PAVO Science Update

Tim White (Aarhus), Daniel Huber (Sydney),
Iva Karovicova (Heidelberg), Ethan Ryan (Sydney),
Amalie Stockholm (Aarhus), Benjamin Pope (Oxford),
Peter Tuthill (Sydney), Mike Ireland (ANU),
Simon Murphy (Sydney), Tim Bedding (Sydney)

PAVO Programs in 2015

PI	Title	Semester
Ireland	Interferometric observations of benchmark stars for calibrating large stellar surveys of the Milky Way	A & B
Huber	Measuring limb-darkening at visible wavelengths with PAVO	A & B
Quinn	Open cluster ages from sizes of giants and A-stars	A & B
Schworer	Binarity and circumstellar matter in formation of bright intermediate mass stars	A
Boyajian /von Braun	Diameters and Temperatures of Main-Sequence FG Stars	A & B
Gordon	Fundamental properties of O- and B-type stars	A & B
Huber	Paving the way for Galactic Archeology: Angular Diameters of oscillating Red Giants	A & B
Jones	How old are the nearest A-stars	A & B
von Braun / Boyajian	Radii of late type-dwarfs, exoplanet hosts, and exoplanet host candidates	A & B
Le Bouquin	Orbital parameters of magnetically interacting SB2 binaries	B
Tuthill	Angular Diameters of Bright Pleiades Stars observed by Kepler/K2	B
Murphy	An interferometric characterization lambda Boo stars	B

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Sydney-PI programs *Non-Sydney-PI programs*

PAVO@CHARA Papers

Bazot et al. (2009), A&A	Asteroseismology
Derekas et al. (2011), Science	Eclipsing Binary
Huber et al. (2012), MNRAS	Exoplanet Hosts
Huber et al. (2012), ApJ	Asteroseismology
Baines et al. (2012), ApJ	*Exoplanet Hosts*
White et al. (2013), MNRAS	Asteroseismology
Maestro et al. (2013), MNRAS	Massive Stars
Johnson et al. (2014), ApJ	Asteroseismology
Boyajian et al. (2015), MNRAS	*Exoplanet Hosts*
Jones et al. (2015), ApJ	*A Stars*

Non-Sydney-PI papers

PAVO Archive

- All 2009-2015 data now completely backed-up in Sydney

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- Also: Canberra

PAVO Archive

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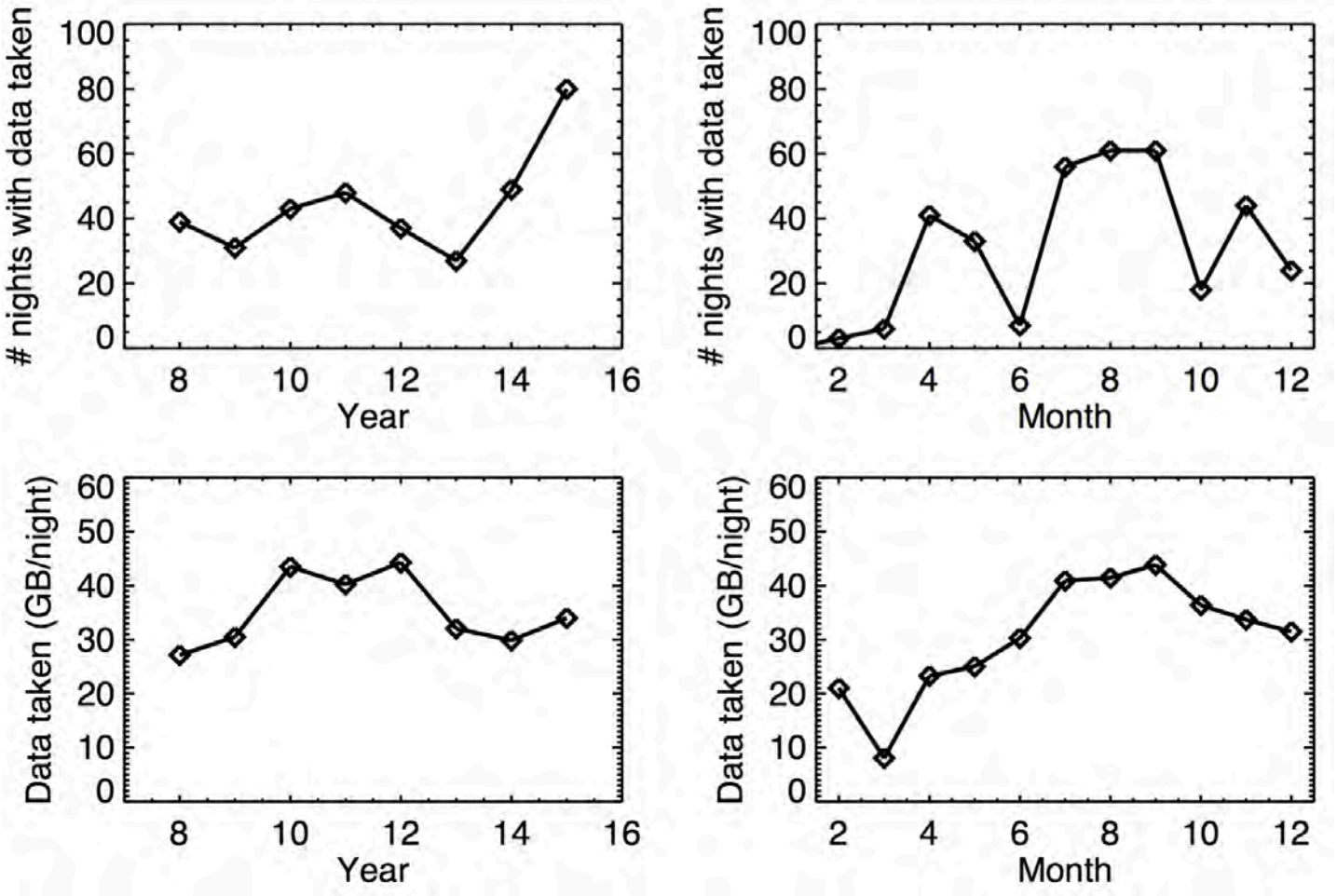
- Also: Mount Wilson

