spectrograph

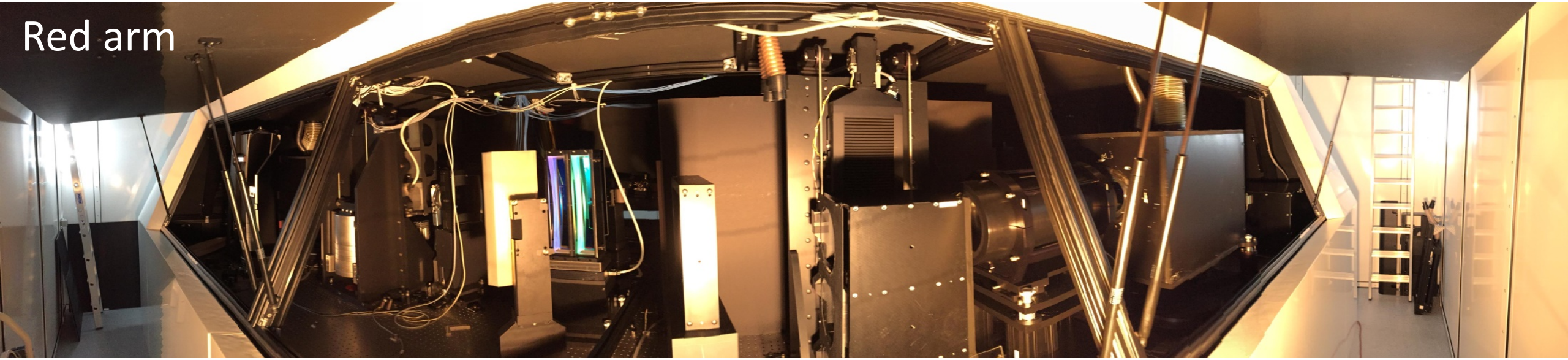
Fibretrain

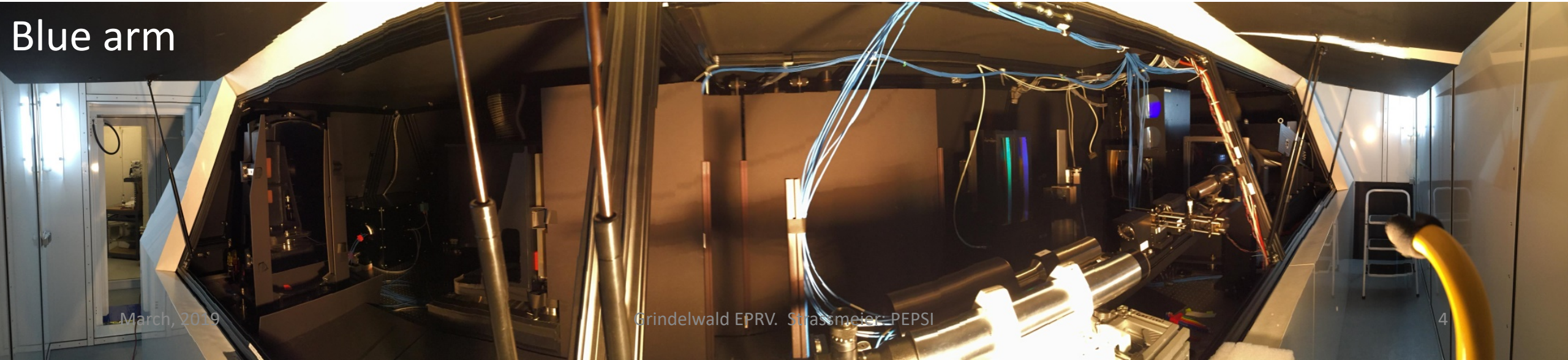
VATT



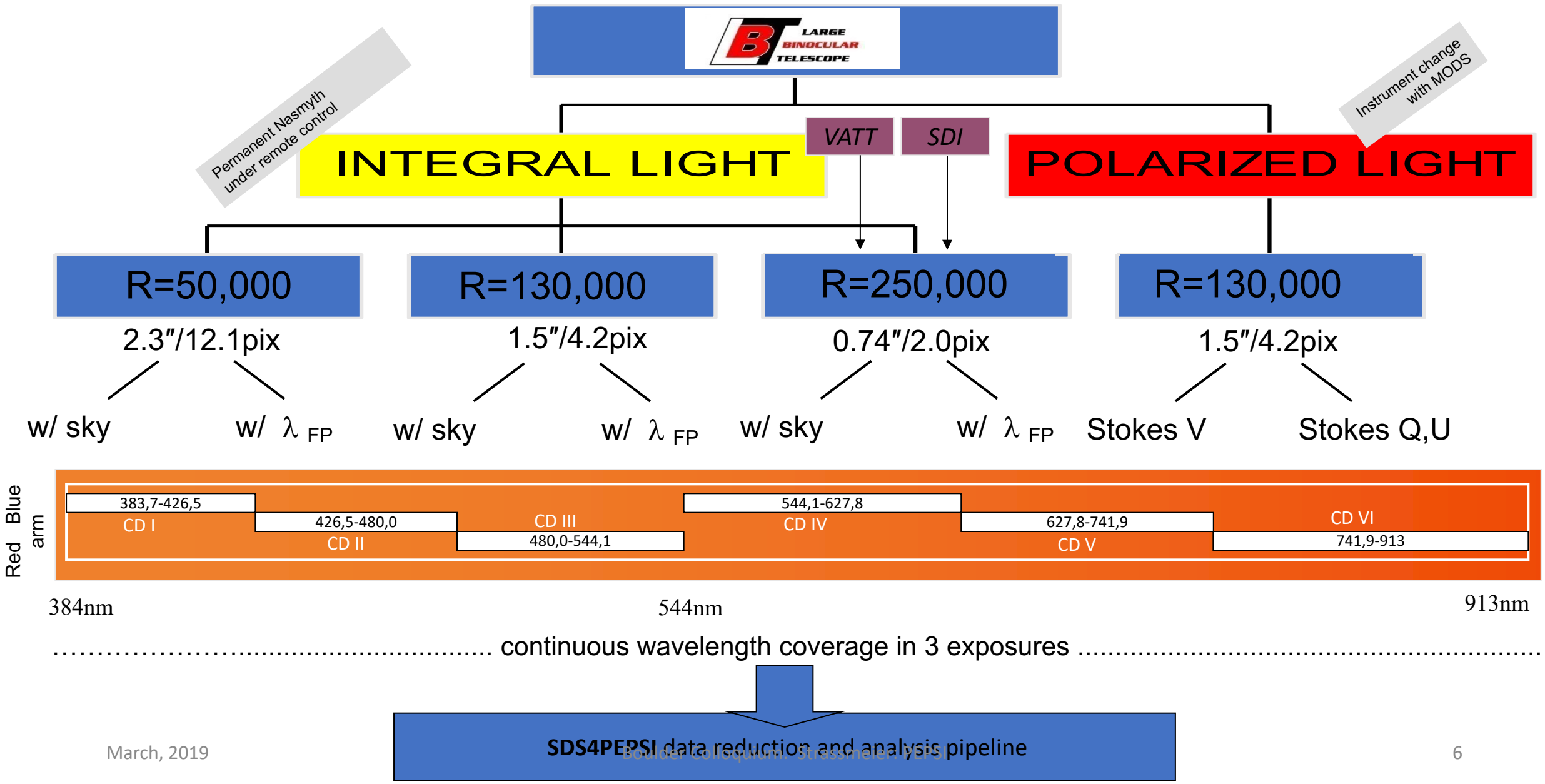
SDI

Panoramic view within chamber

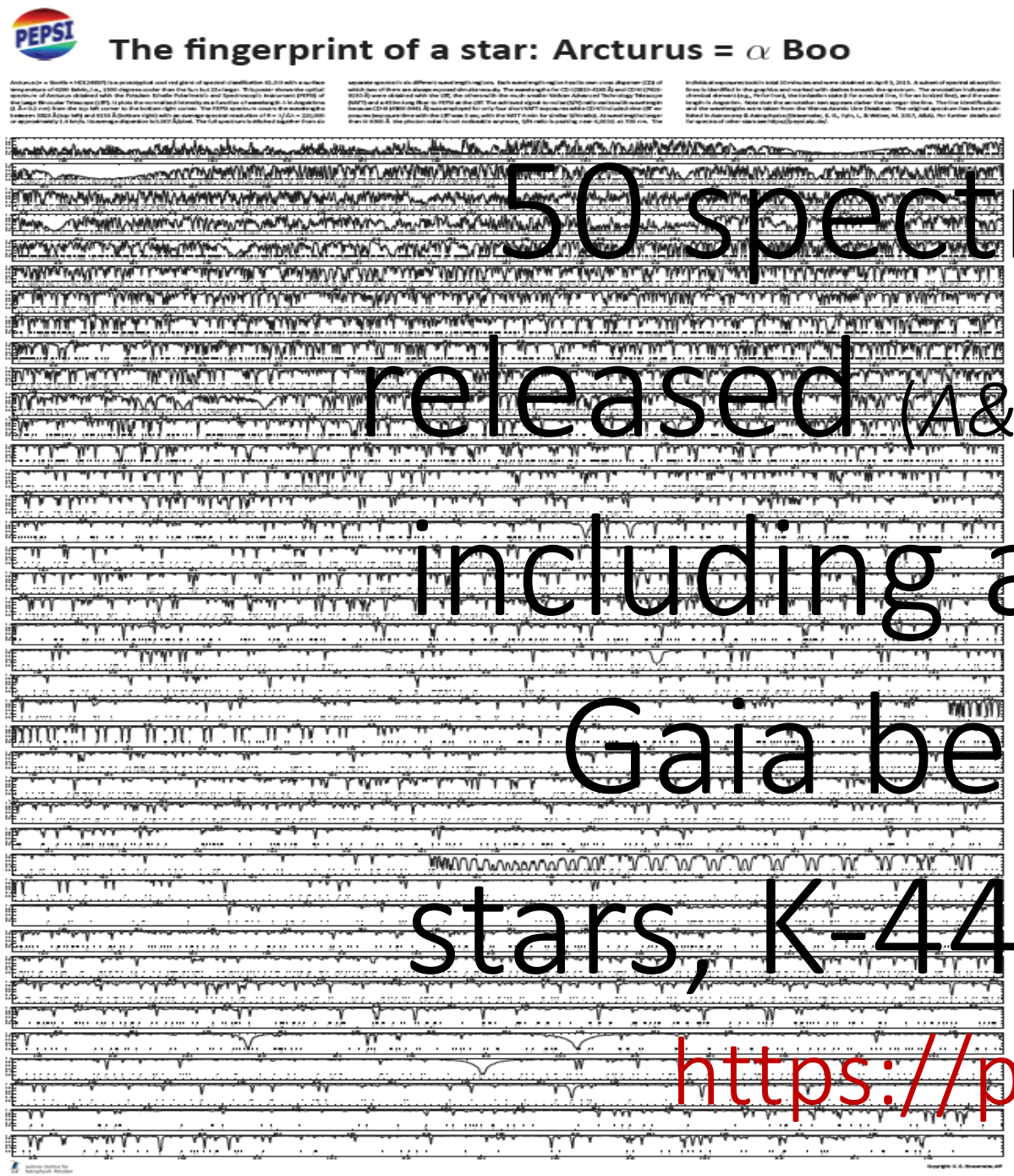




PEPSI observing modes



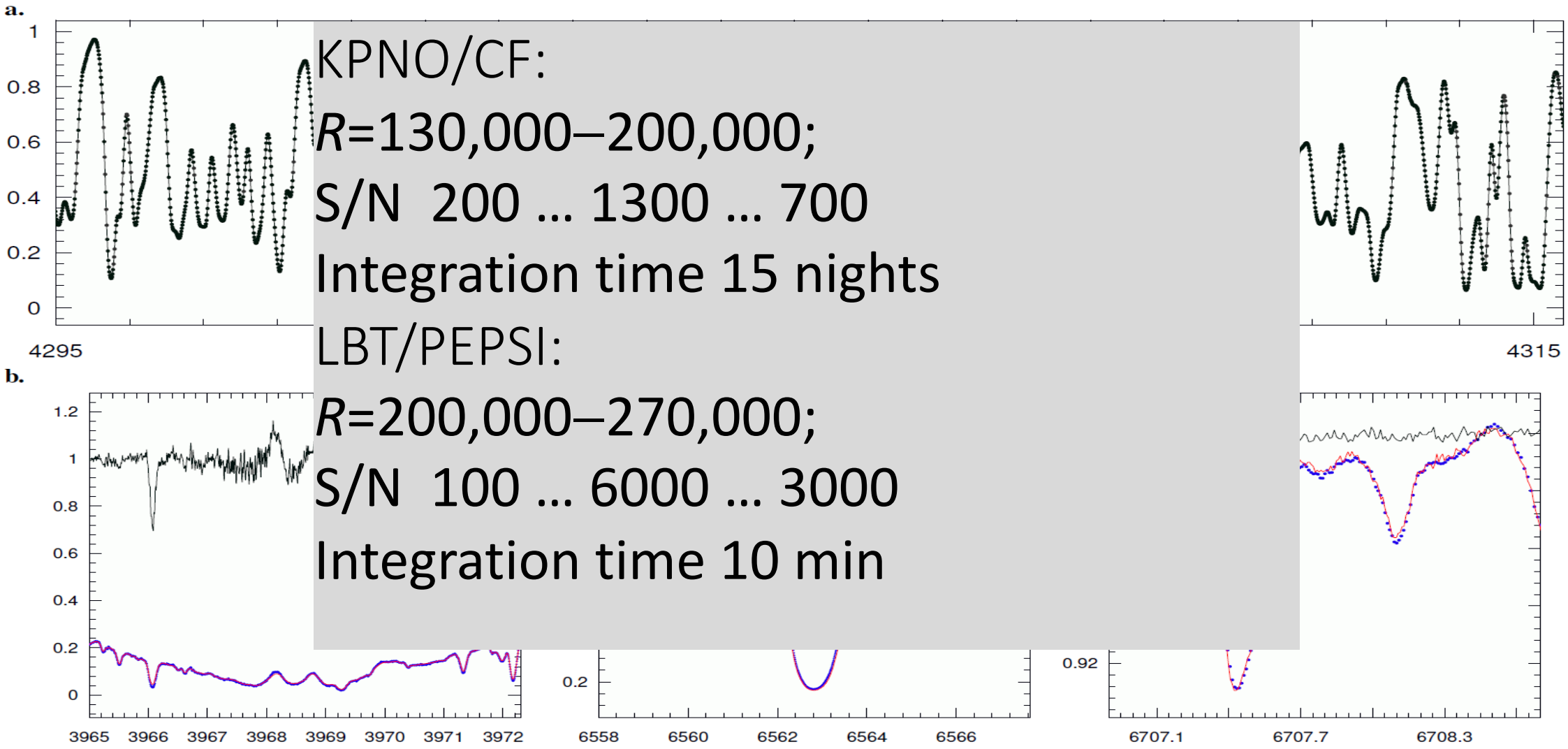
„Deep spectrum project“



50 spectral atlases released (*A&A* 612, A44, A45, A46); including all northern Gaia benchmark stars, K-444 & the Sun

https://pepsi.aip.de

Arcturus: comparison with KPNO atlas (Hinkle et al.)



KPNO/CF:

R=130,000–200,000;

S/N 200 … 1300 … 700

Integration time 15 nights

LBT/PEPSI:

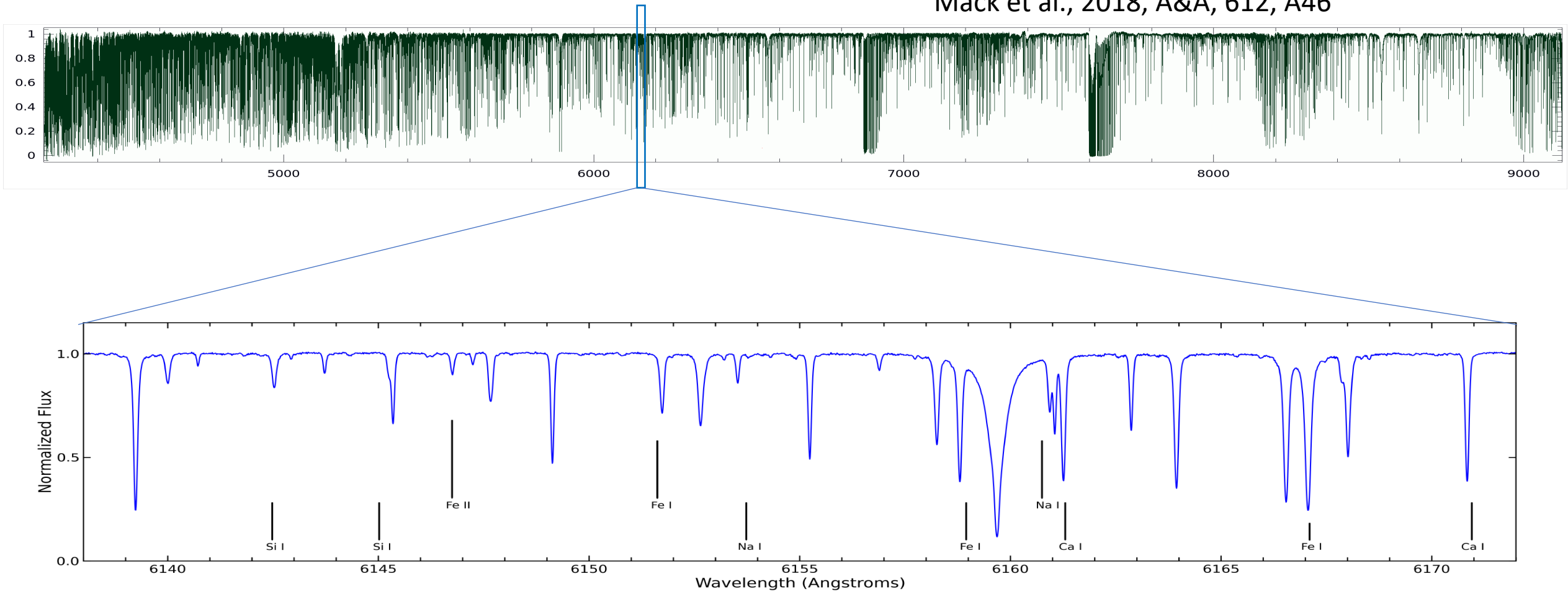
R=200,000–270,000;

