PAVO Data Analysis Update and first Science Results

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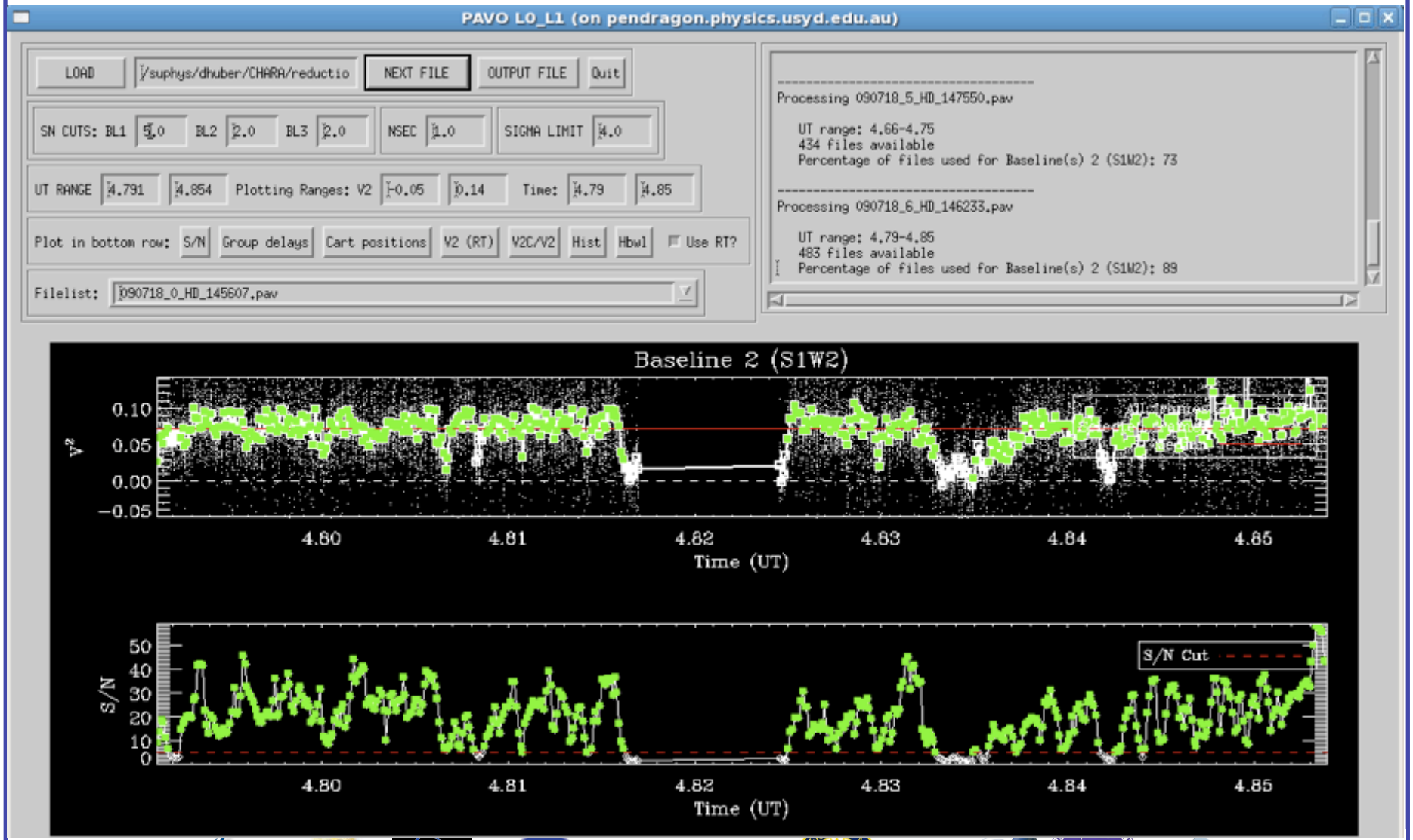
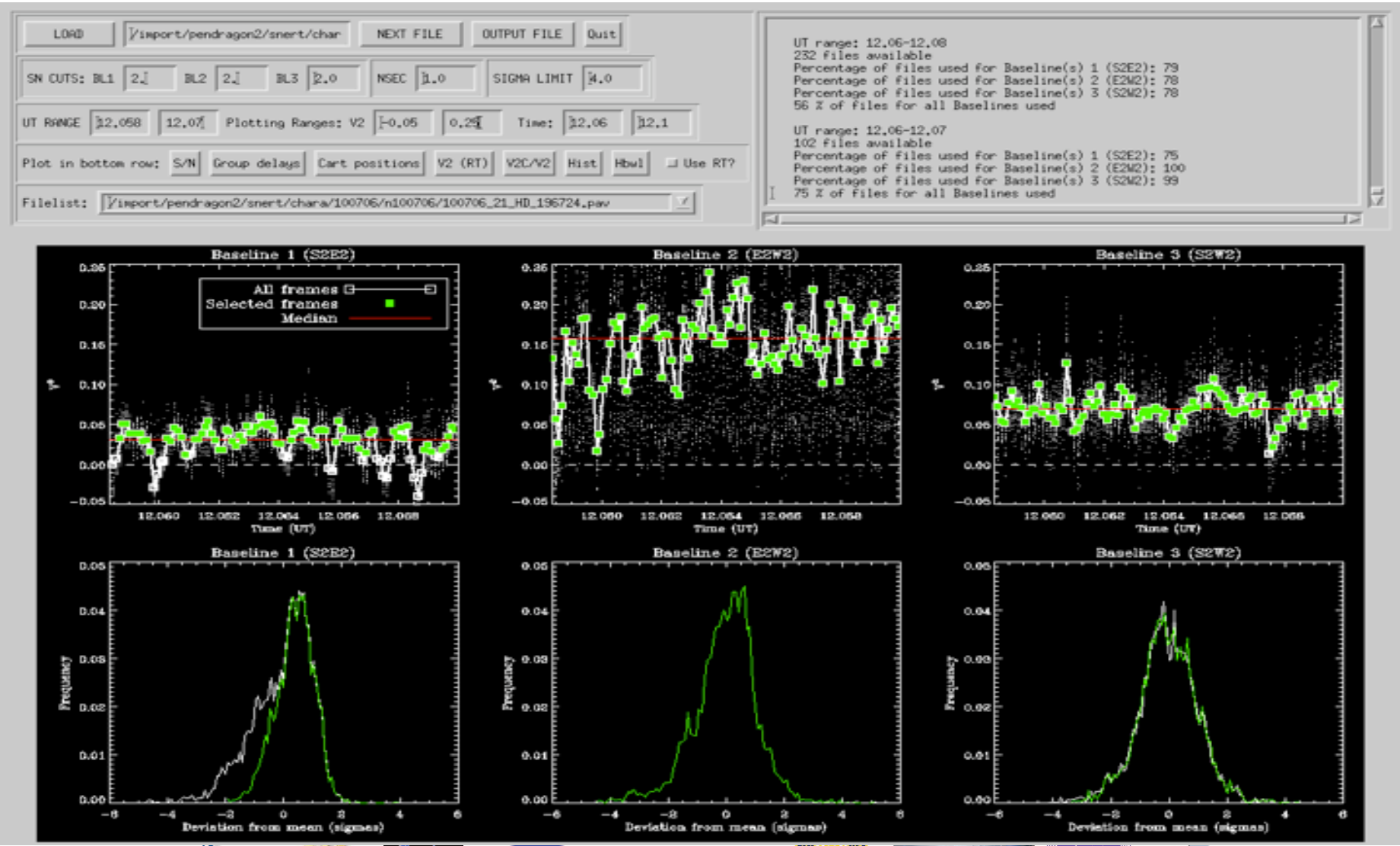
PAVO Data Analysis Tools