PAVO Archive



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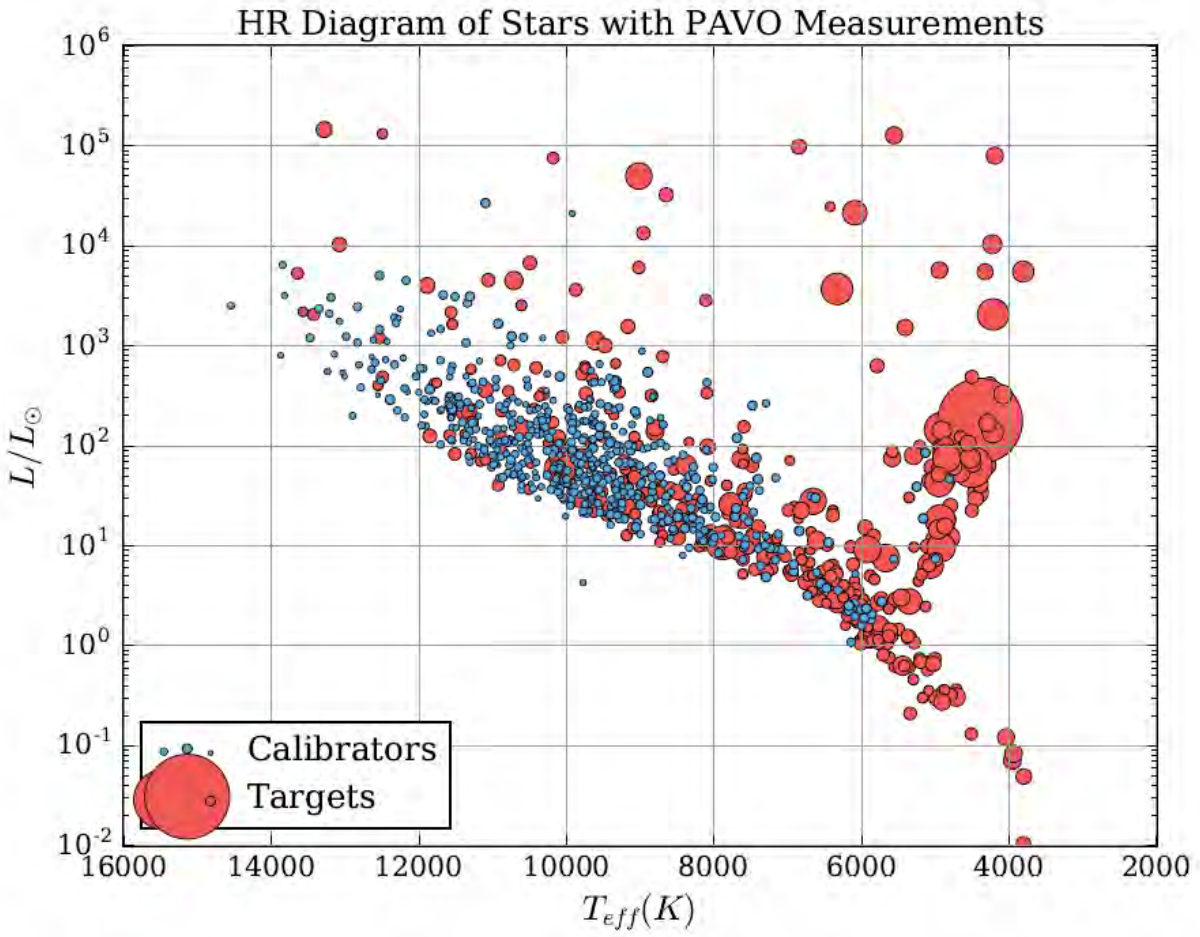
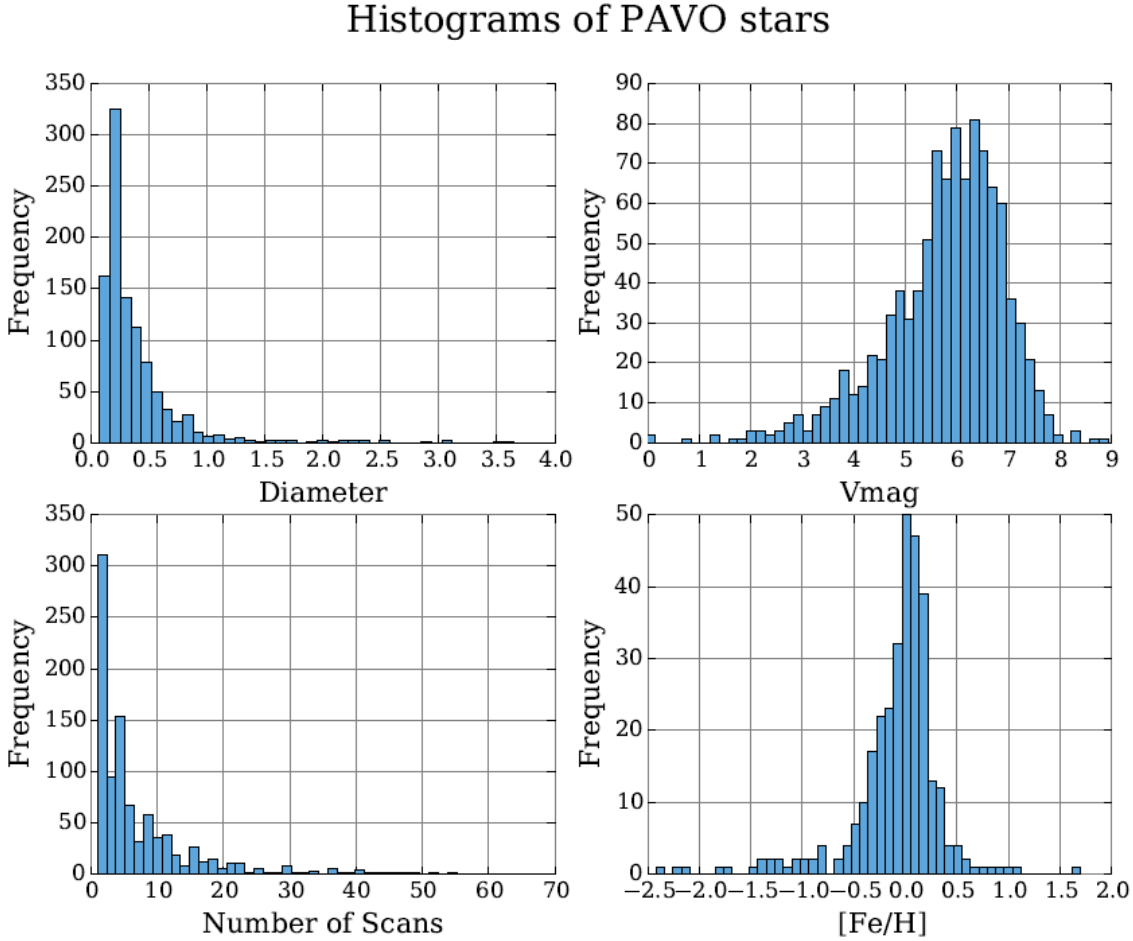


Your target may have been observed!

PAVO Archive



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PAVO Software

- 2T data reduction is routine; software tools available. Check for updates!

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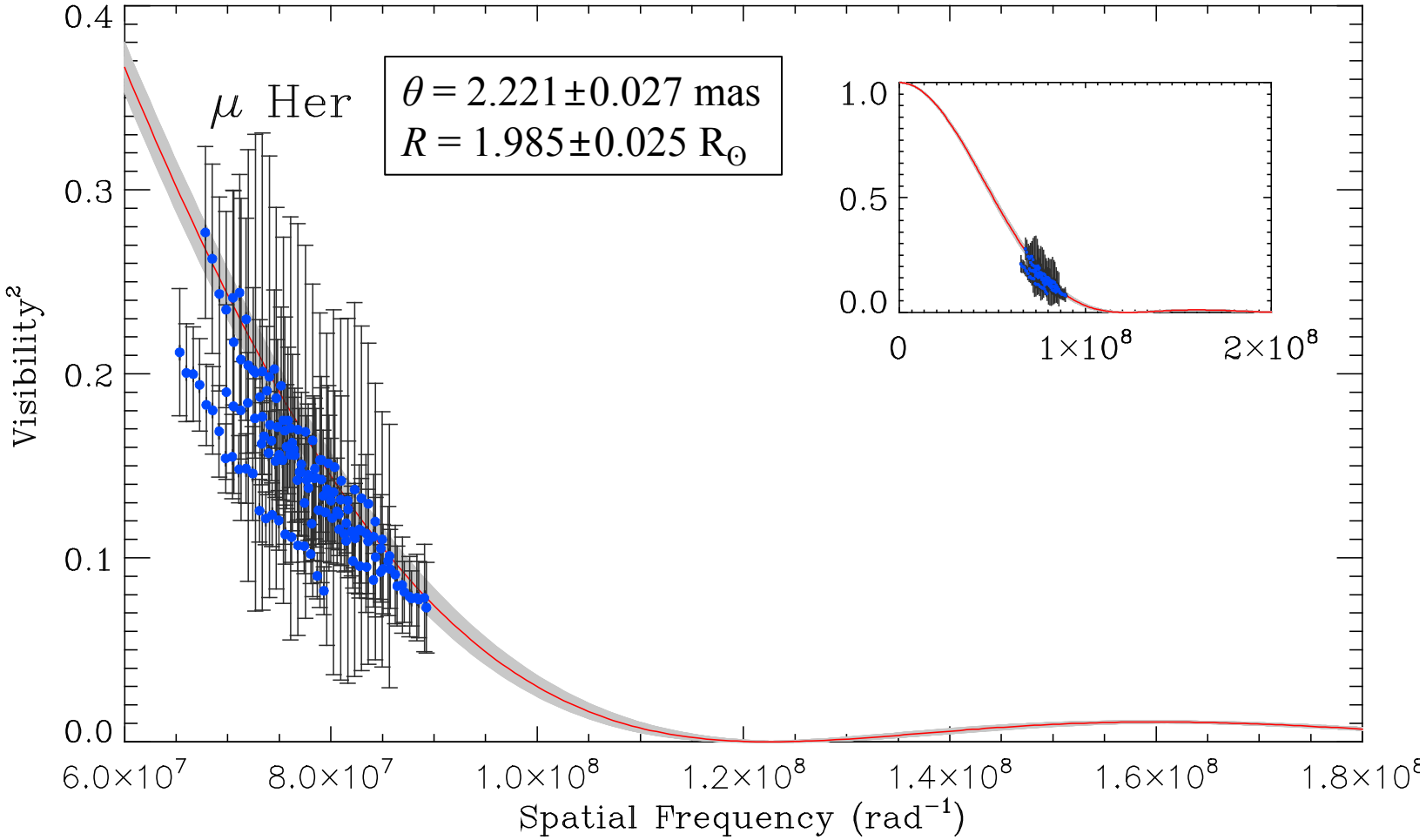
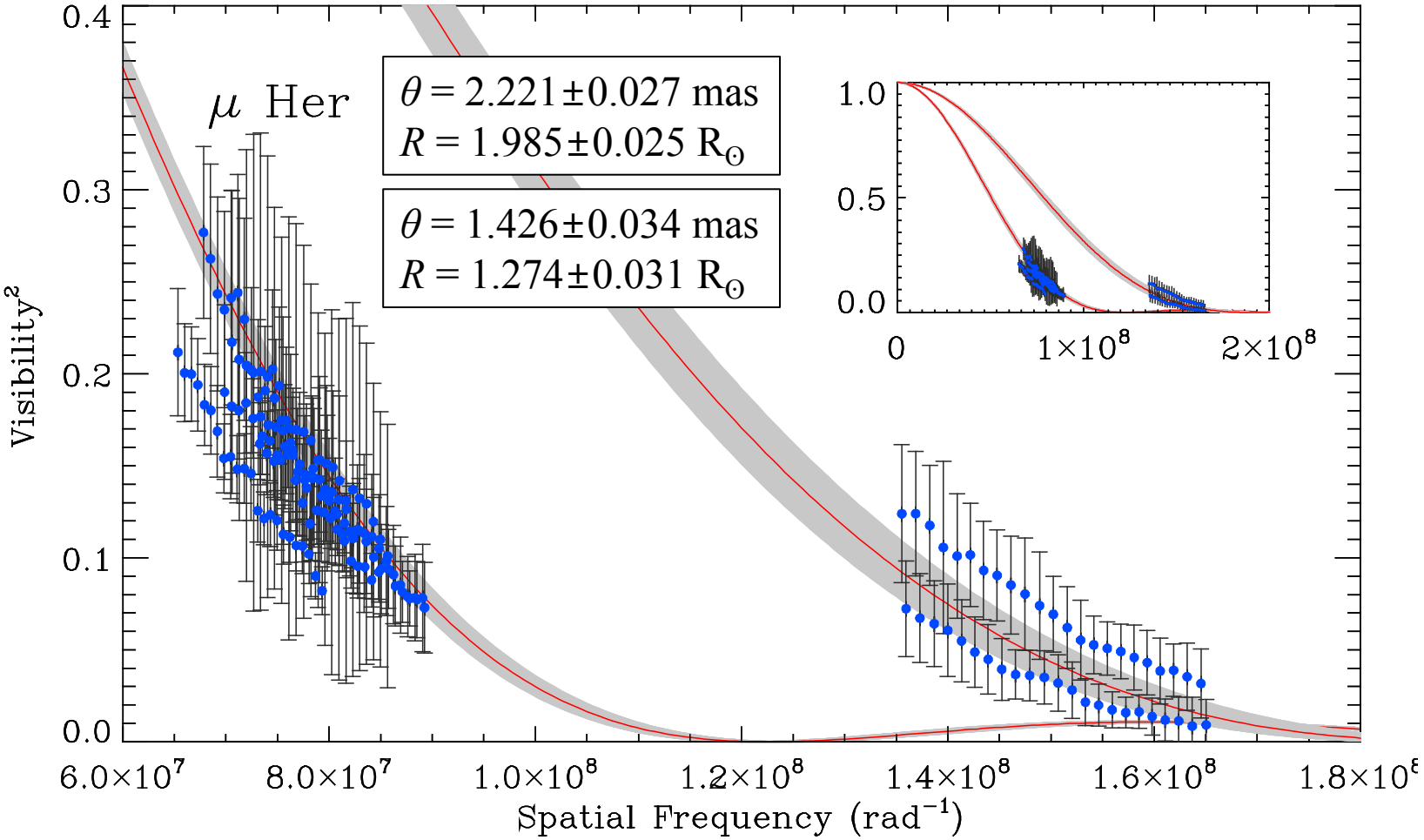
- Serious bug in the code recently found:
  - Wrong star positions being looked-up for a *few* stars