S/N 100 … 6000 … 3000

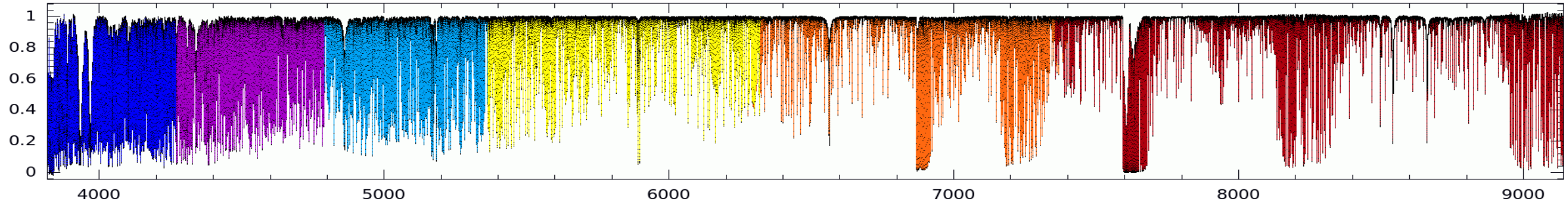
Integration time 10 min

Kepler-444: age 10-11 Gyr, 5 planets. Abundance analysis

Mack et al., 2018, A&A, 612, A46

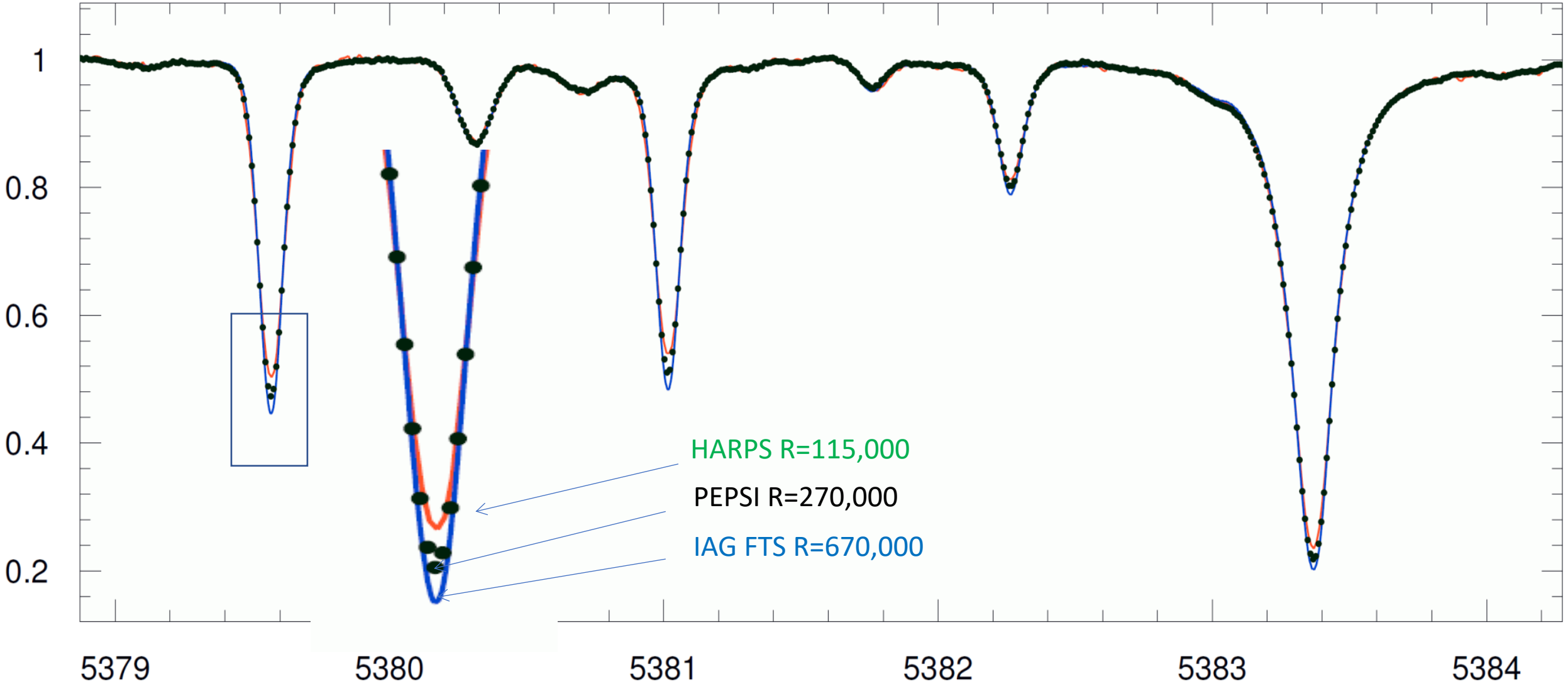


The toughest test of all: the Sun



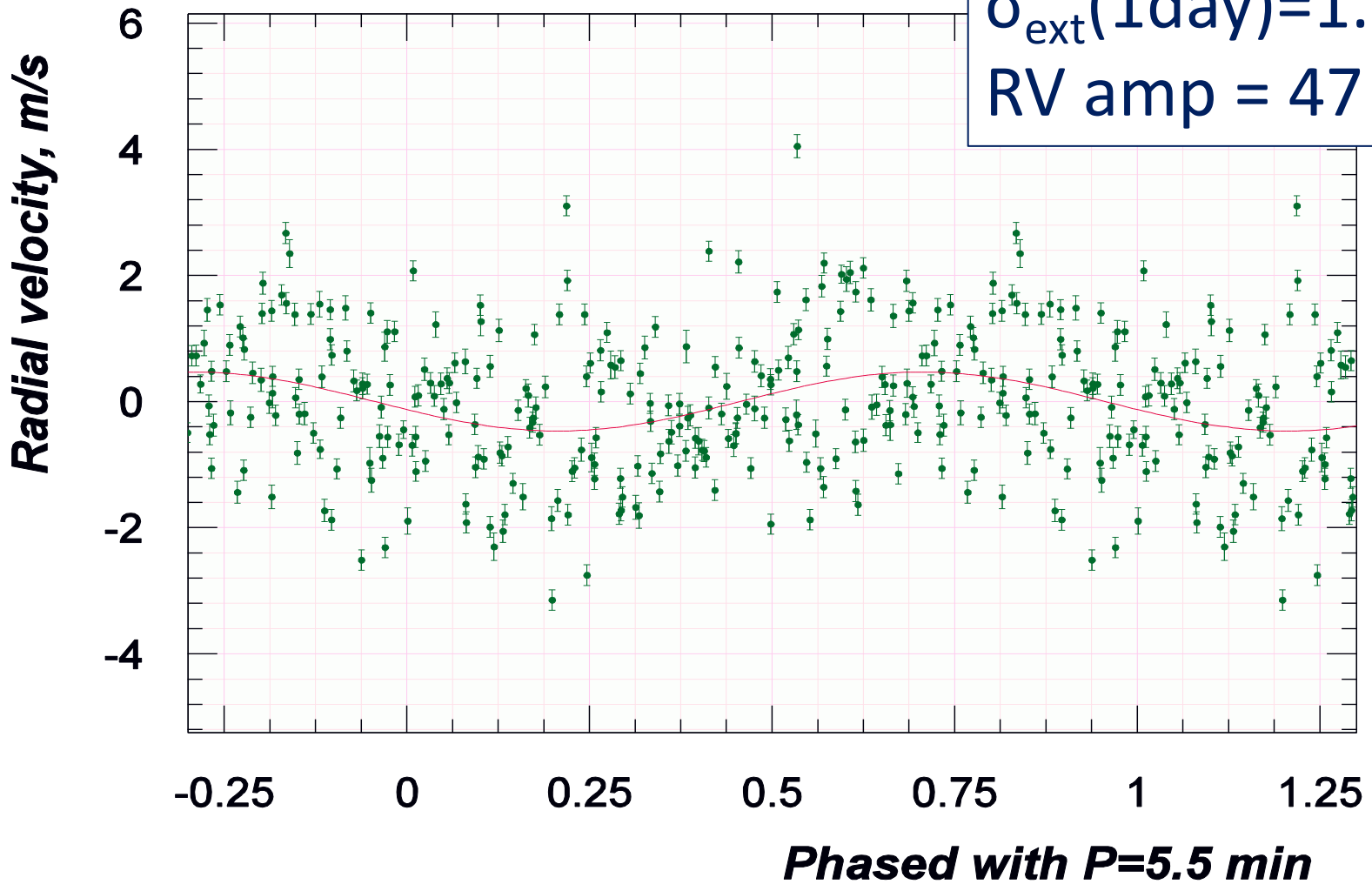
Dots = SDI PEPSI in Oct. 2016; **line** = NSO FTS in 1981

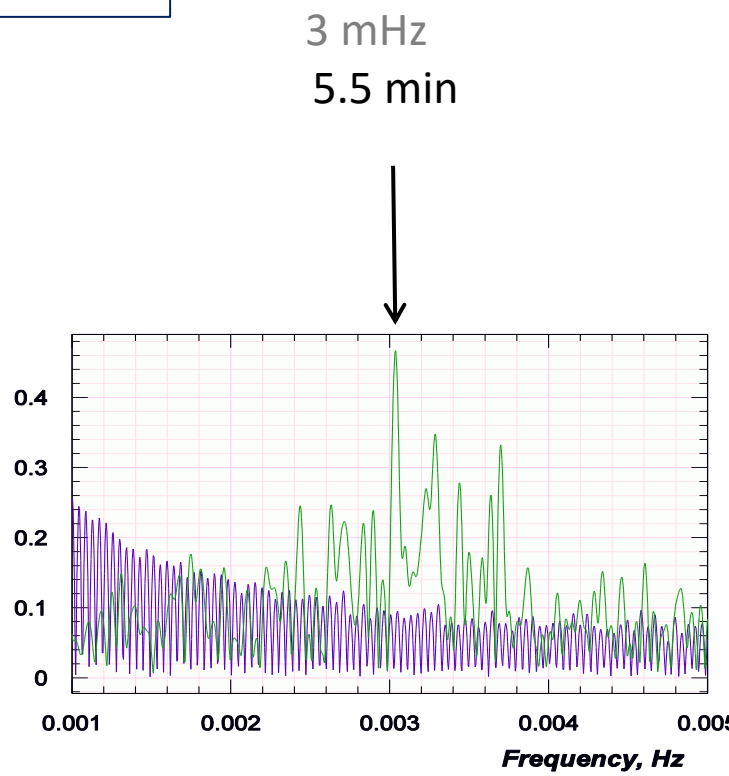
C I 5381.8 Å


1
0.8
0.6
0.4
0.2
5379
5380
5381
5382
5383
5384
HARPS R=115,000
PEPSI R=270,000
IAG FTS R=670,000