- sensible calibration requires manual inspection/ rejection of data
- IDL-based GUIs are now available to perform easy PAVO post-processing:
  - level0->level1: outlier rejection
  - level1->level2: multi-bracket calibration
- λ errors & correlations necessary for reliable estimation of uncertainties

Level 0 -> Level 1



Level 0 -> Level 1



Level 1 -> Level 2

PAVO L1_L2 (on pendragon.physics.usyd.edu.au)

INPUT FILE | trinity_all.dat_1011.res | RESET DISPLAY | OUTPUT FILES | Quit

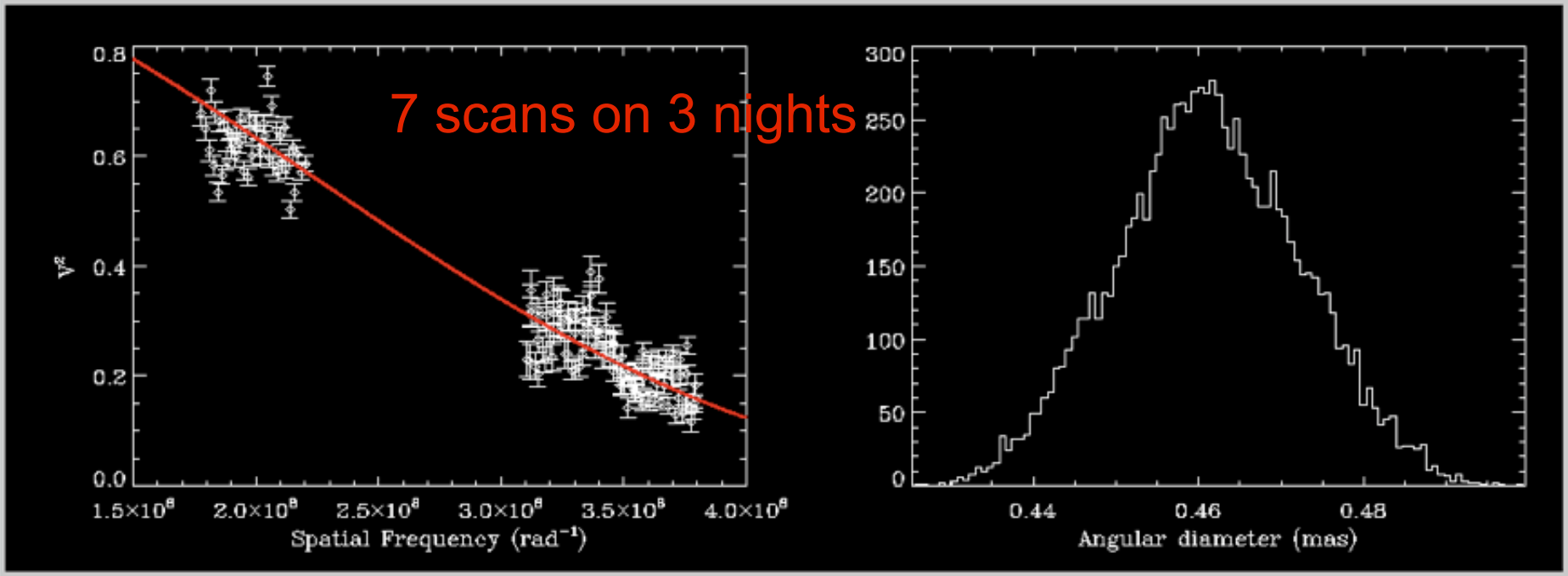
TARGETS: 12 | CALS: 13 | CALIBRATE

CAL DIAMETERS | ../calibrators_diams.dat | LAMBDA RANGE | 0.65 | 0.80

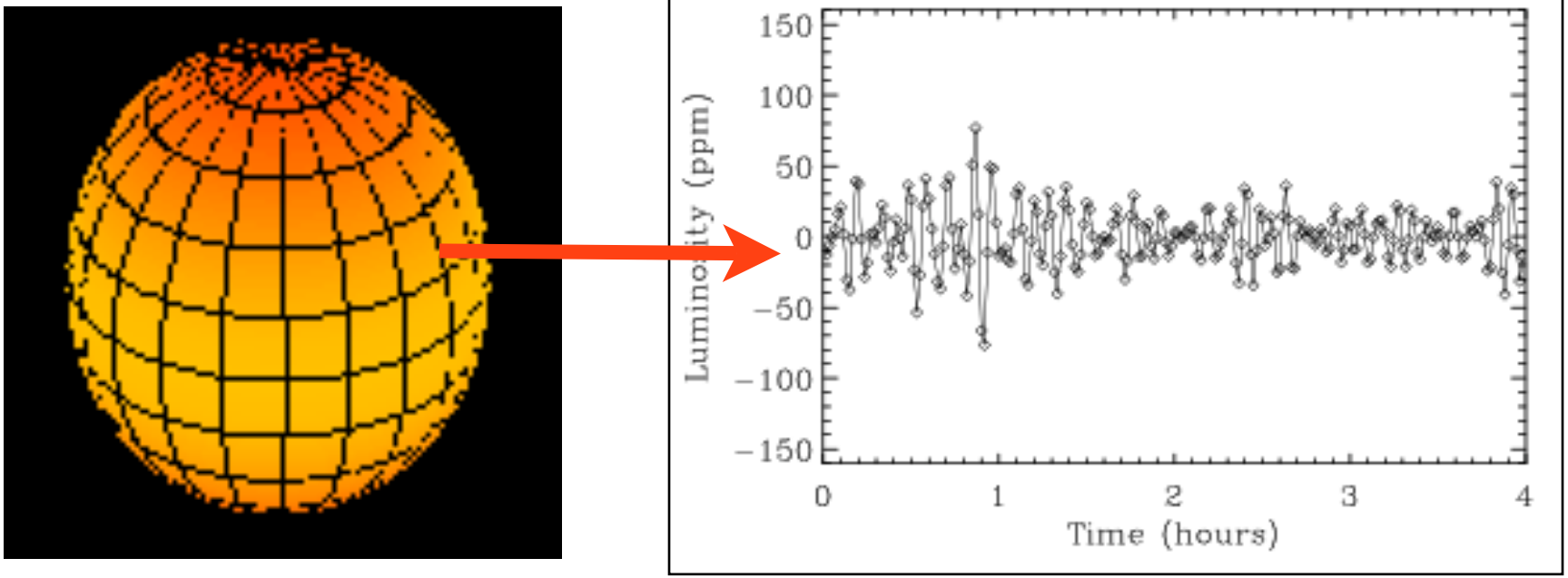
t0 Cor | Coherent | Exp | Linwt | PS | SET SUSI TELS

LOAD CONFIG FILE | 1112.config_trinity | CALIBRATE | RUN MC

```
(19): 100721_13_HD_182487.pav  69.1 min   AZ: 299.5  EL: 42.9 HR: 0 Dia: 0.138+/-0.00

Calibrating multiple brackets according to config file
diameter: 0.46113531+/-0.0022787382

Calibrating scans 12  with scans 13
UD diameter: 0.42170378+/-0.0027596474

Calibrating multiple brackets according to config file
diameter: 0.46113531+/-0.0022787382

fitted diameter: 0.46113531
Running MC simulation with 10000 iterations
mean & standard deviation: 0.46120801 +/- 0.011105383
median & credible regions: 0.46106446 + 0.010261786 - 0.011394442
```