    →Wrong projected baselines

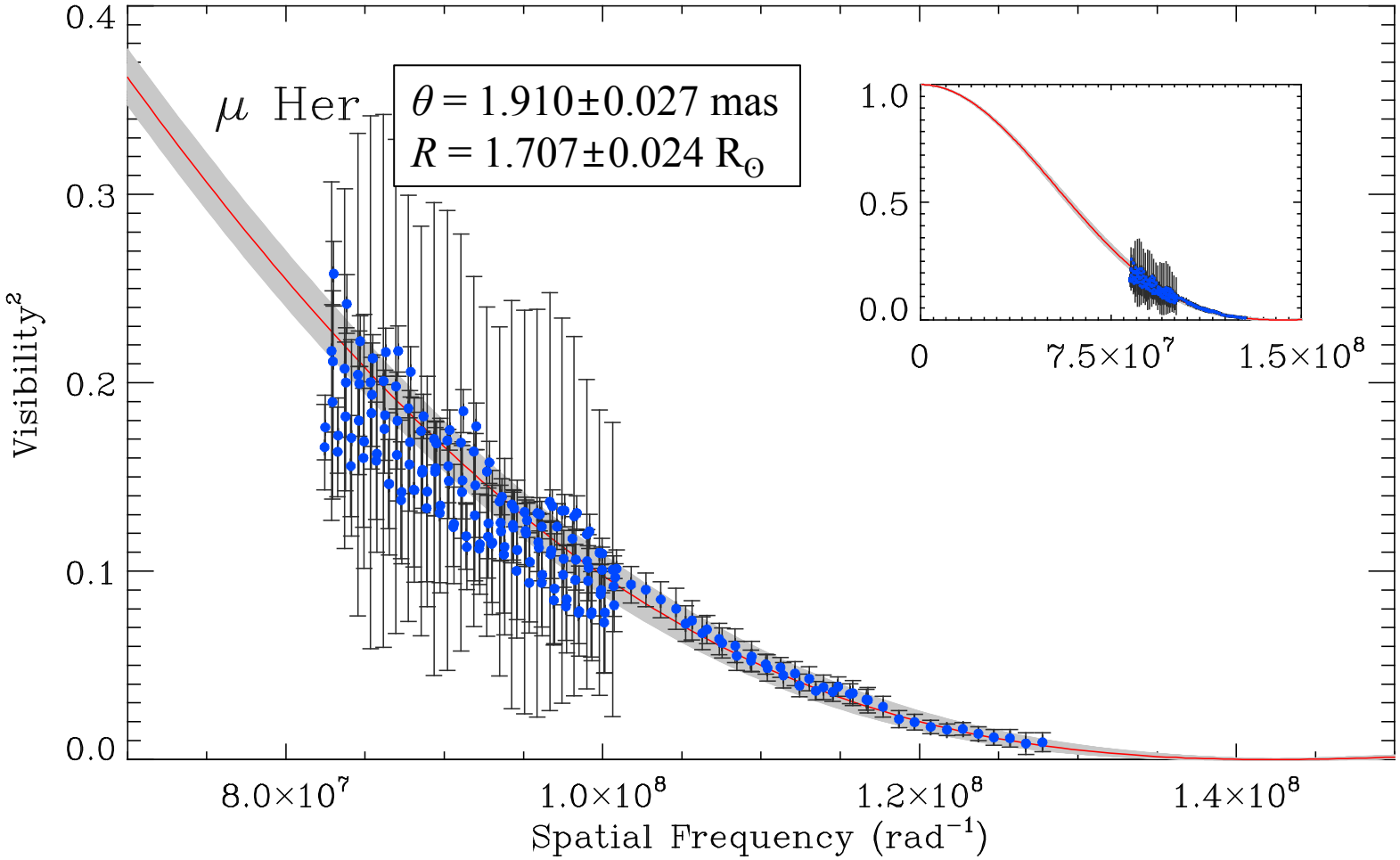
PAVO Software



PAVO Software



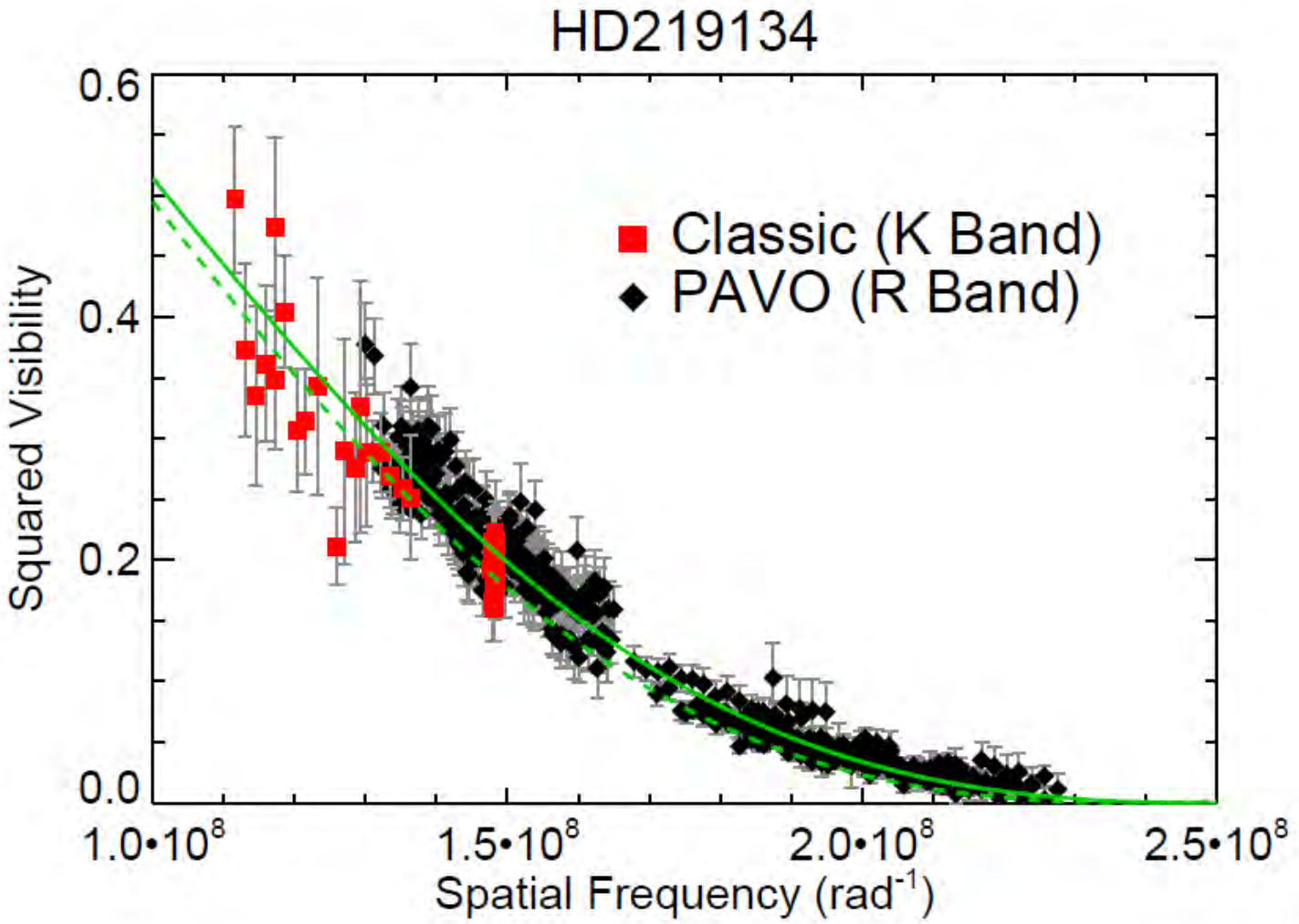
PAVO Software



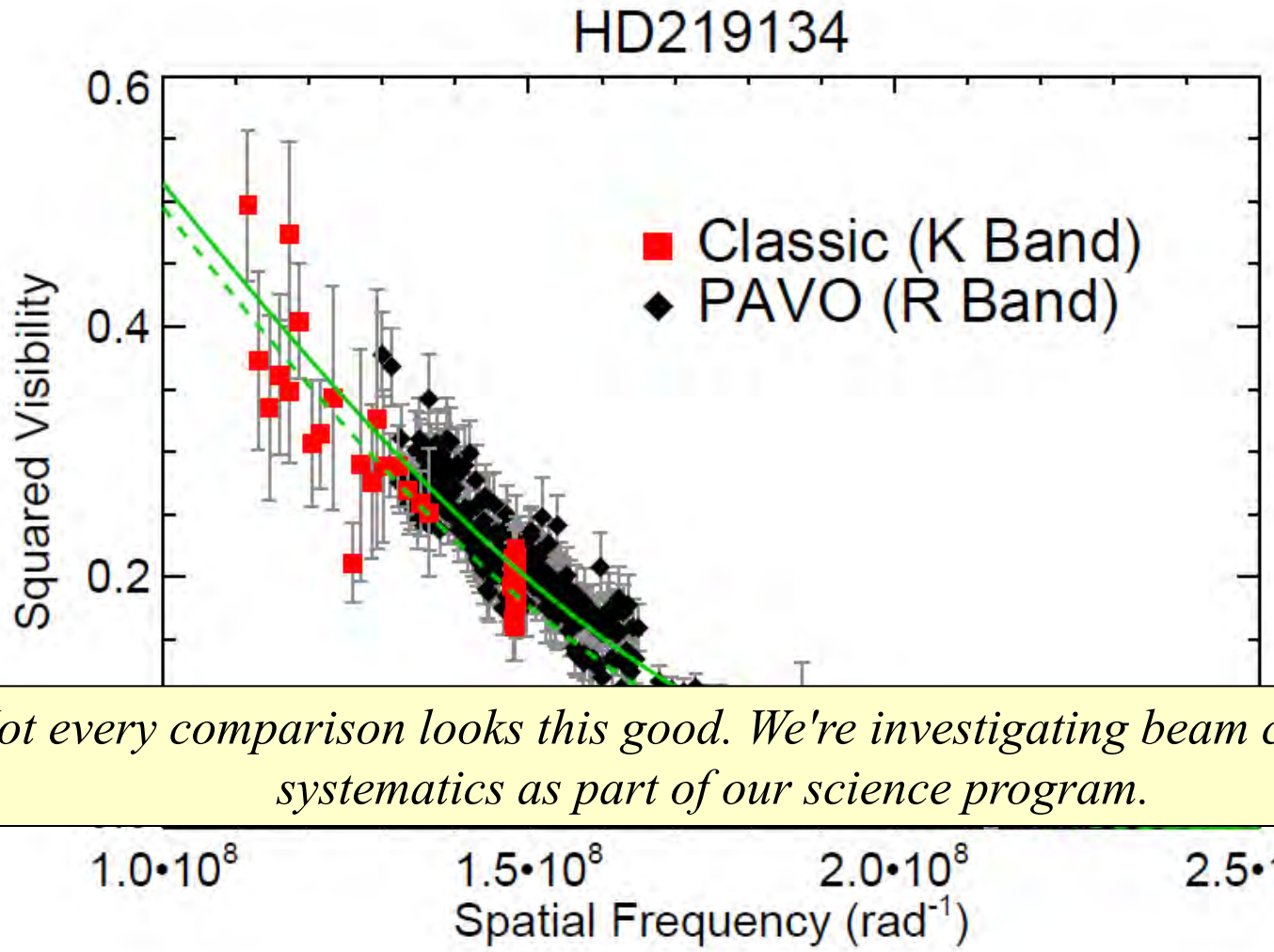
PAVO Software

- 2T data reduction is routine; software tools available. Check for updates!
- Serious bug in the code recently found:
  - Wrong star positions being looked-up for a *few* stars
    → Wrong projected baselines
- Future updates:
  - Allow addition of observations with other combiners

PAVO Software



PAVO Software

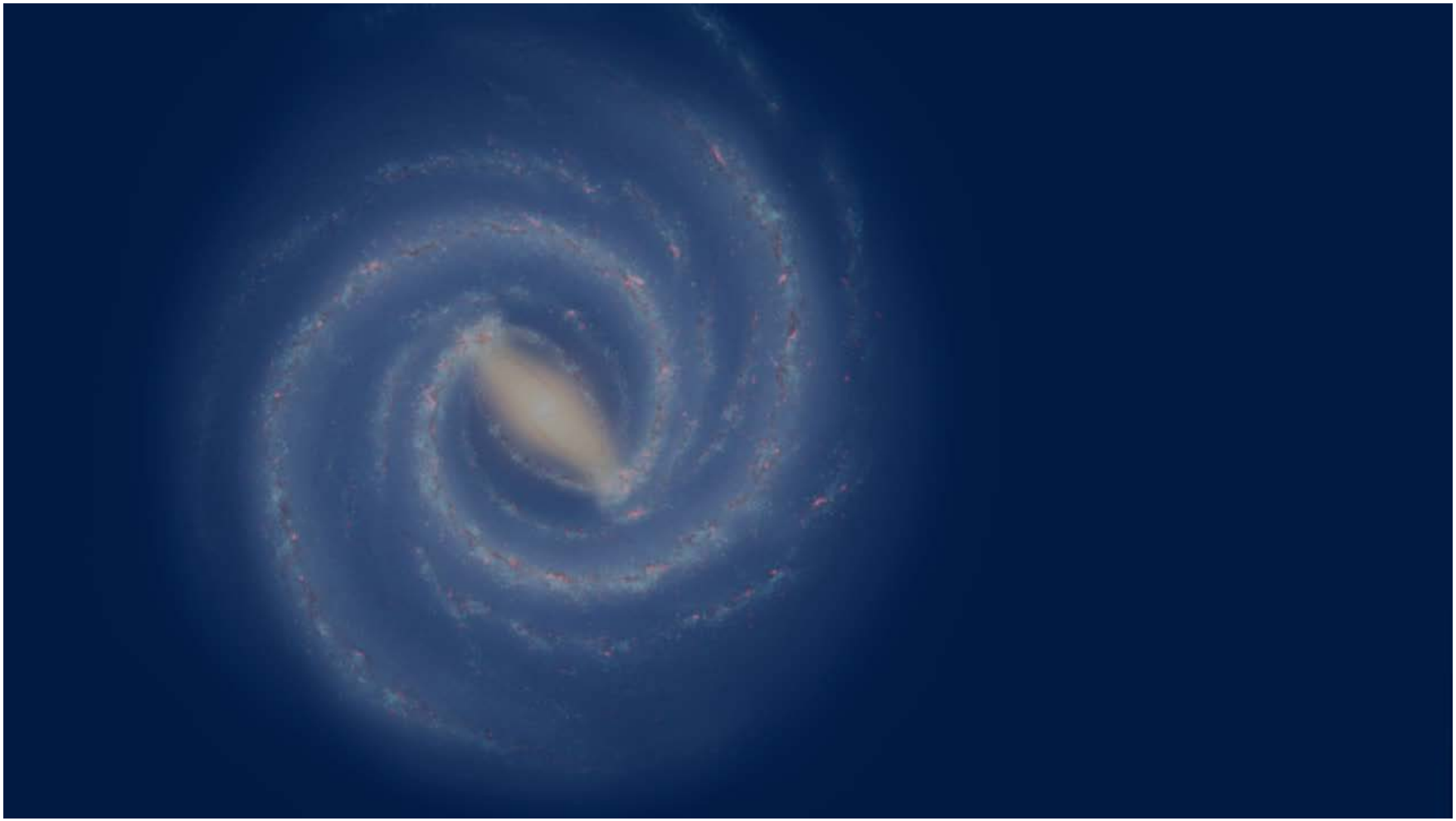


Not every comparison looks this good. We're investigating beam combiner systematics as part of our science program.