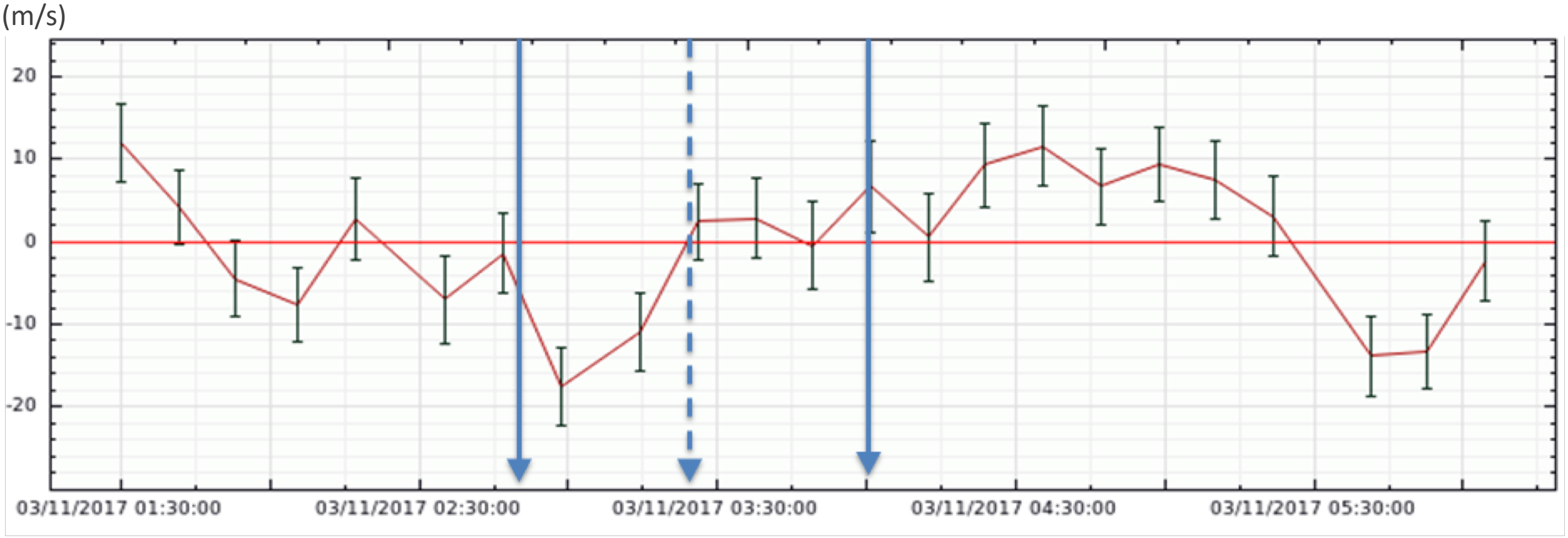
Chamber RV stability reached in 2017: Solar p-mode oscillations detected

σ_{ext}(1day)=1.2 m/s
RV amp = 47 cm/s





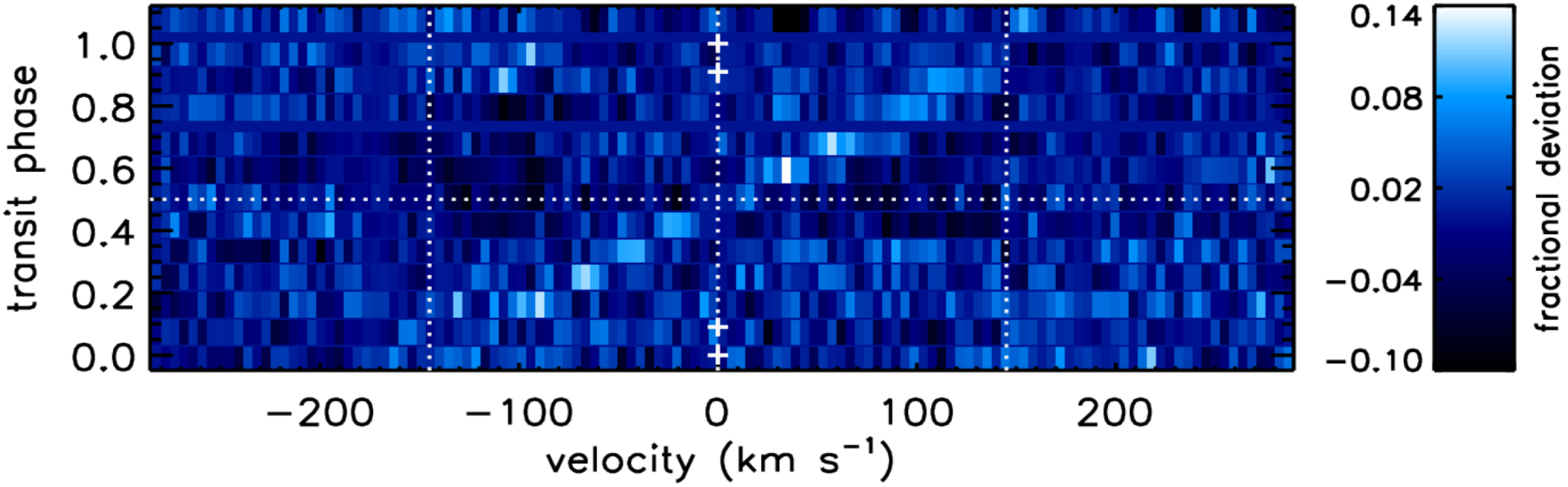
RVs of TRAPPIST-1g transit



Transit Nov. 3, 2017: Trappist-1 (*V*=18.8, *I*=14.0): **rms = 5 m/s** w/ integration time of 10 min.

Bender (UA), **Edwards** (LBTO) *et al.* and AIP PEPSI team.

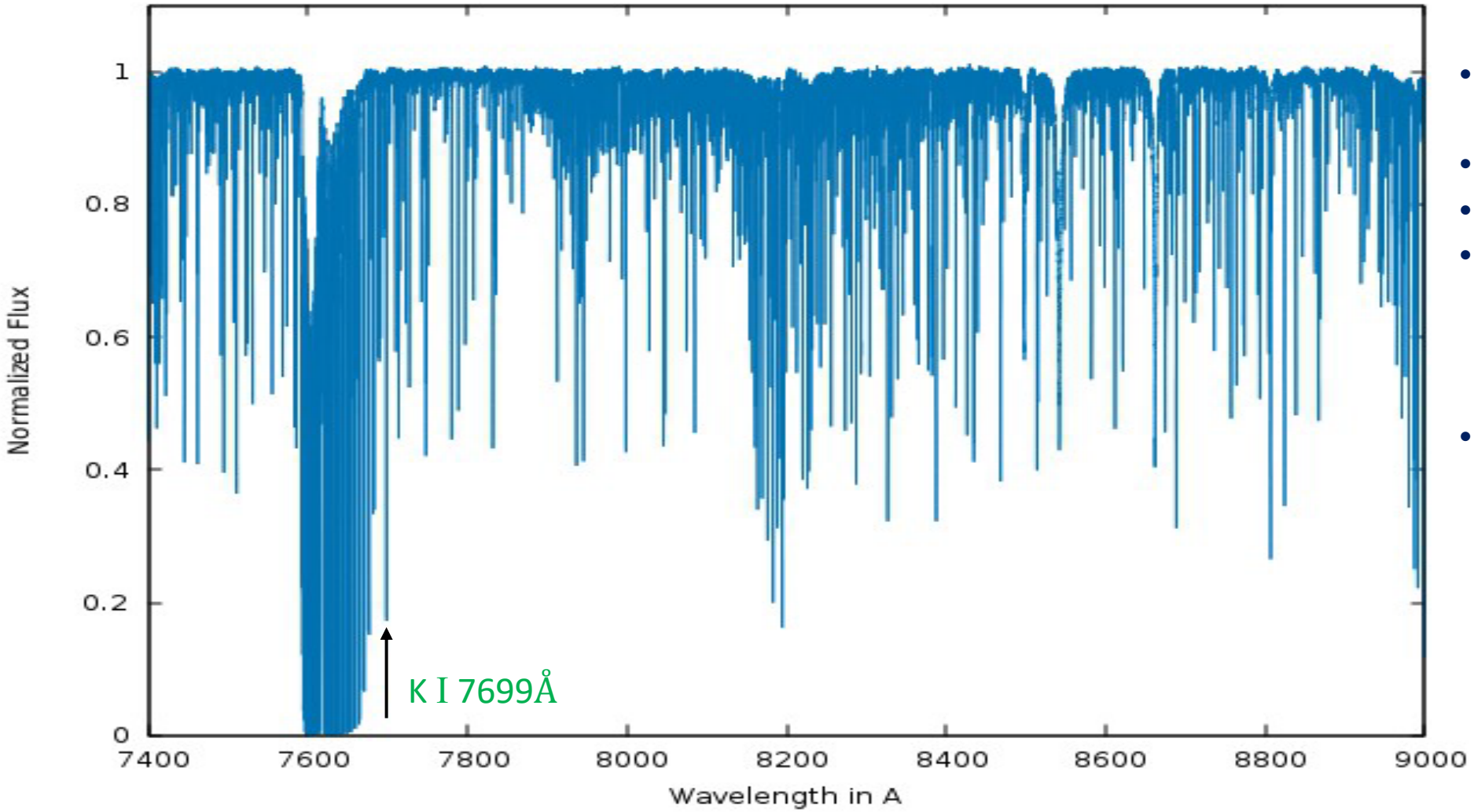
KELT-21: direct detection of its planet at optical wavelengths