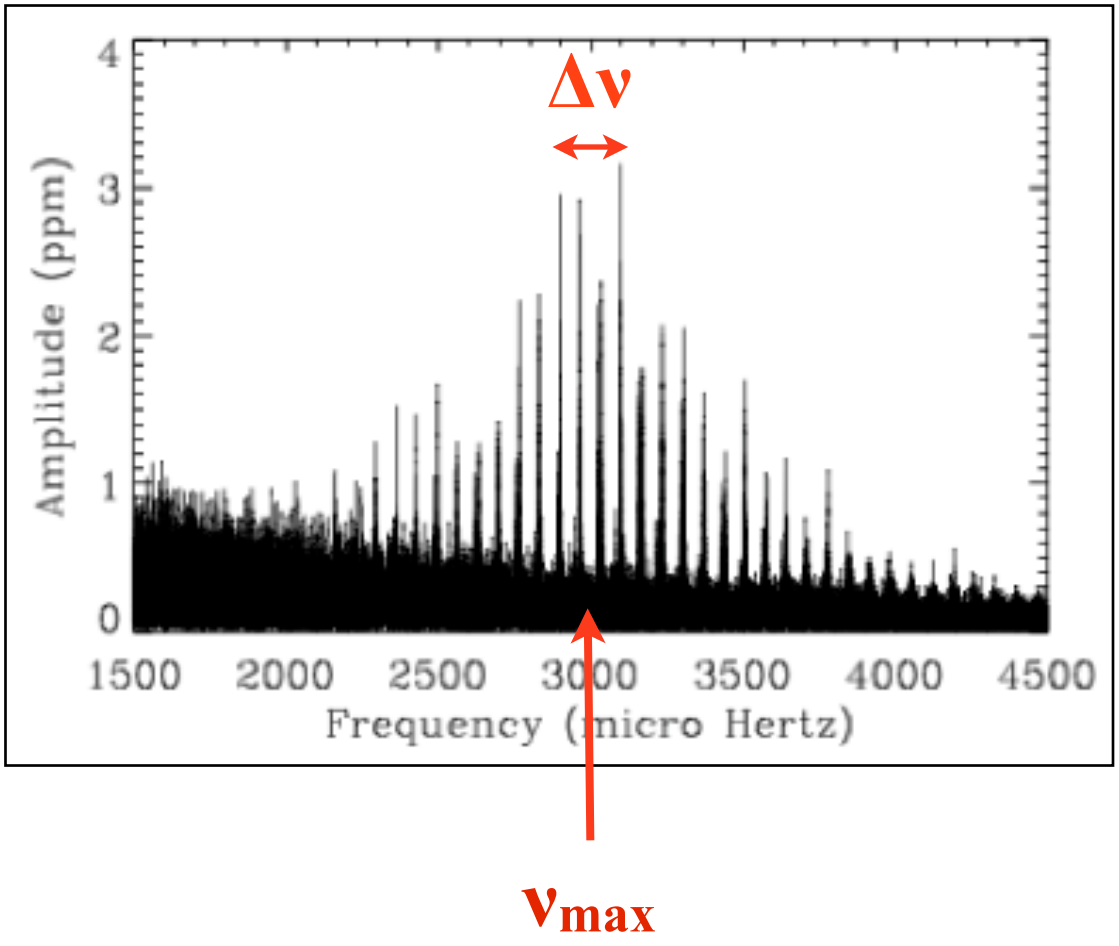


Asteroseismology & Interferometry



oscillations are standing sound waves excited by surface convection in low-mass stars