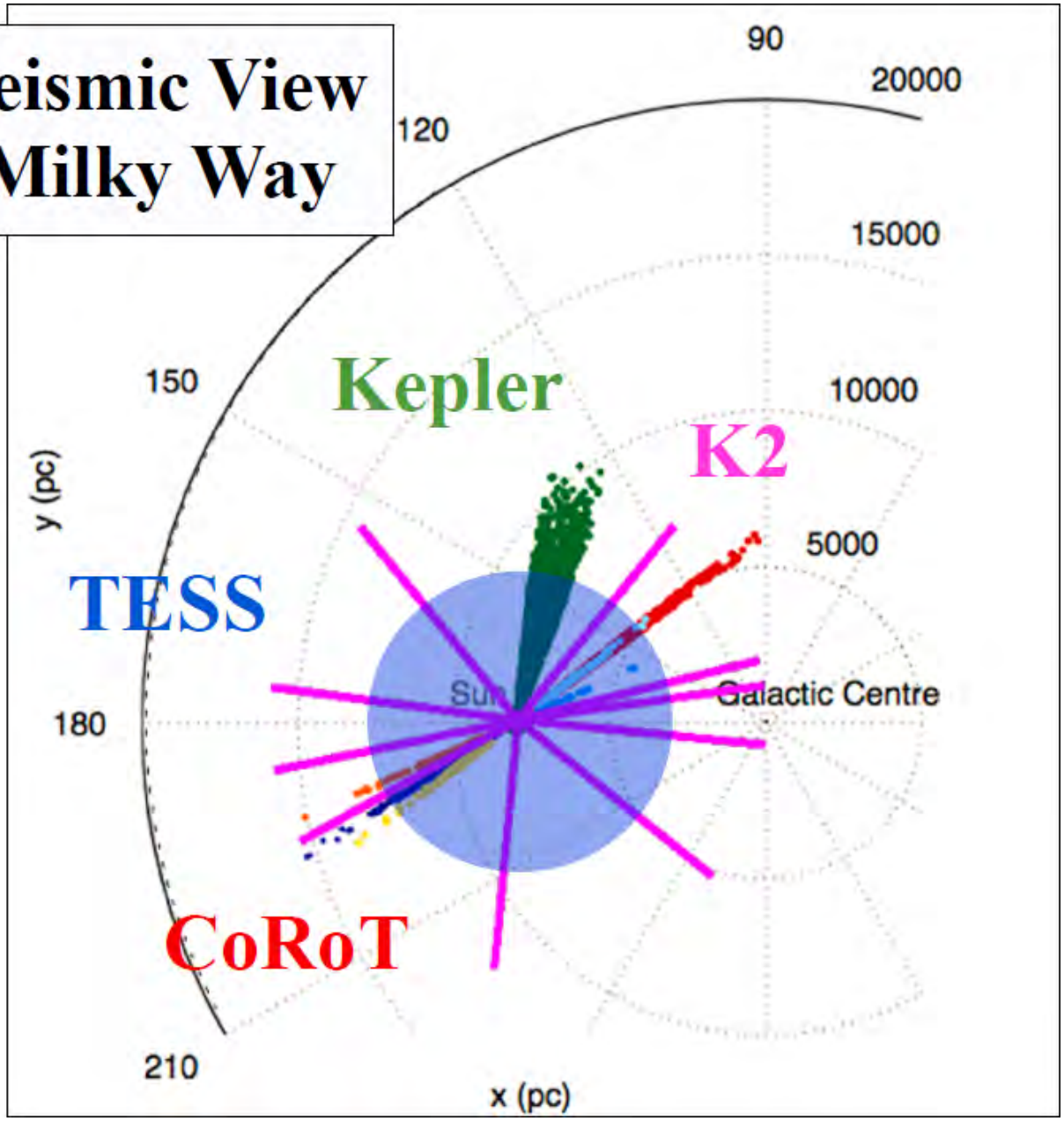
PAVO Science: Asteroseismology

White, Huber, Boyajian, Creevey,
Silva Aguirre, Bedding, Stockholm, Pope, et al.