Johnson (OSU) and the AIP PEPSI team,
„KELT-21b: A Hot Jupiter Transiting the Rapidly Rotating Metal-poor Late-A Primary of a Likely Hierarchical Triple System", AJ 155, 100 (2018)

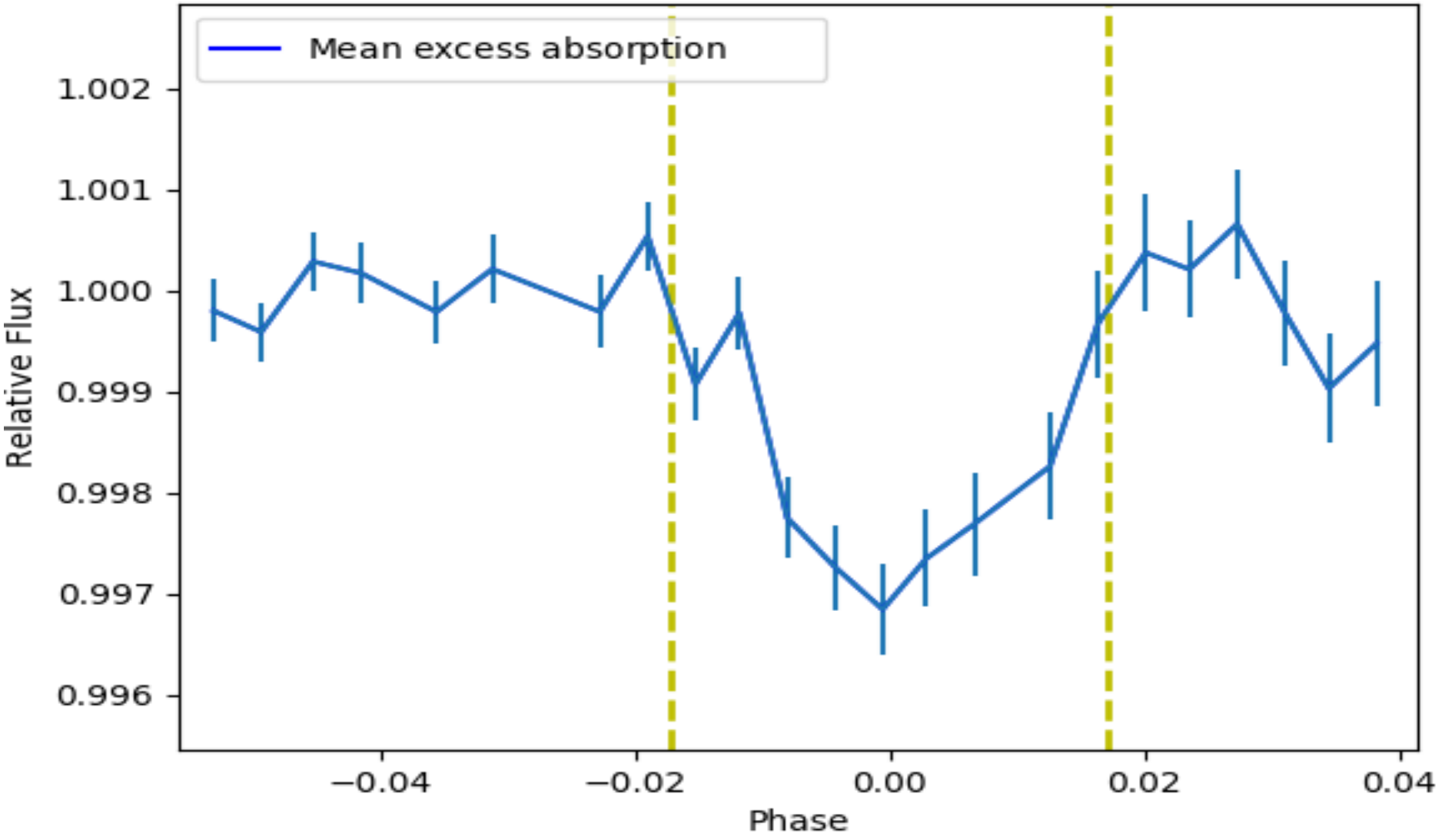
Potassium detection in HD189733b

(Keles et al., 2019, MNRAS, submitted)



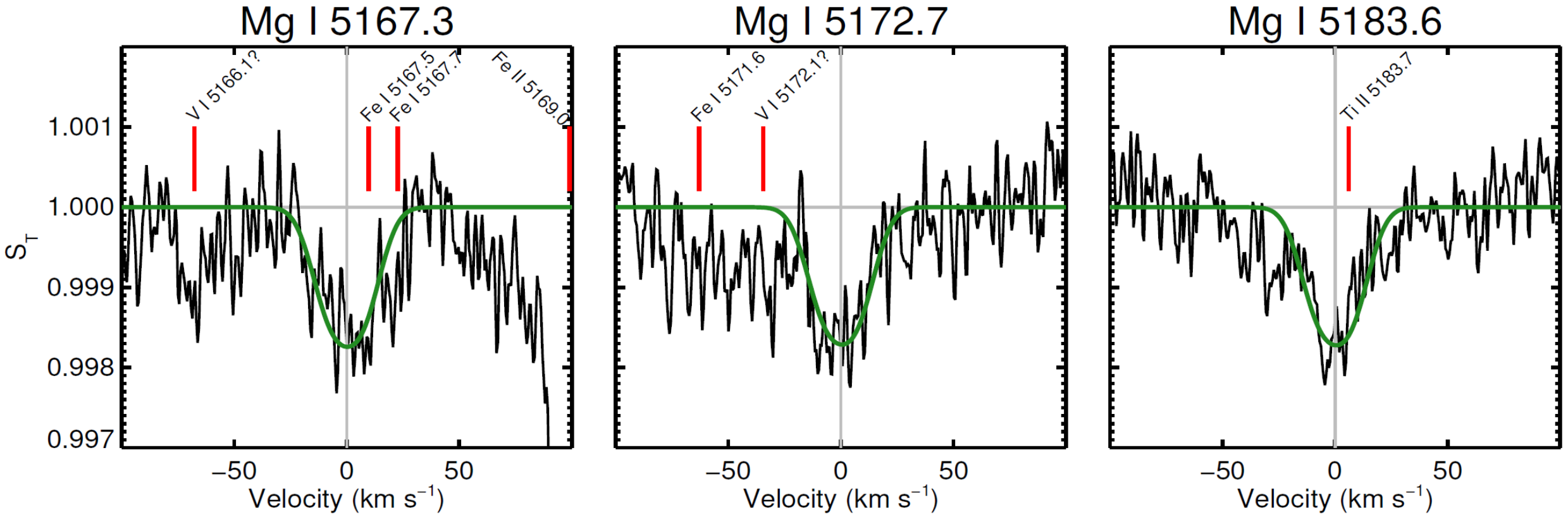
- Transit in October 2017 during POL commissioning
- R=130,000
- 24 exposures w/ S/N≈500
- Building excess absorption specs from different bins centered on KI line (up to 2 ref bins)
- Best result for 0.5Å