Asteroseismology & Interferometry

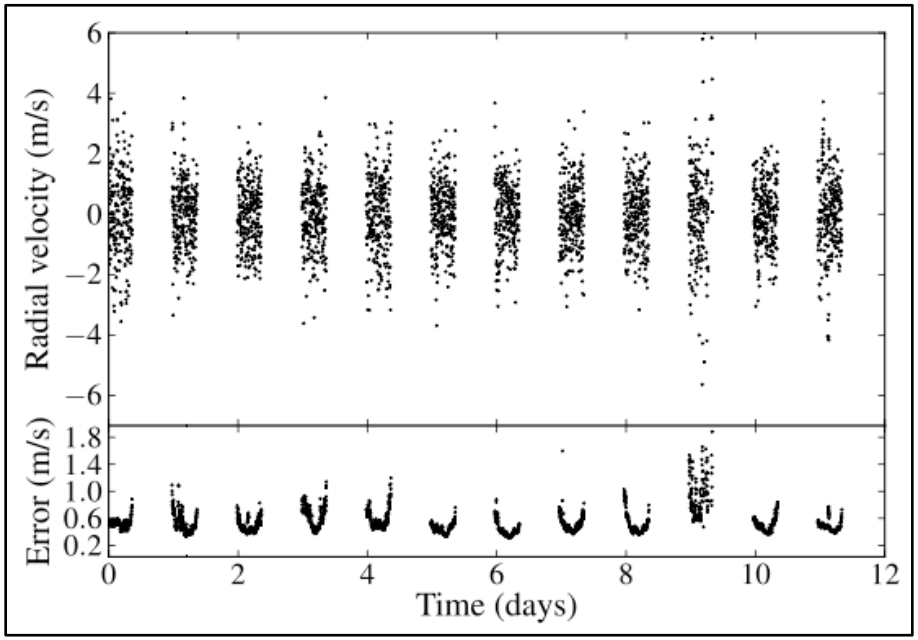


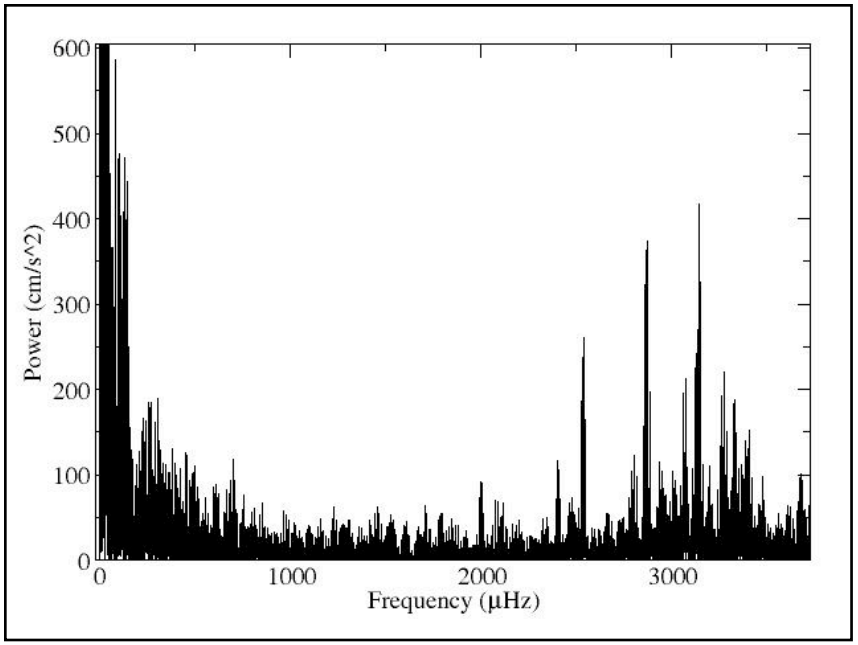
$\Delta\nu \propto (2 \int dr/c_s)^{-1} \propto$
M^1/2 R^-3/2
(density)

$\nu_{max} \propto$ g Teff^1/2 $\propto$
M R^-2 Teff^1/2
(radius)