Asteroseismic View of the Milky Way

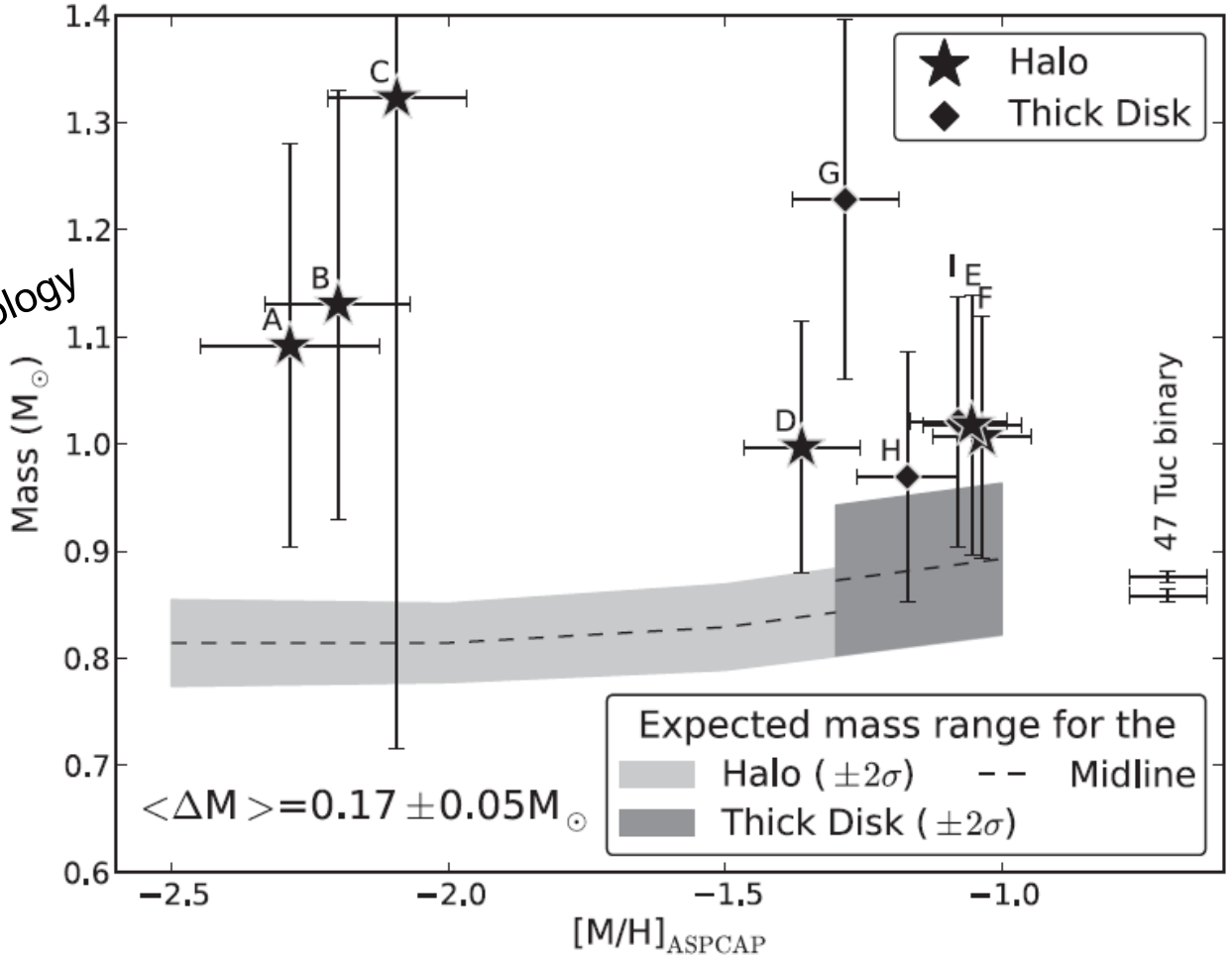


Asteroseismic View of the Milky Way



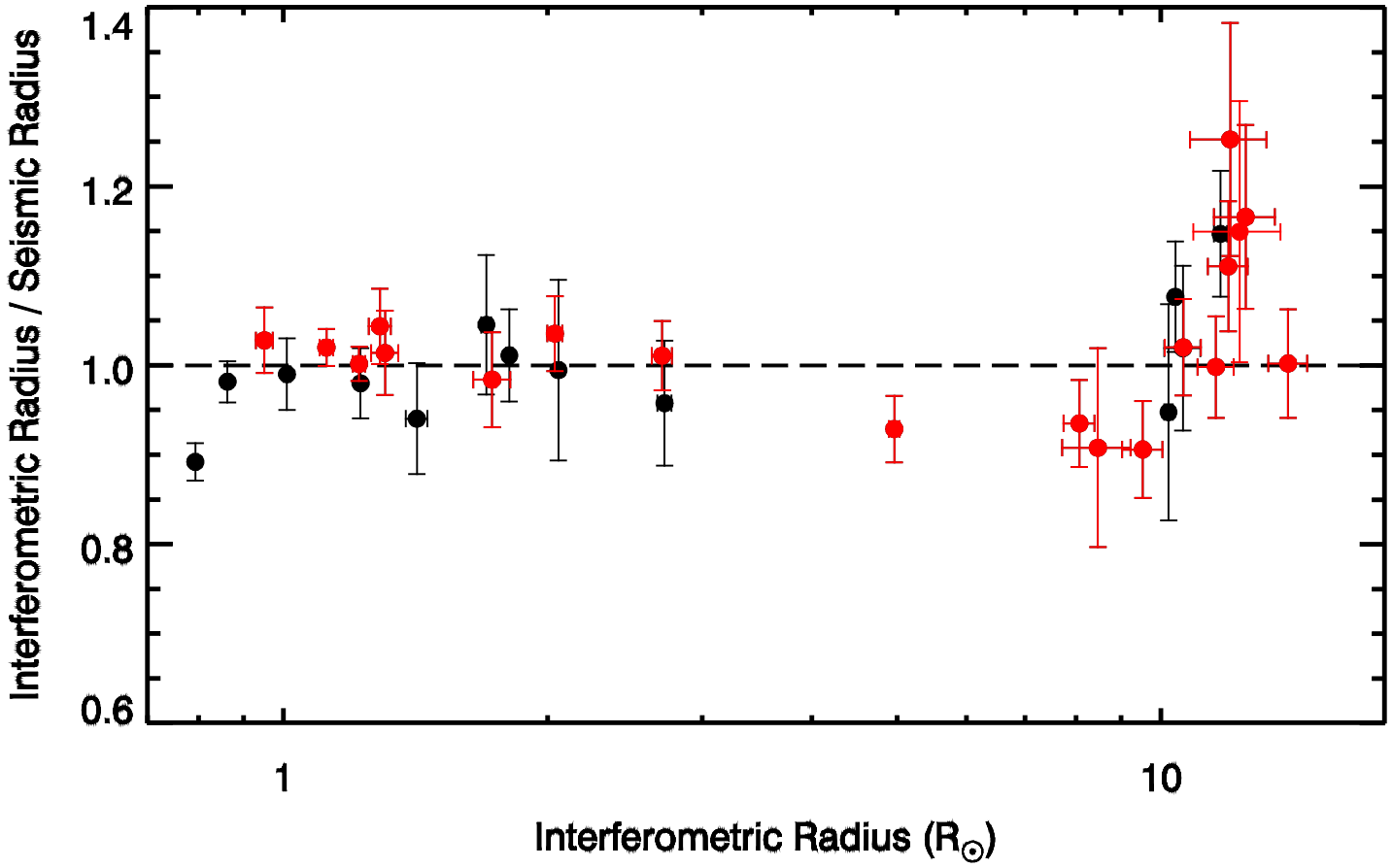
Asteroseismic Masses

Mass from Asteroseismology



Epstein et al. 2014

Interferometric Calibration



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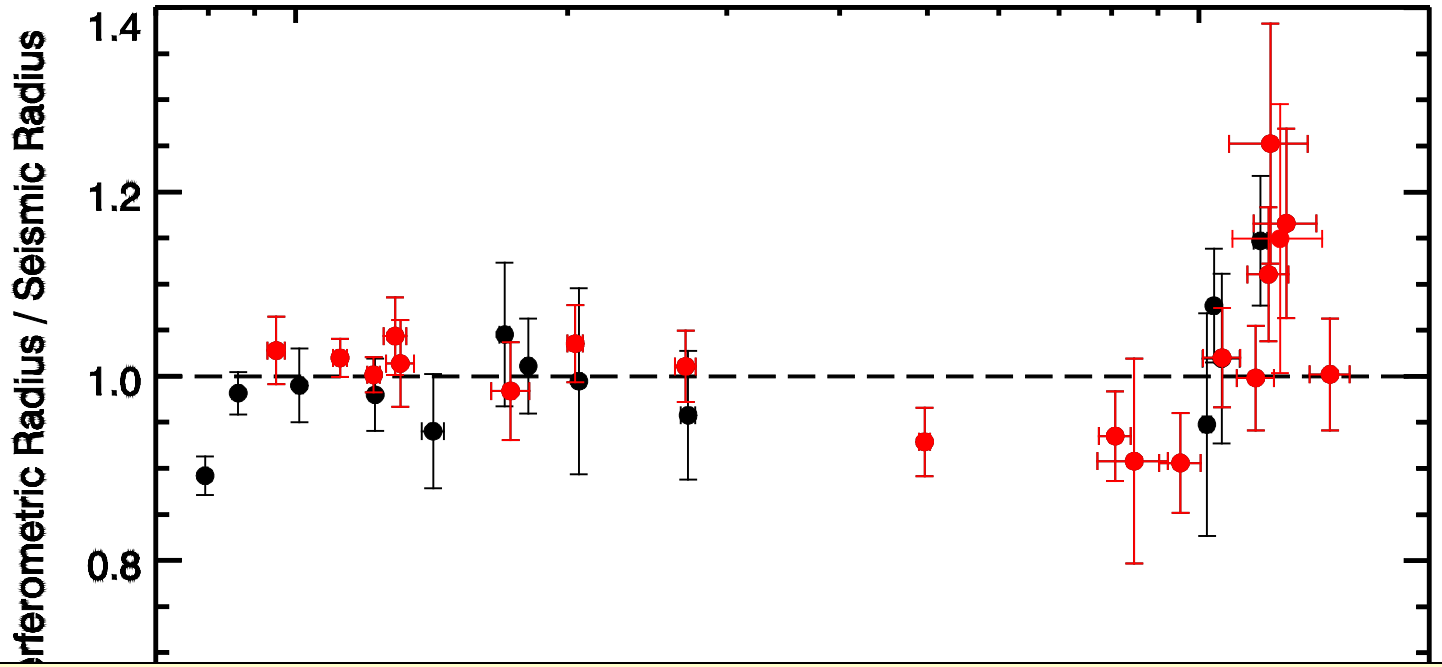
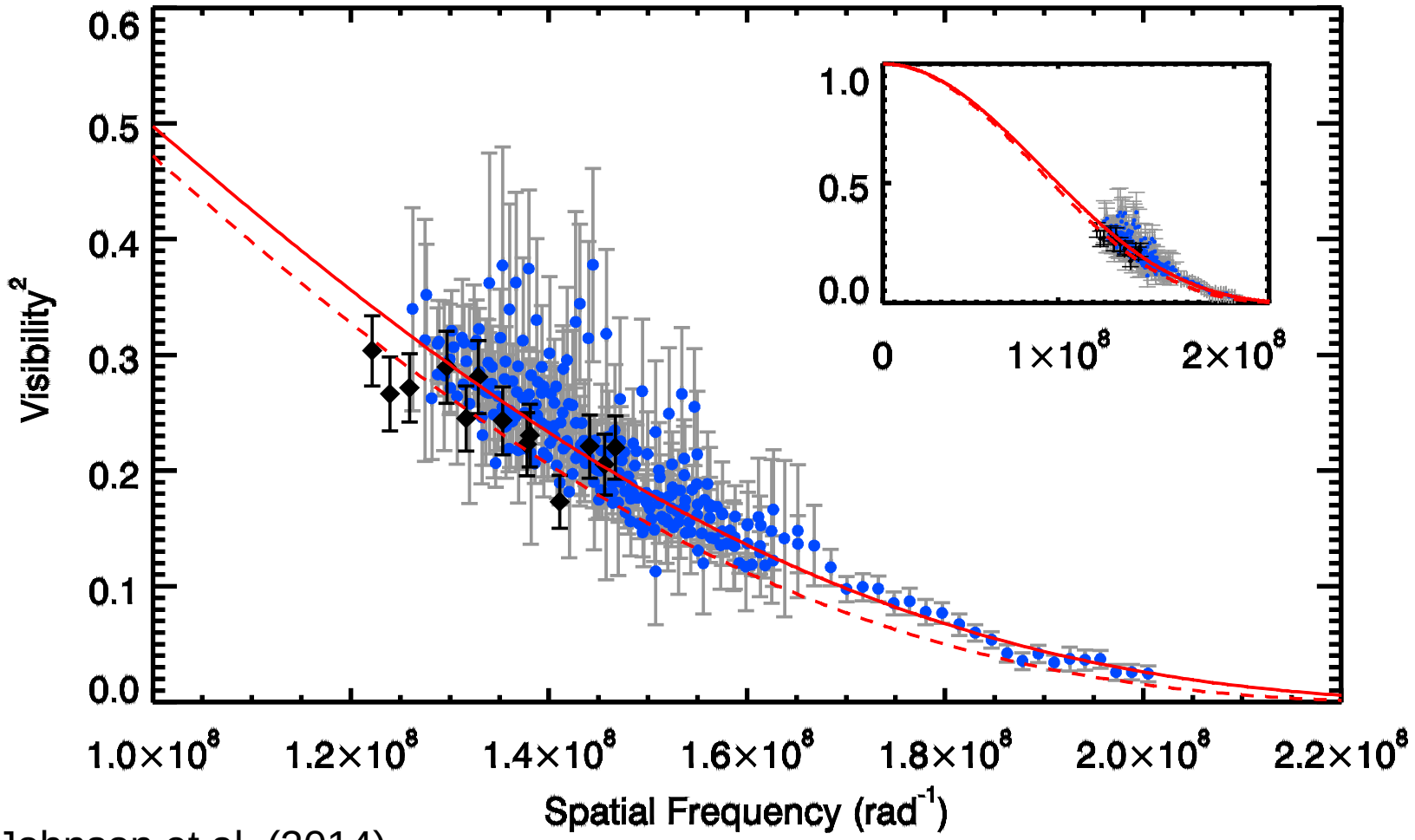