8σ potassium detection in HD189733b

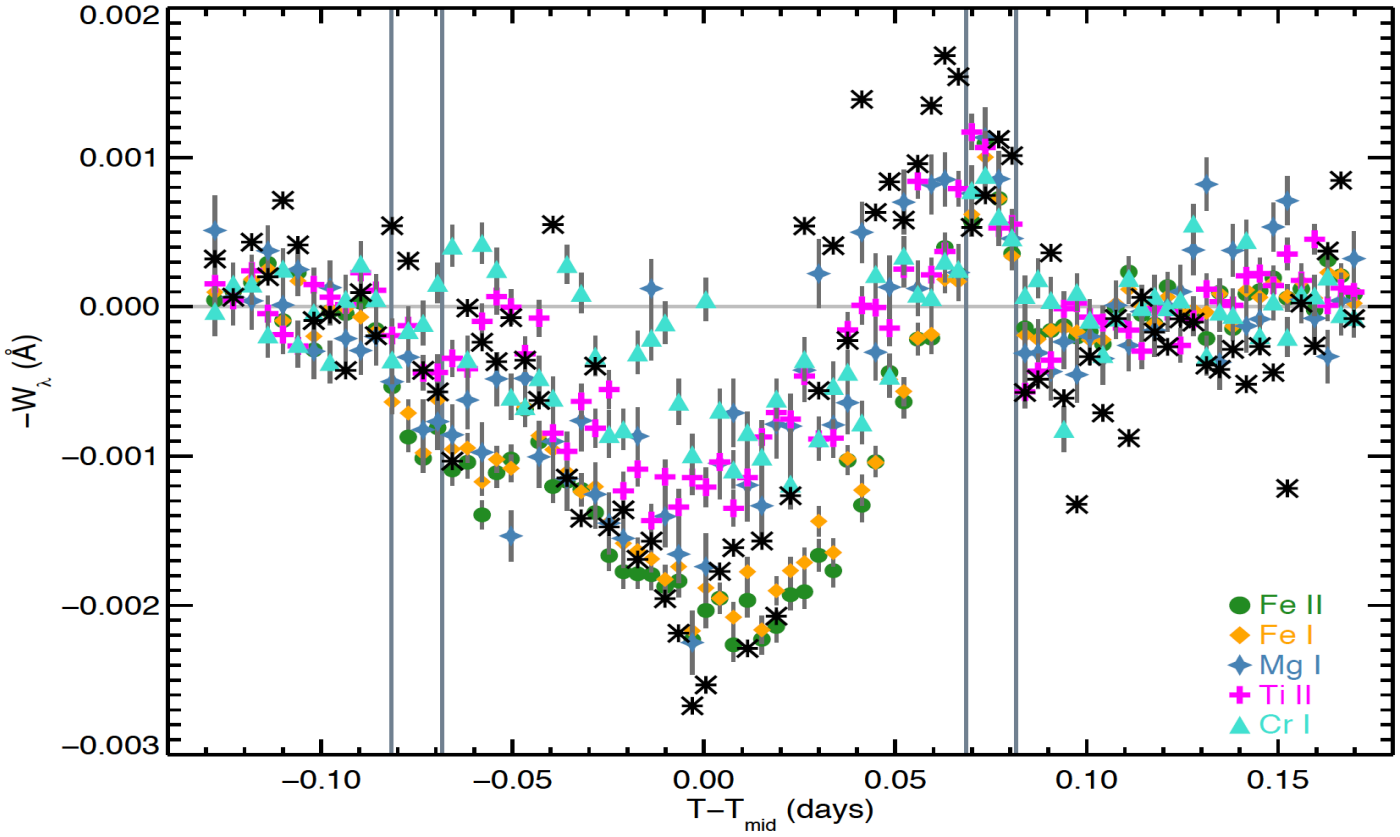


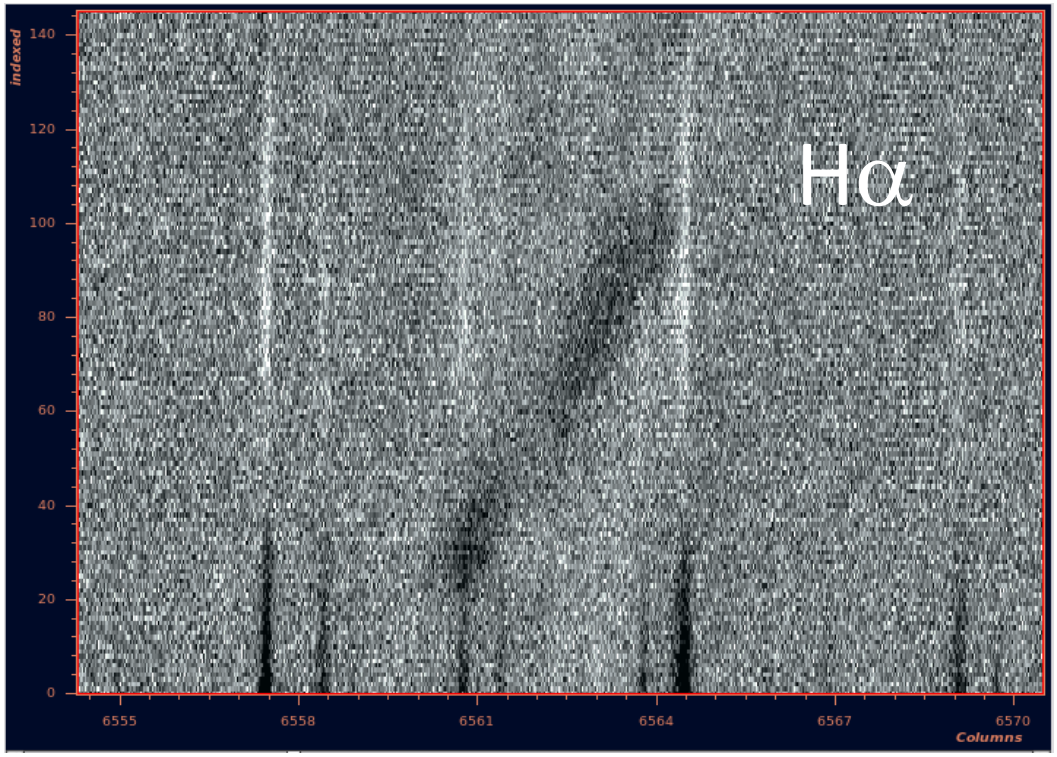
Kelt-9b atmospheric spectrum - detection of Fe & Ti but also Cr I and Mg I

Ratio spectrum „star inside transit“ / „star outside transit“: CD III, 4750-5430Å, *R*=50,000



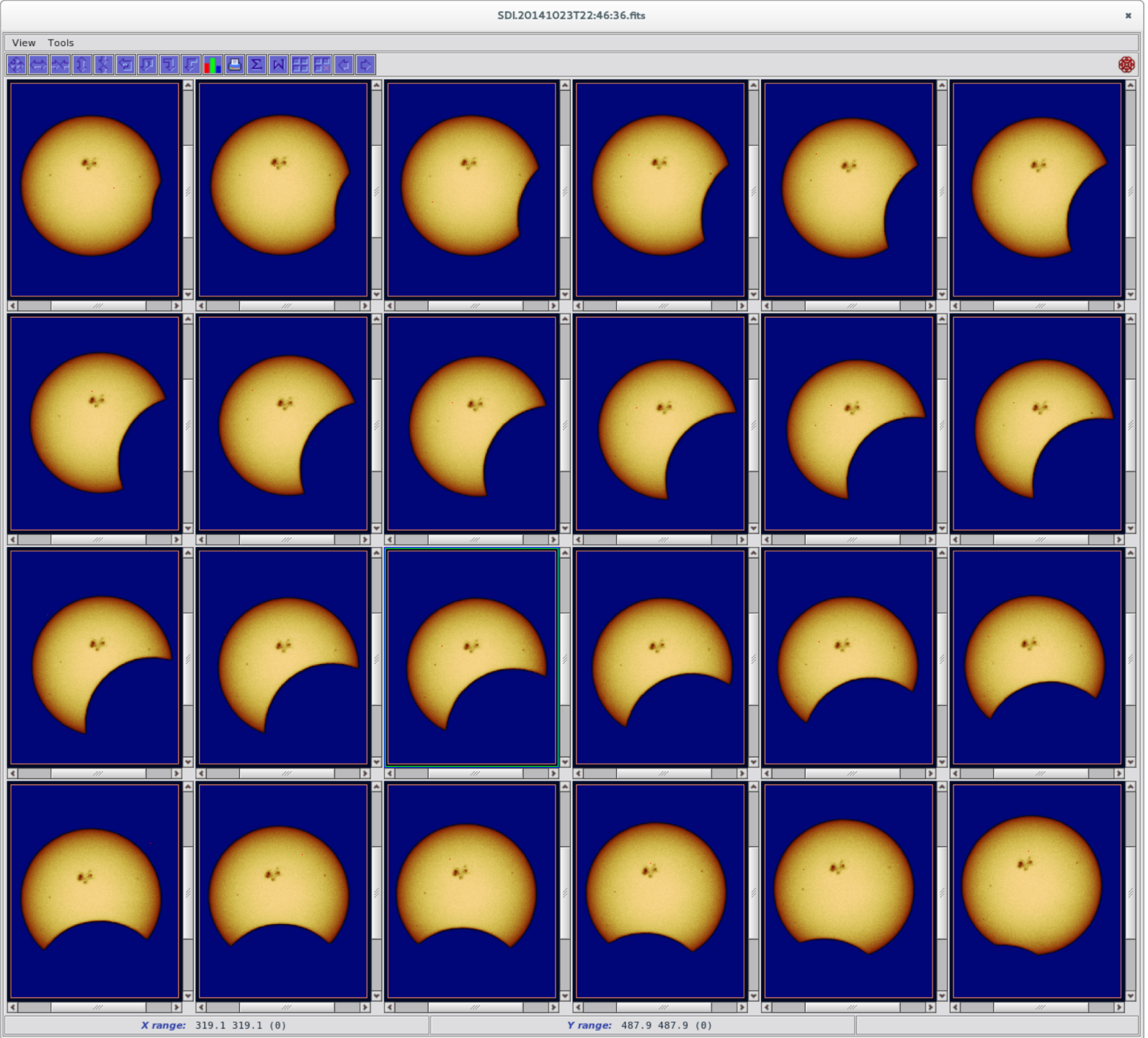
KELT-9b: detection of Fe & Ti but also Cr I and Mg I





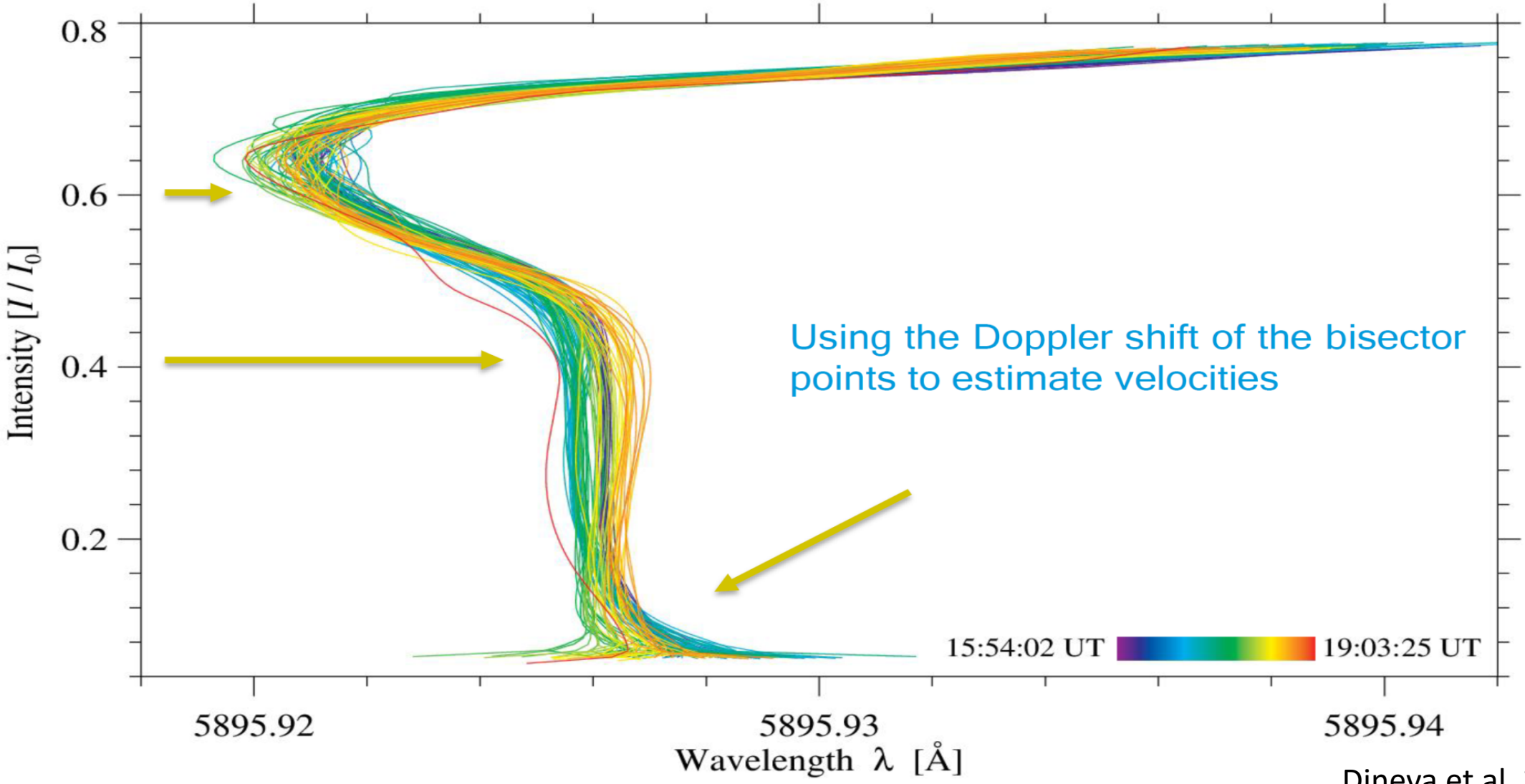
W. Cauley et al. 2019, AJ, 157, 69

„Detections of Mg I in the thermosphere of Kelt-9b"