18 Sco: A solar twin

Bazot et al. 2011, A&A Letters

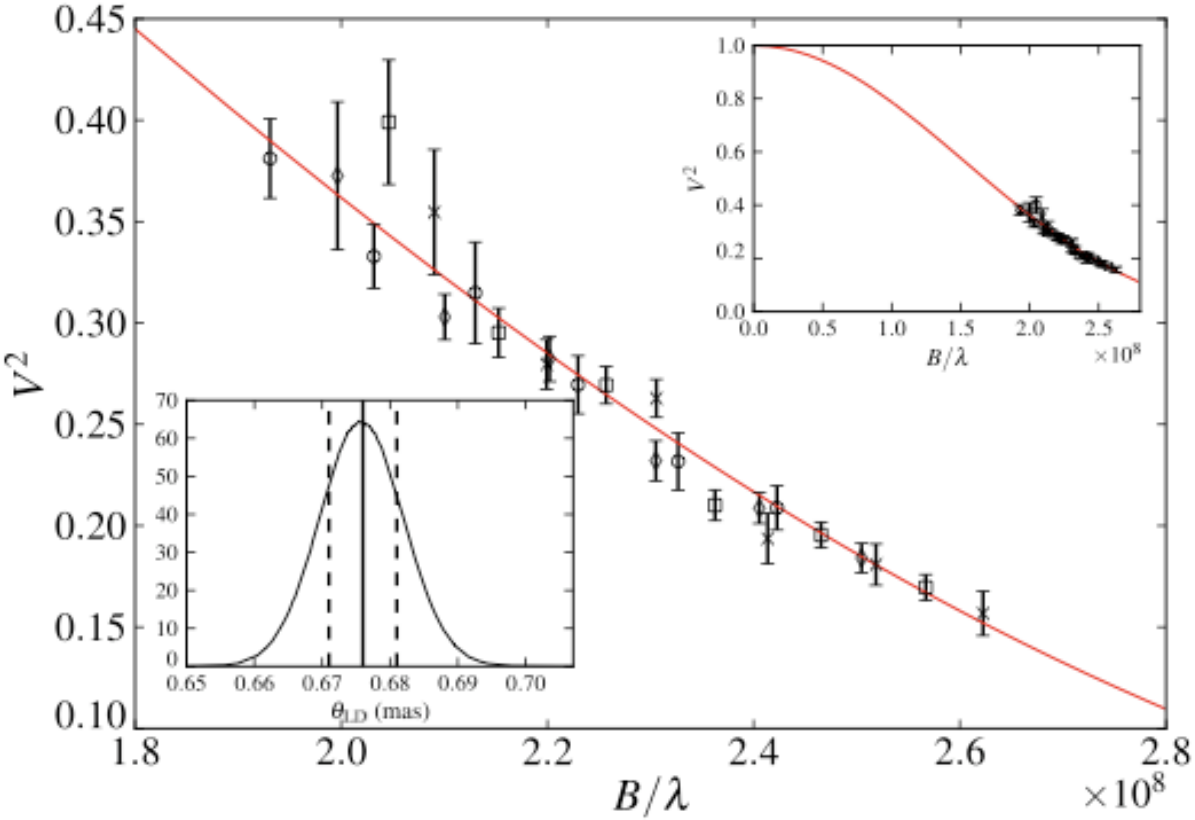




Density (solar)
0.993 +/- 0.002

18 Sco: PAVO Data

LD = 0.676 +/- 0.006



Radius (solar)
1.010 +/- 0.009

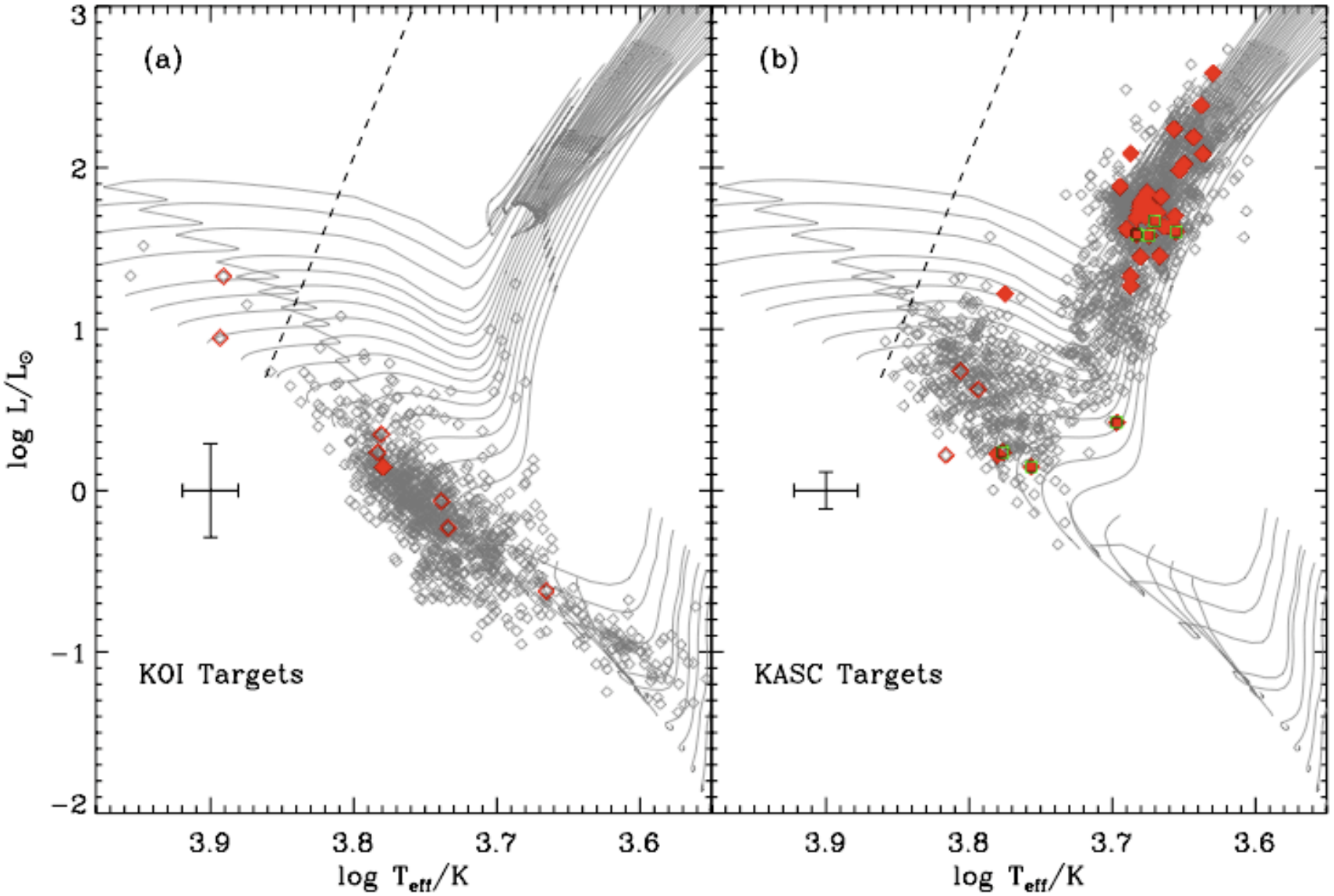
Density (solar)
0.993 +/- 0.002

Mass (solar)
1.02 +/- 0.03

Kepler & PAVO

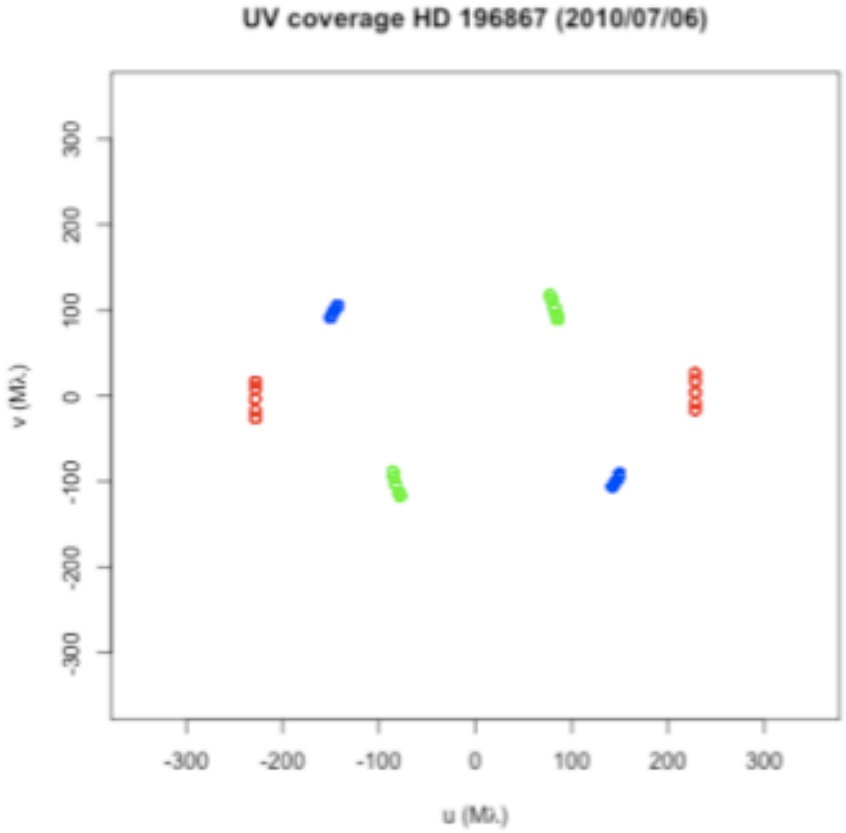
- Kepler is nominally observing ~ 1000 stars with V < 10