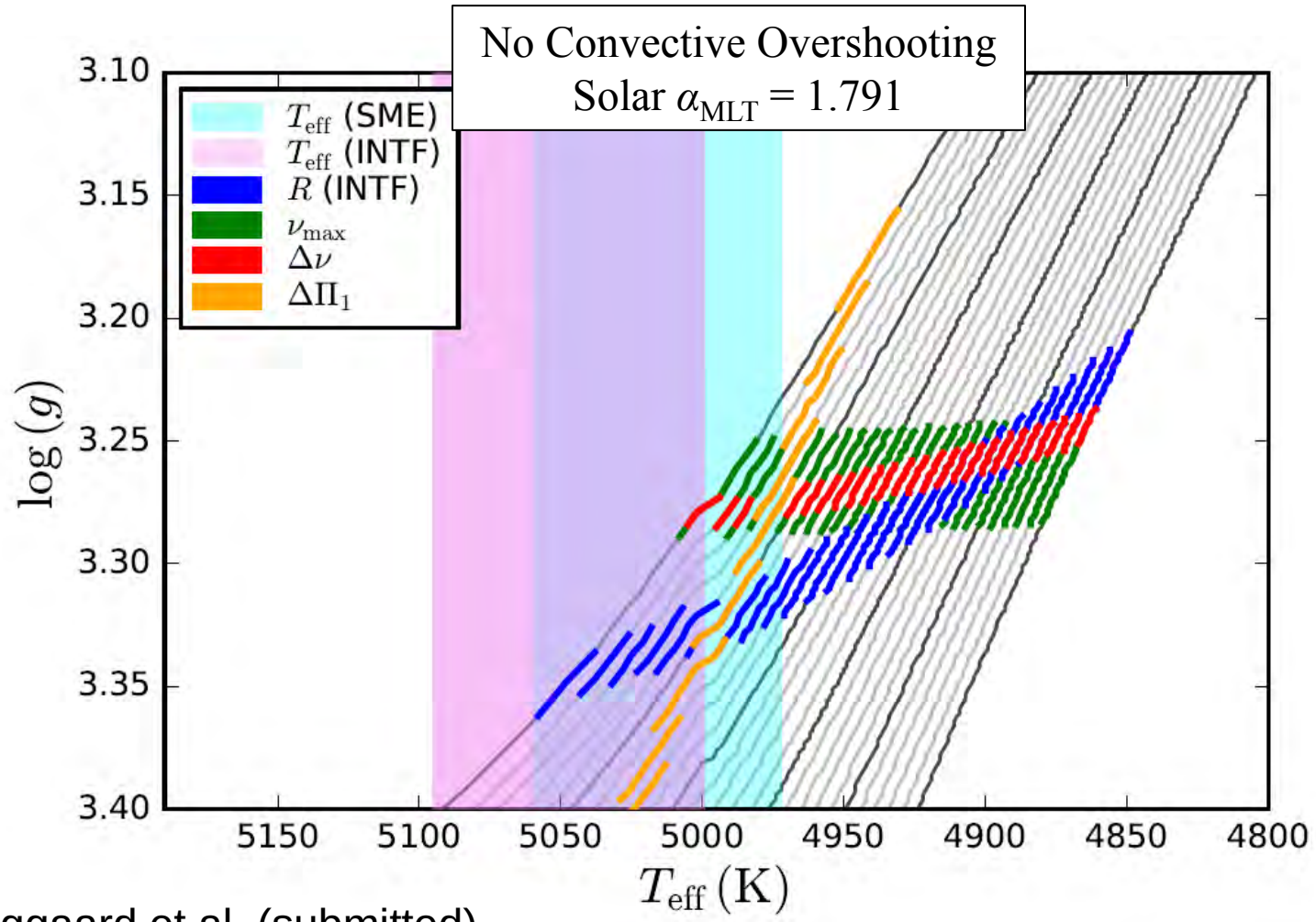
Interferometric calibration of red-giant asteroseismology across [Fe/H] & evolutionary states is crucial for the success of galactic archaeology!

Testing Stellar Models – HD 185351



Johnson et al. (2014)

Testing Stellar Models – HD 185351



Hjørringgaard et al. (submitted)

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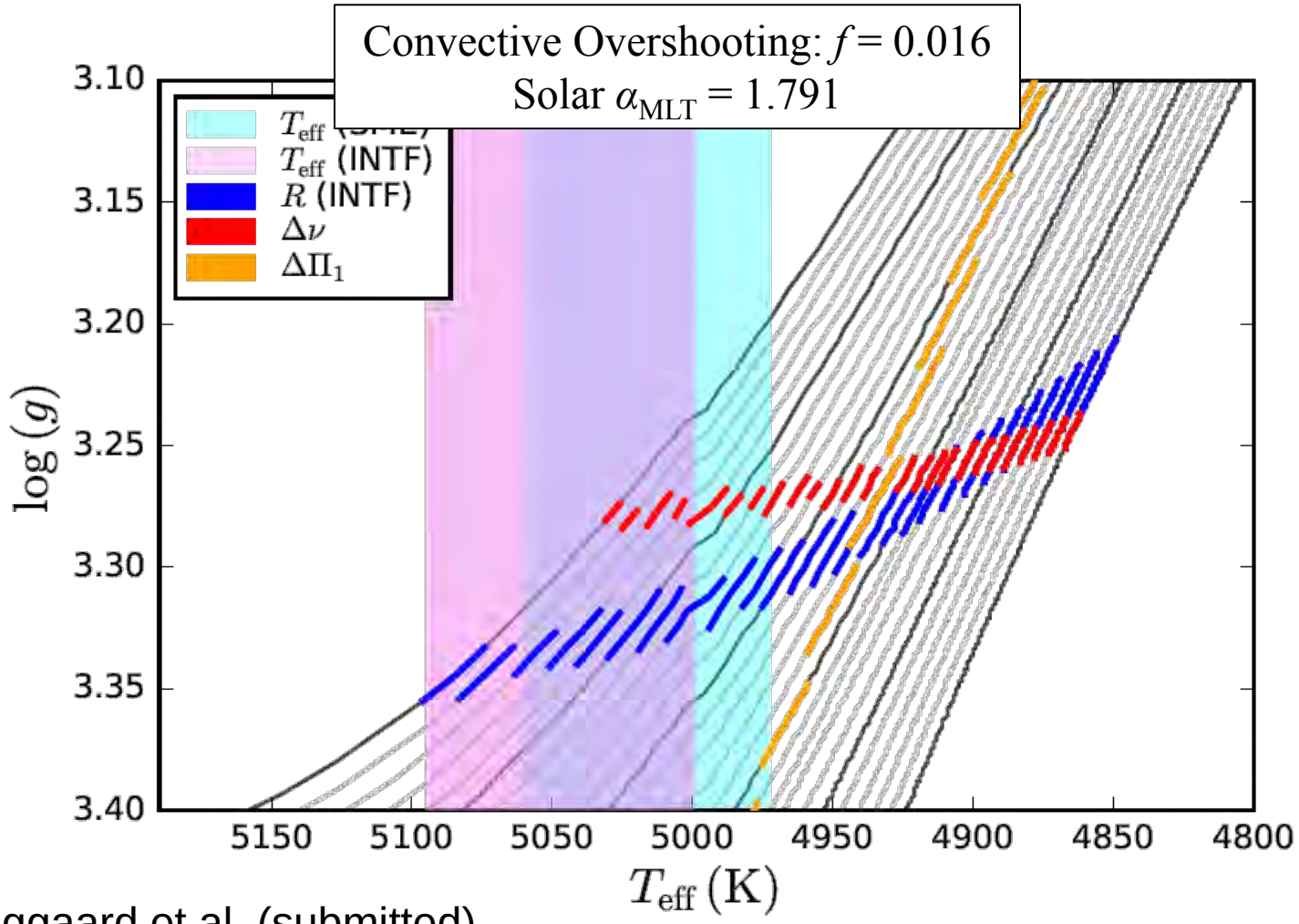