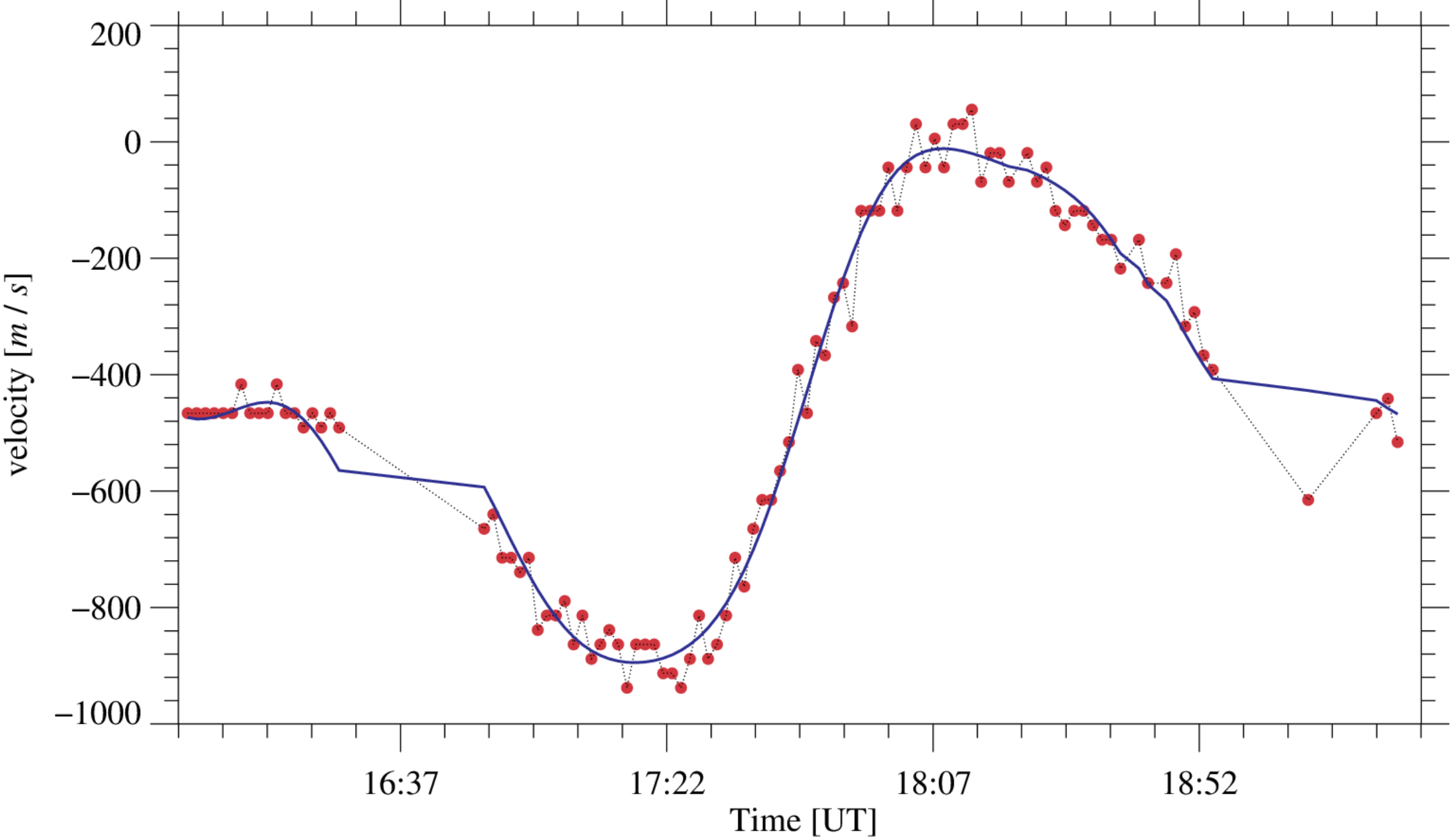


Solar eclipse
August 11, 2018

Na D_1 line bisector during eclipse



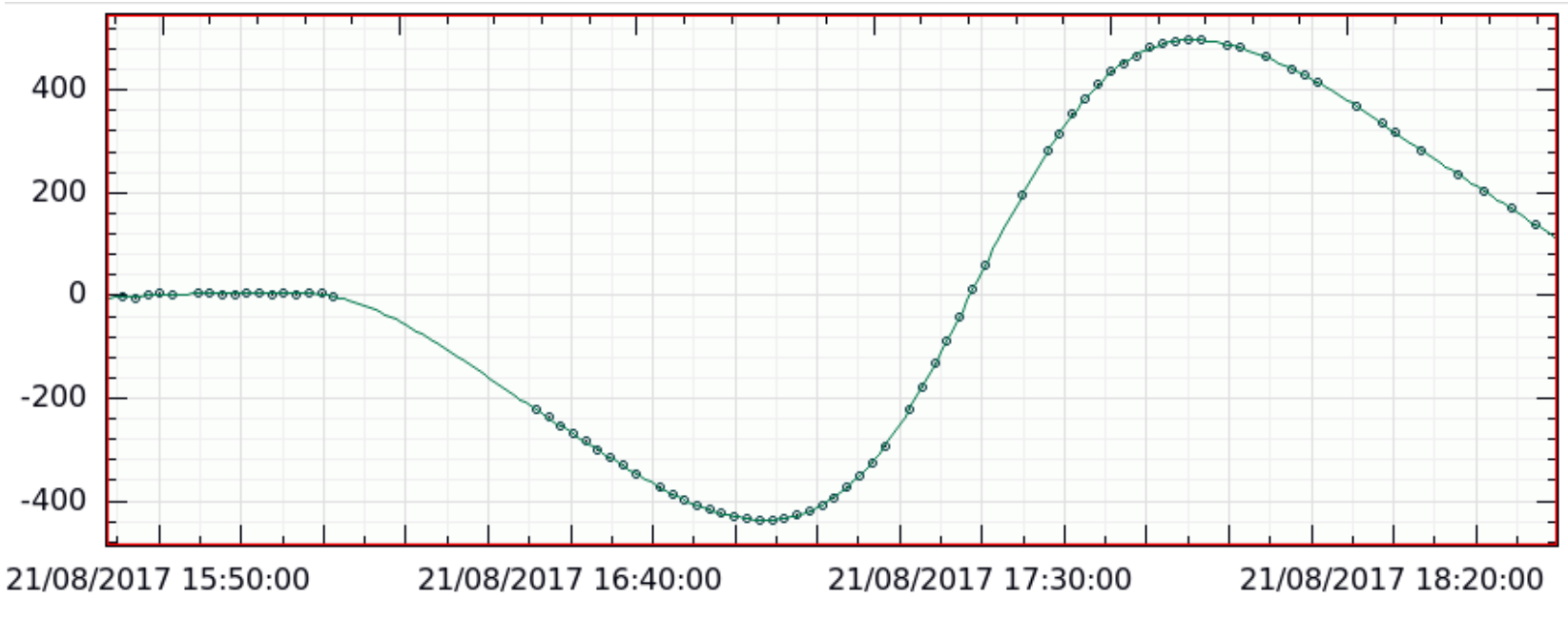
Dineva et al. 2019, in prep

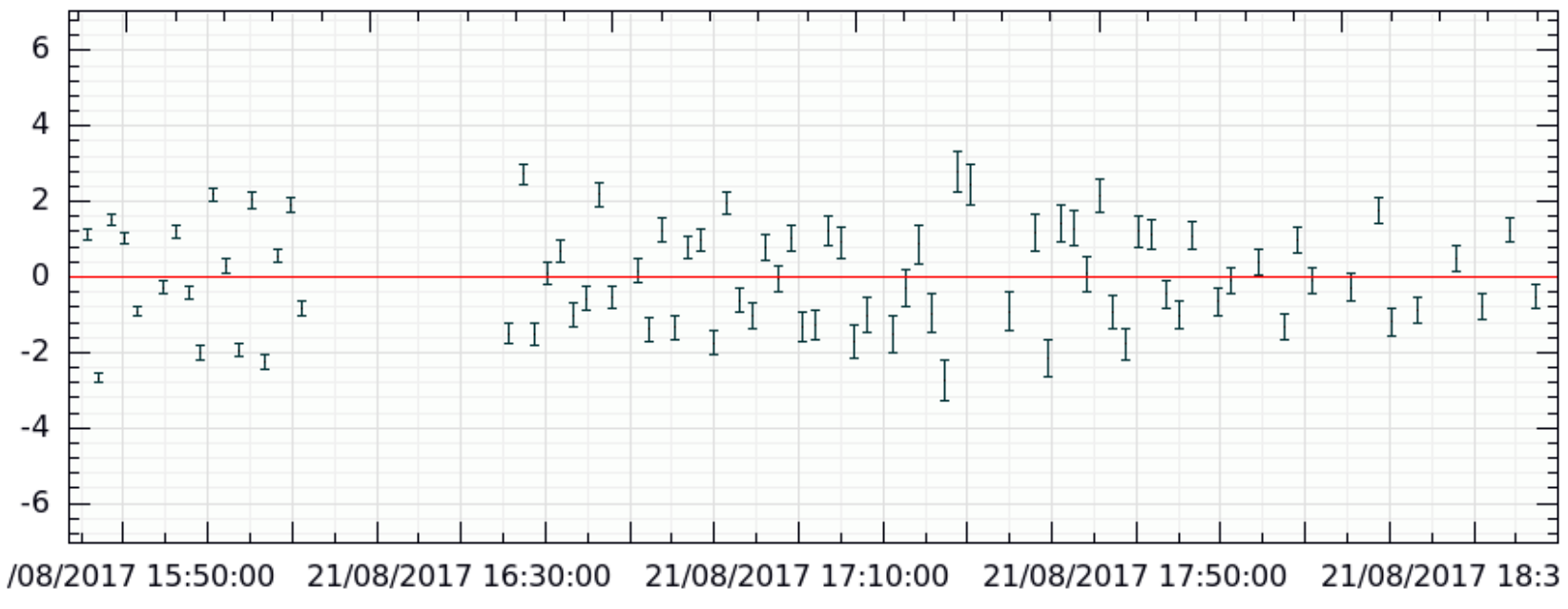

200
0
−200
−400
−600
−800
−1000
velocity [m / s]
16:37
17:22
18:07
18:52
Time [UT]

… and from photspheric lines with full CD IV coverage

(rms ≈1 m/s)

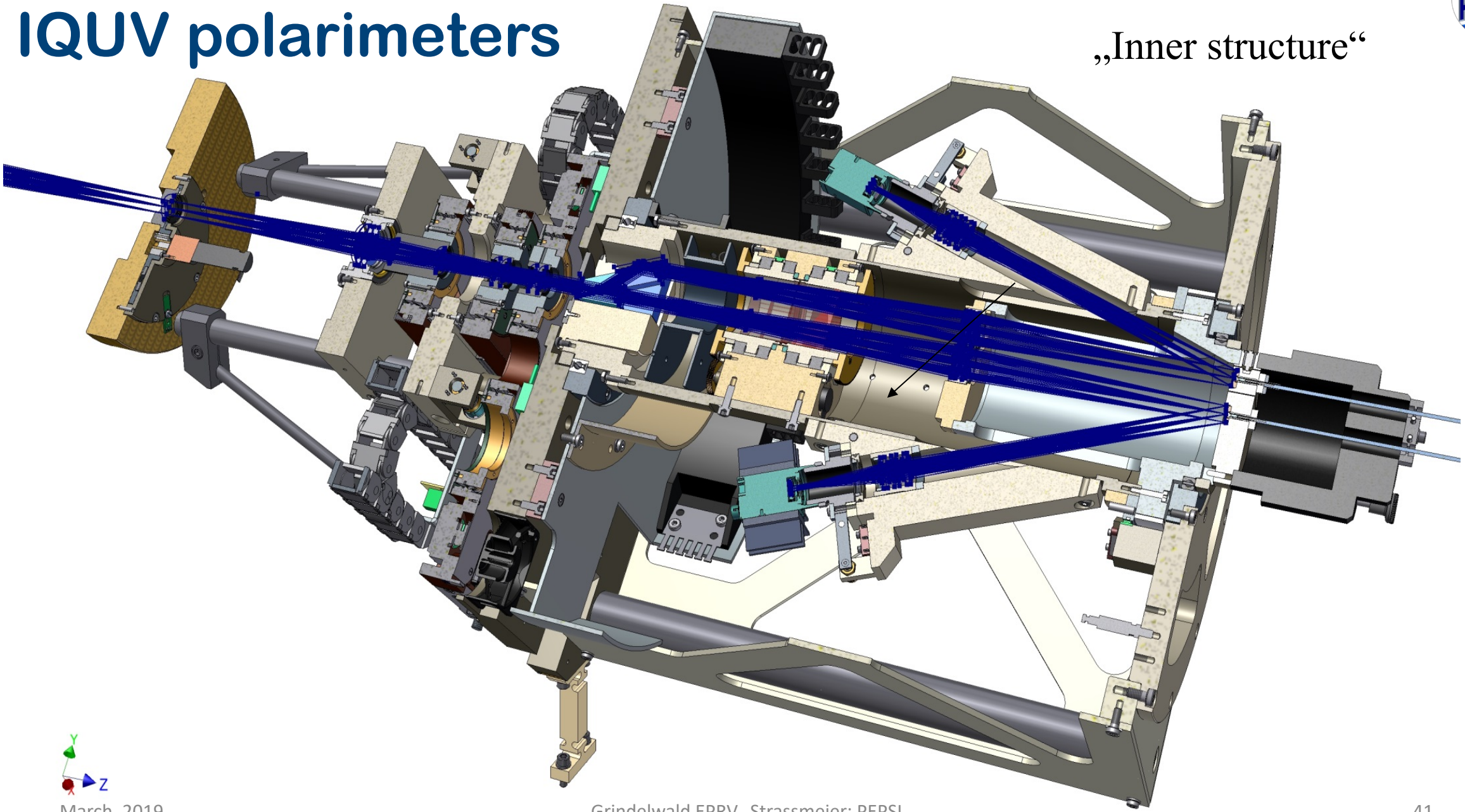
See also Reiners et al. 2016, A&A 595, A26 for the March 2015 eclipse