- PAVO only beam-combiner sensitive enough for Kepler follow-up
  - Asteroseismology: fundamentally calibrate scaling relations (Radius and Teff!)
  - Exoplanet host stars: *measure* planetary radii, exclude false-positives by probing multiplicity, constrain habitable zone (Teff and L)

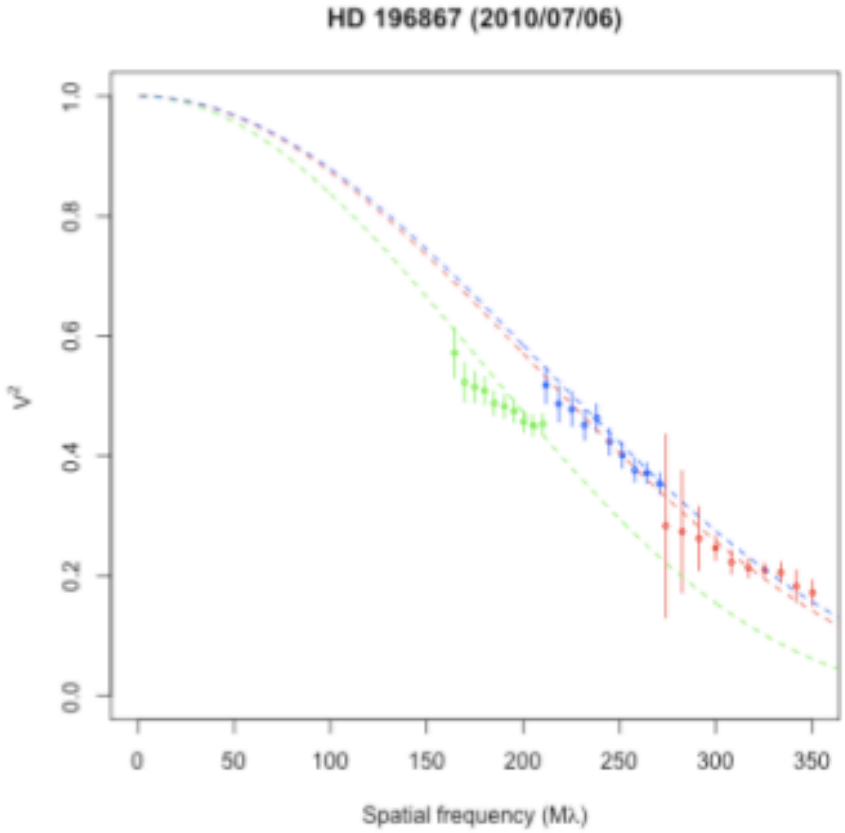
Kepler & PAVO


(a)
(b)
KOI Targets
KASC Targets
log L/L⊙
log T_eff/K
3
2
1
0
−1
−2
3.9
3.8
3.7
3.6