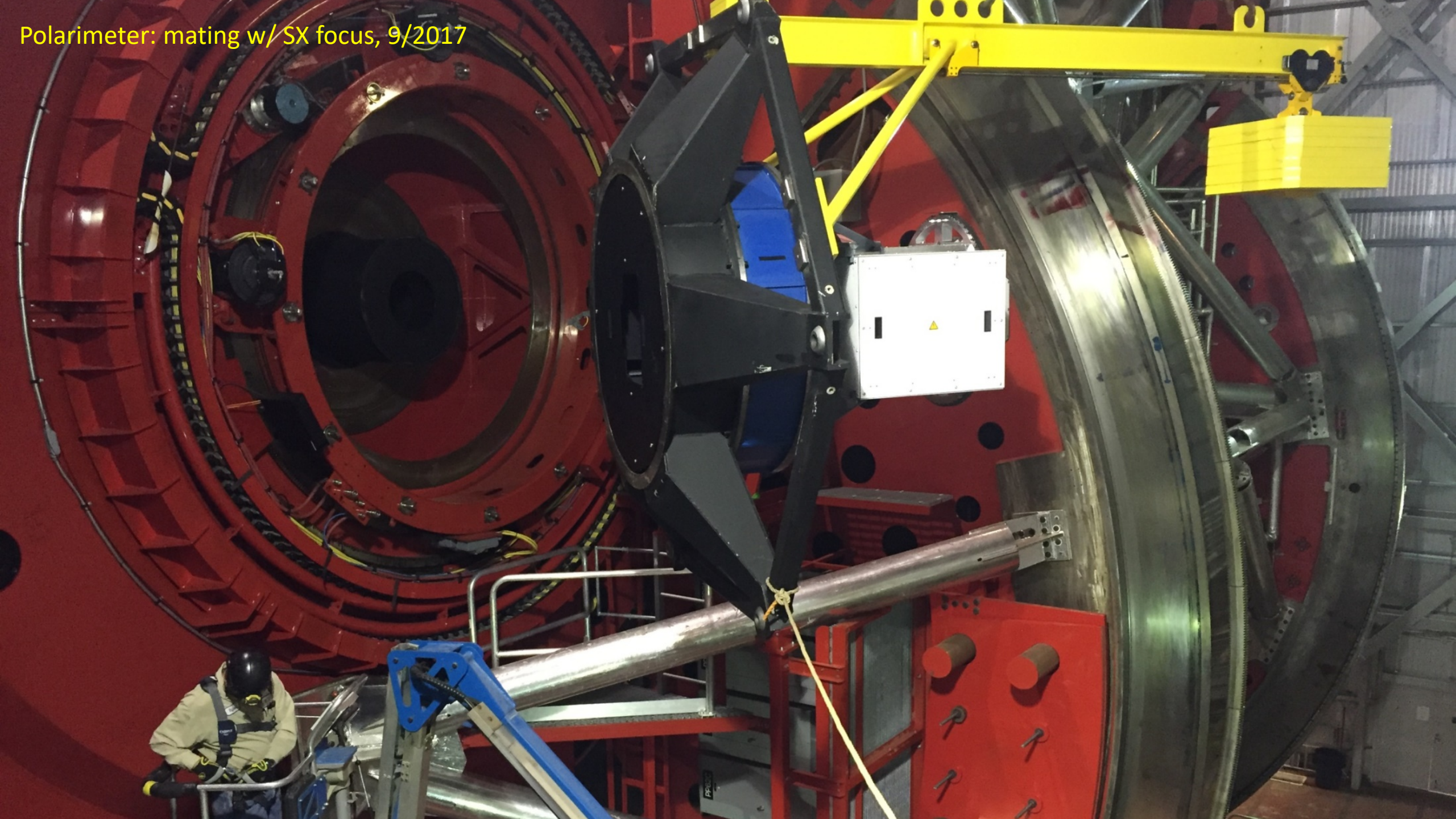




IQUV polarimeters

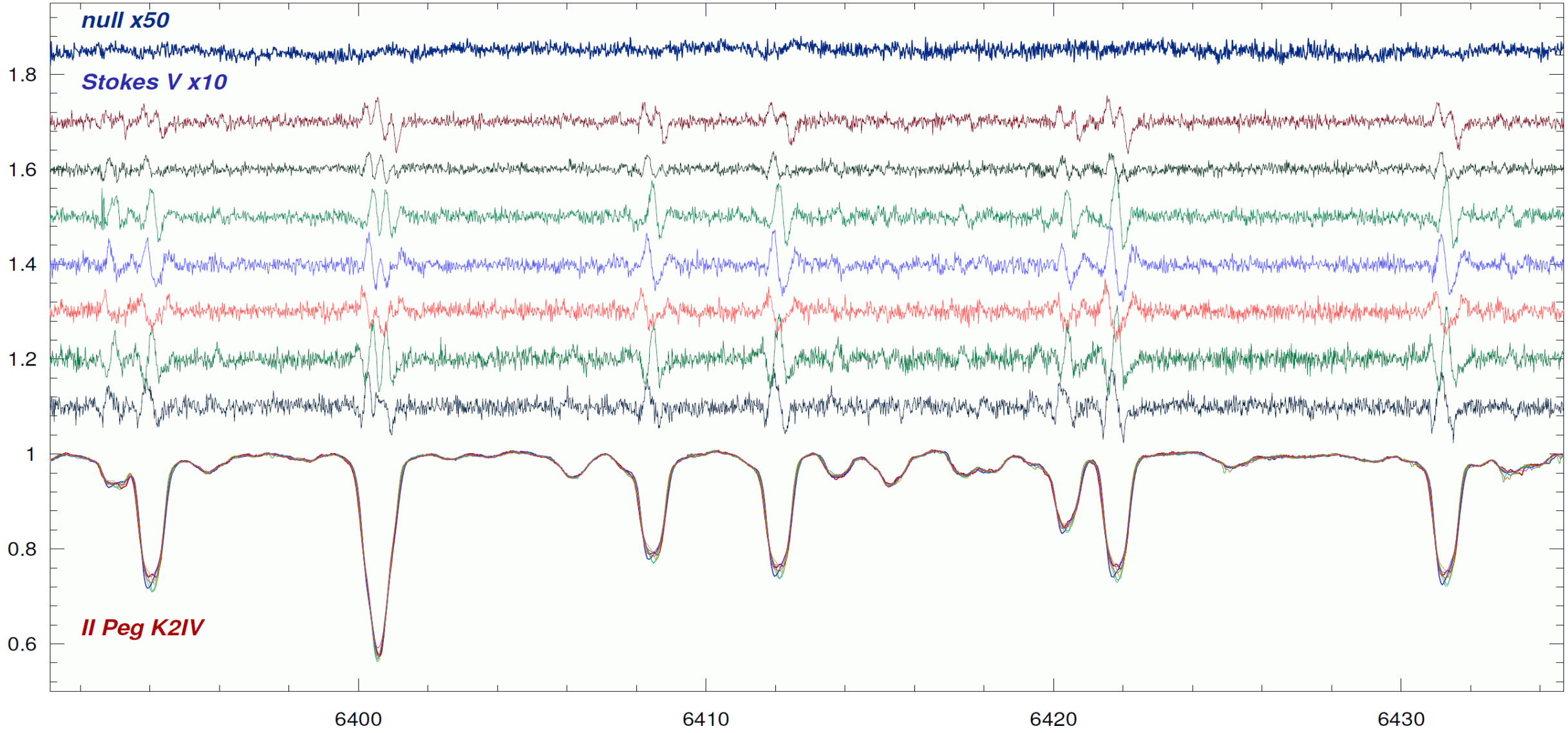
„Inner structure“




Polarimeter: mating w/ SX focus, 9/2017

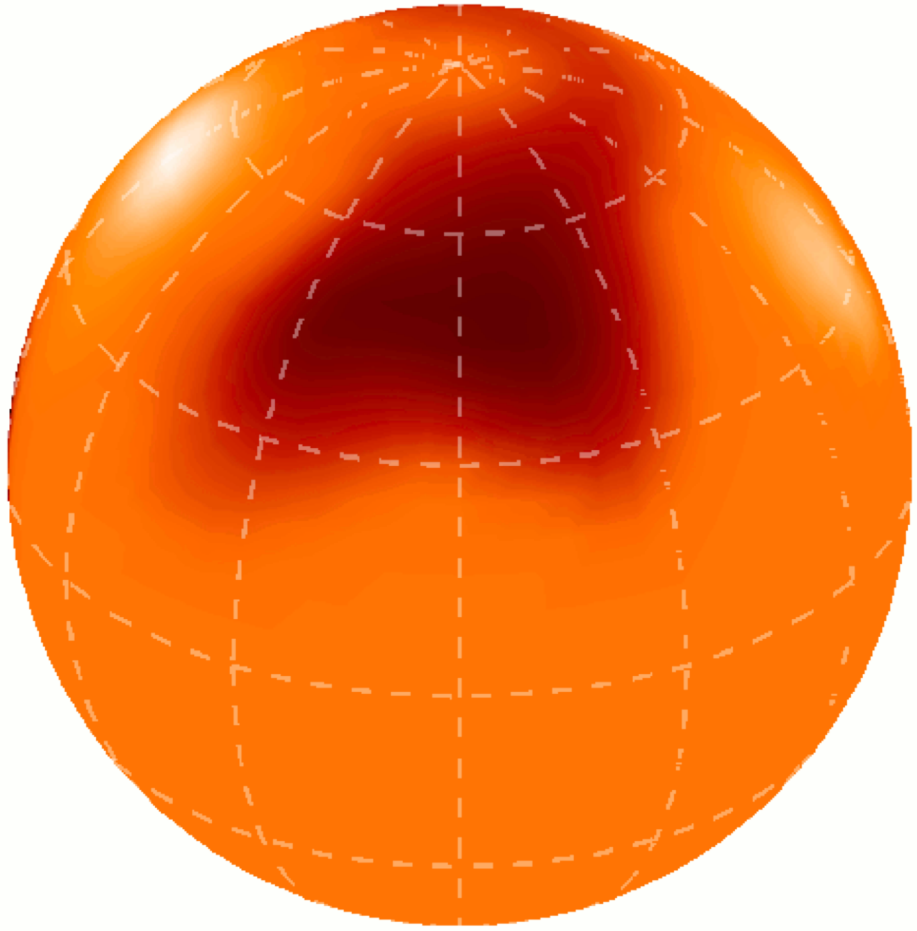
DX Polarimeter w/ science fibres connected

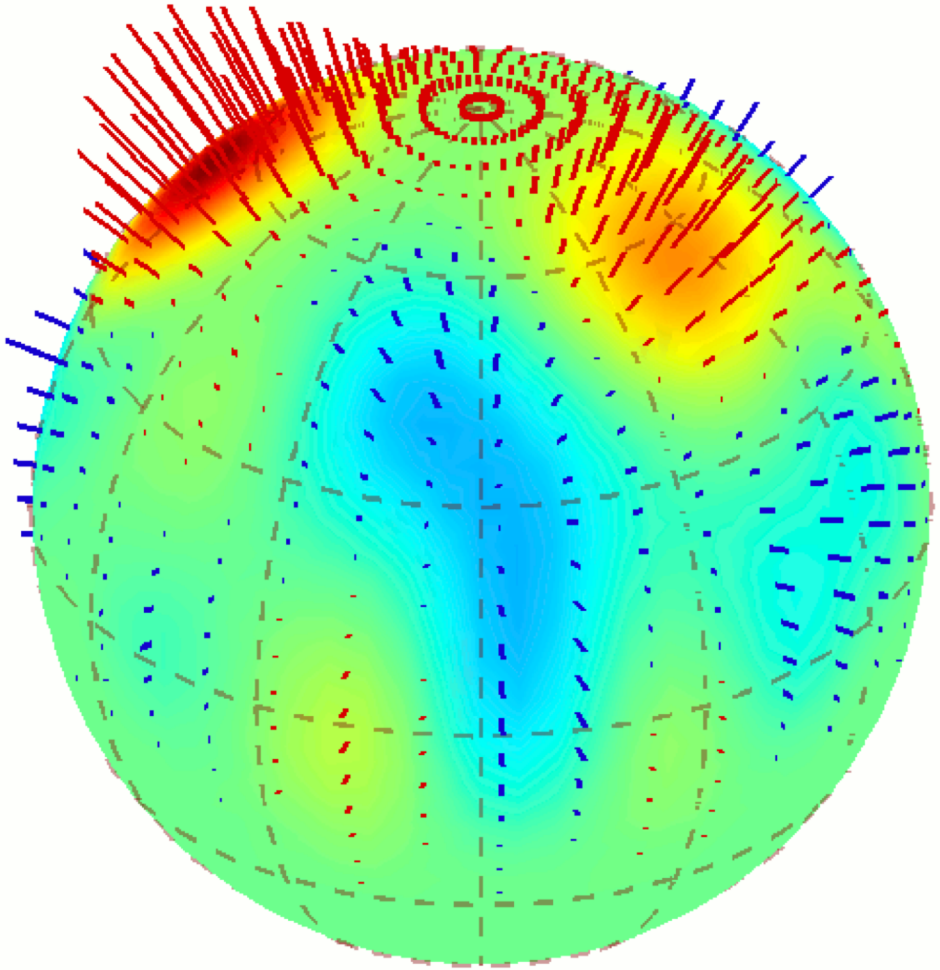
Magnetically active star II Peg



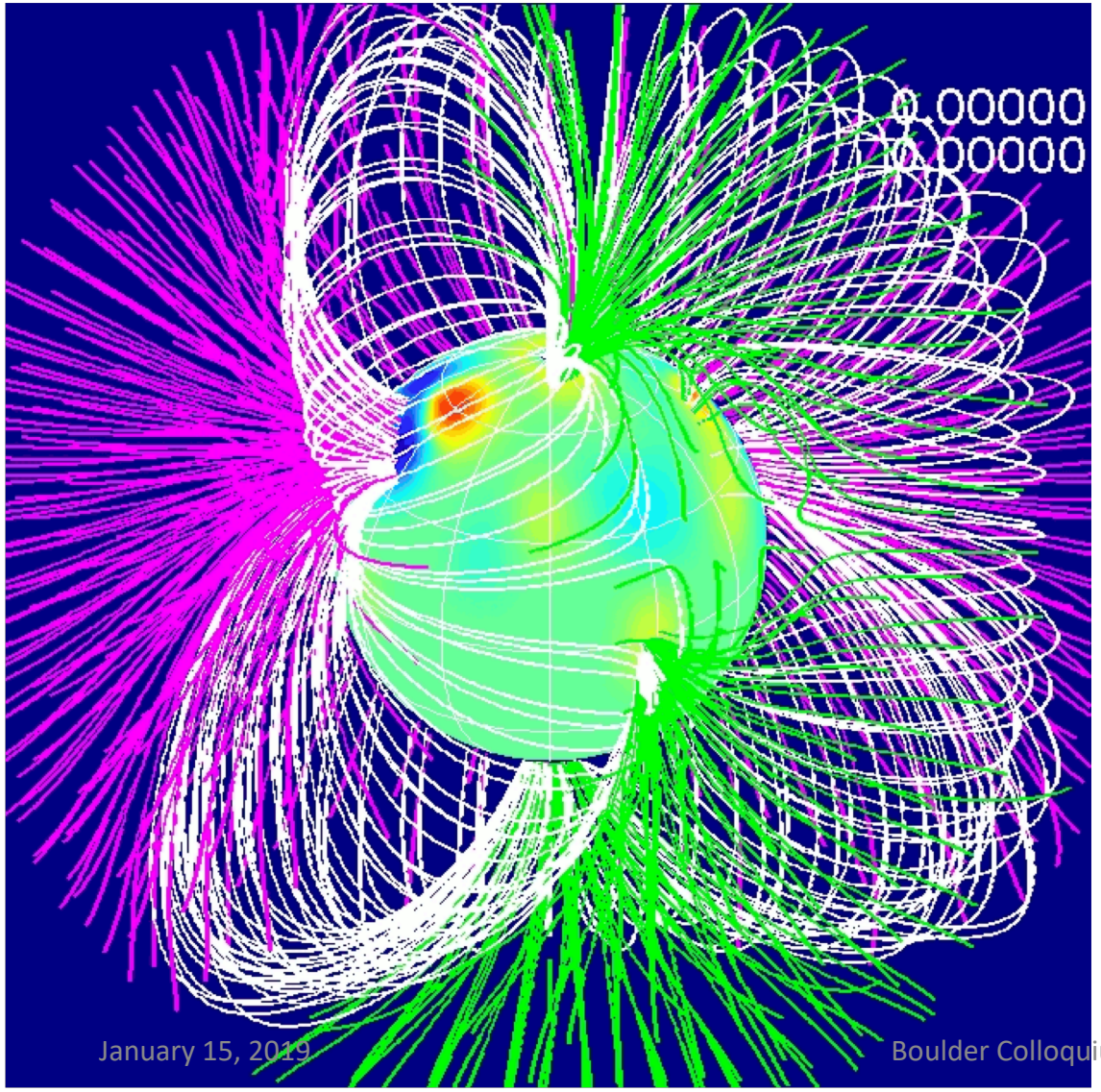
Magnetically active star II Peg

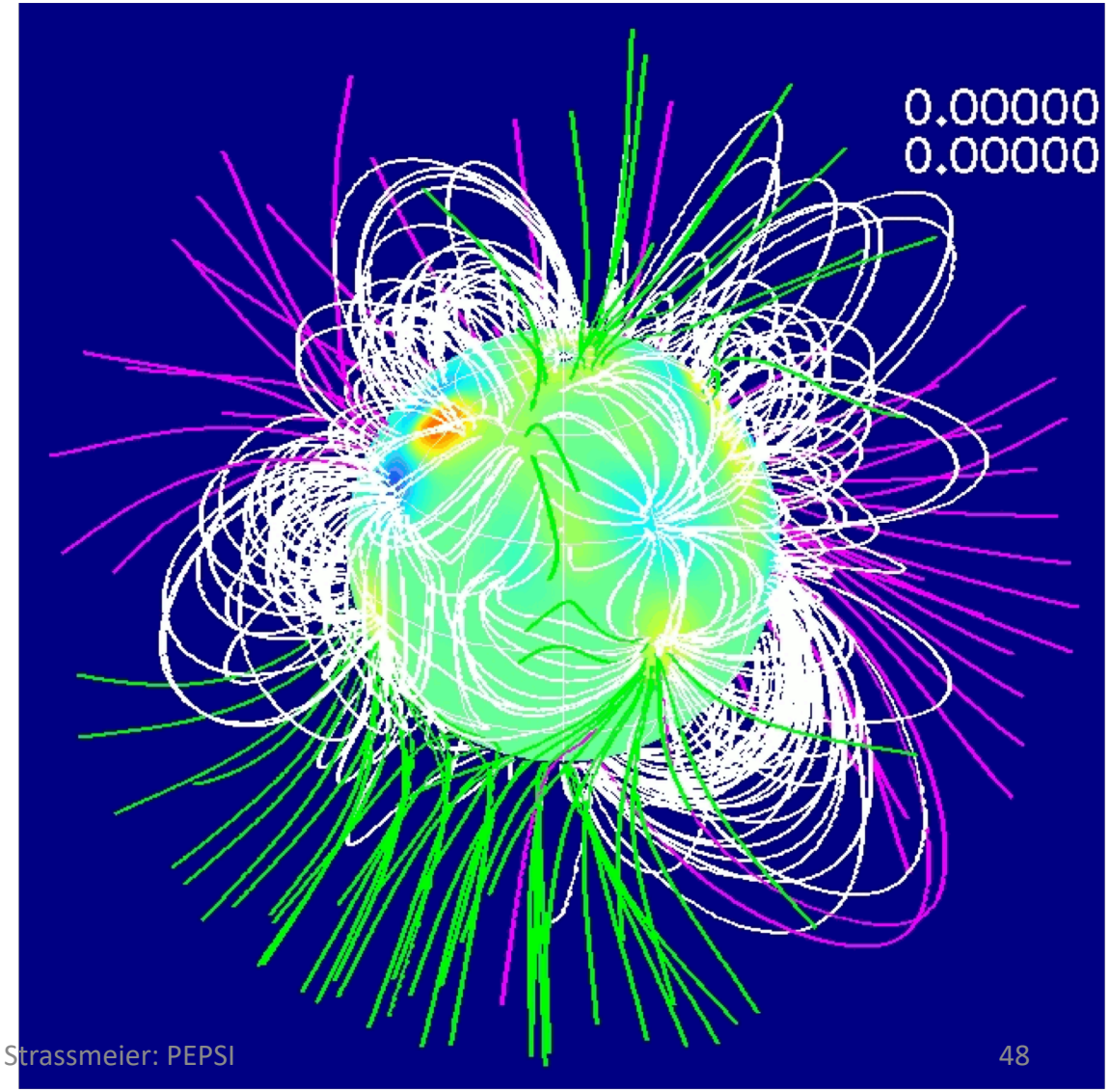
(Strassmeier et al. 2019, A&A, in press)





Warm & cool spot of opposite polarity: evidence for flux loops



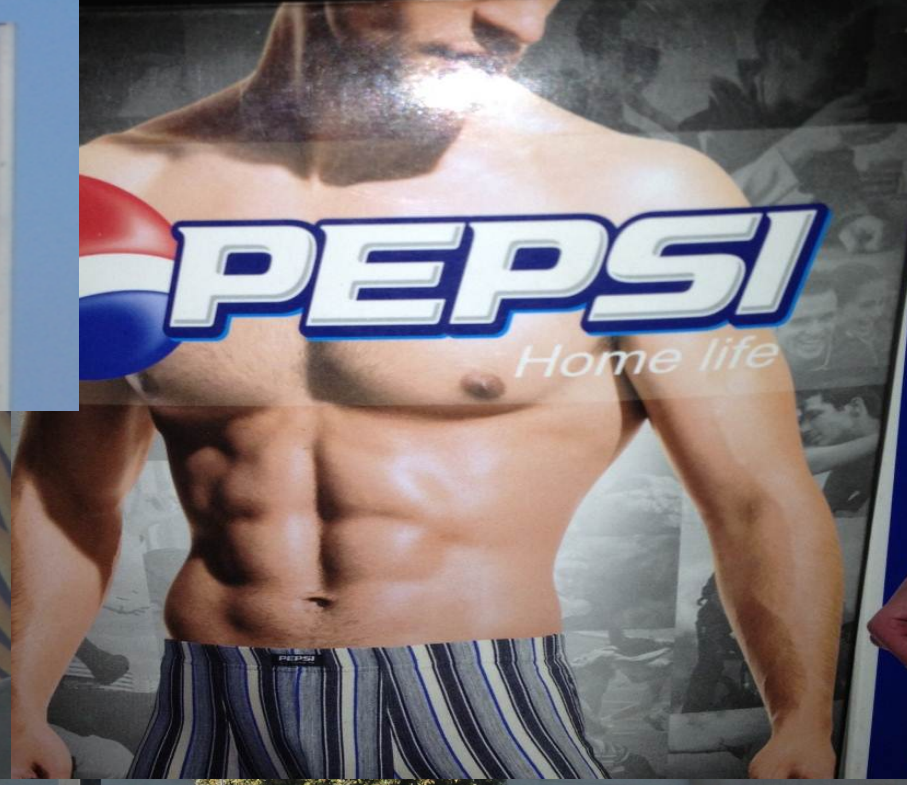


Summary

- Exoplanets analyzed so far: Kelt-21b, Kelt-9b, HD189733b, Trappist-1g.
- In work: XO-2, Kelt-5, Wasp-76, Wasp-77, K-1514, HD222175, HD209458, KC11C039…, Epic2111…, K2-99, Wasp-12, Epic247…, K2-260, K2-232, Sun (partial eclipse 8/2018), Moon (total eclipse 1/2019 in IQUV).
- PEPSI is a hi-res spectrograph and polarimeter for the 2x8.4m LBT.
- Two fibres per telescope = 4 spectra per echelle order
- λ384-913nm; *R*=50.000 (12px), 130.000 (4px), 250.000 (2px); Stokes IQUV in *R*=130.000.
- Stabilized to RV < 1m/s on short-term; long-term tbd but < 5 m/s
- 450m fibre feed from 1.8m VATT
- Sun-as-a-star telescope SDI – soon with ist own polarimeter
- Use w/ LBT and VATT in remote control from Potsdam, SDI runs automatic


Pepsi invites you
Tucson
OktoberFest
Sept. 29 - Oct. 2
ett Field


PEPSI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