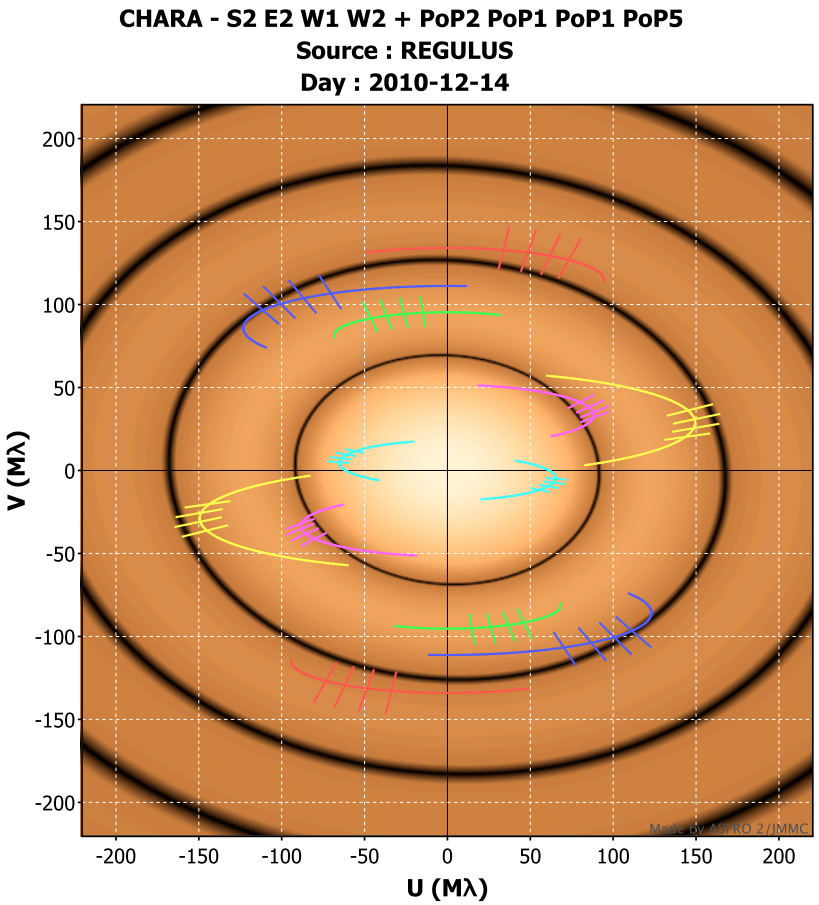
Rapid rotators with PAVO

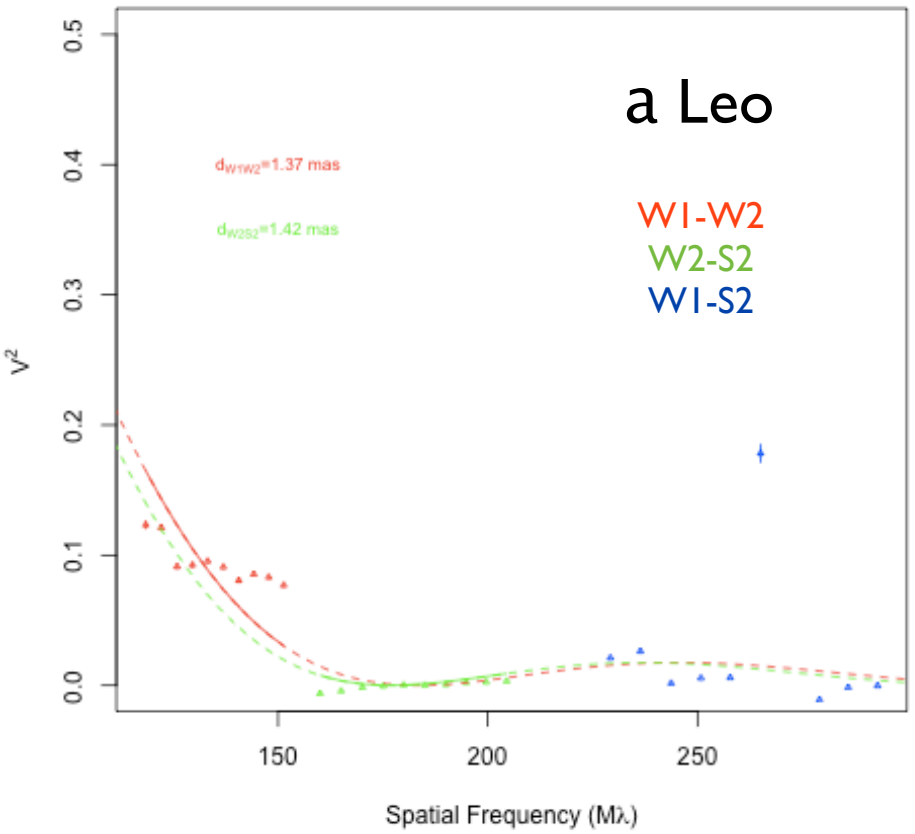
α Del, 0.5 mas





Rapid Rotators: PAVO + MIRC





Outlook

- *18 Sco (Bazot et al. 2011, A&A Letter)*
- *Trinity (Derekas et al. 2011, Science)*

- PAVO pipeline / Plejades paper (Ireland et al. 2011)
- Kepler angular diameters (Huber et al. 2011)
- PAVO rapid rotators (Maestro et al. 2011)

  + Noel, Tabby, Ellyn, Jeremy ...