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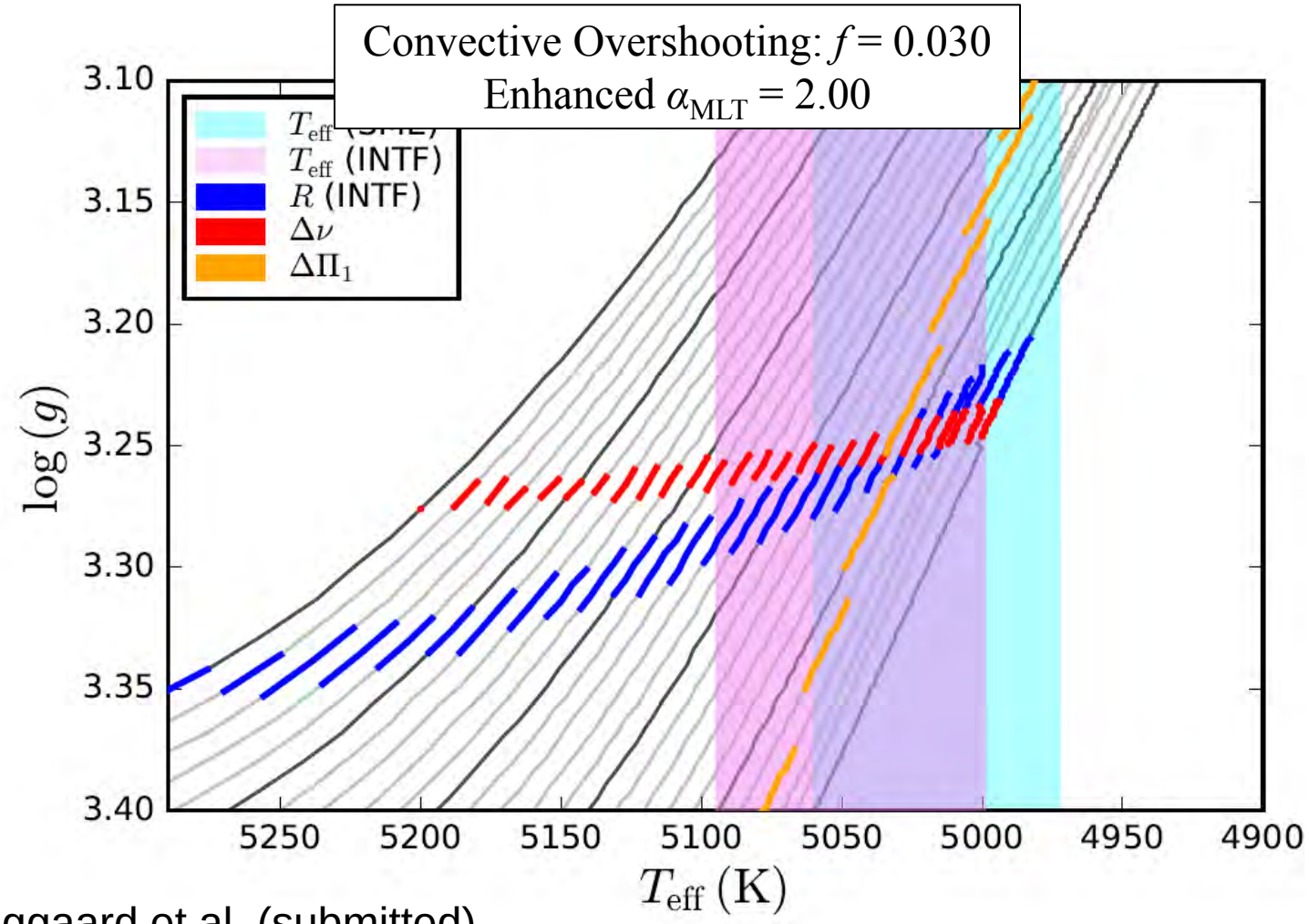
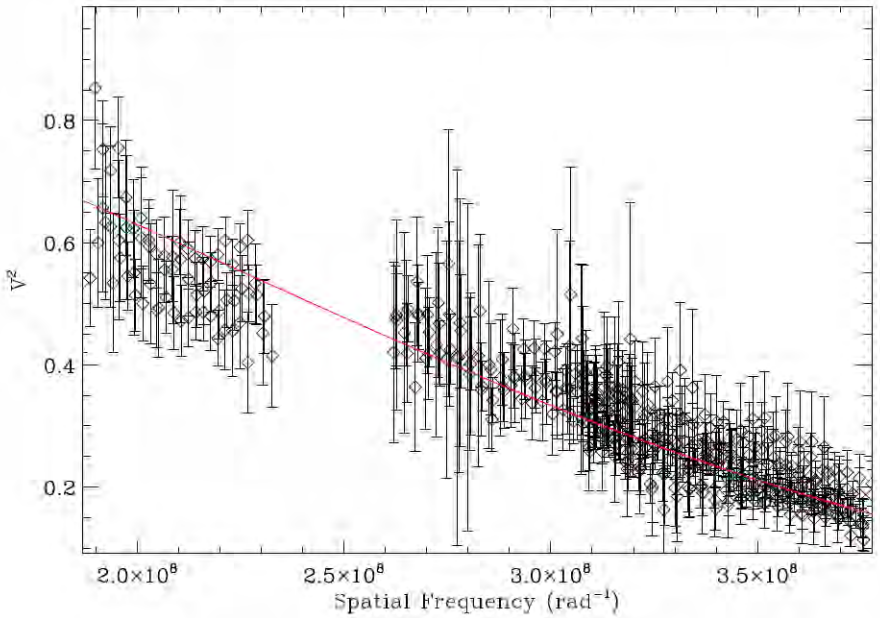


Hjørringgaard et al. (submitted)

Testing Stellar Models – HD 181096

Amalie Stockholm et al.

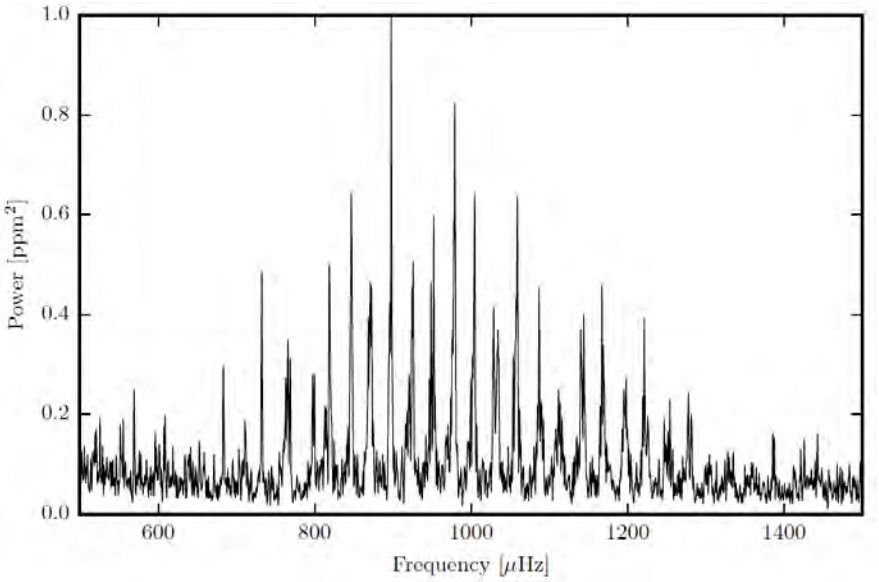


F6IV - V = 6.00

$\theta = 0.459 \pm 0.008$ mas

$R_{\mathrm{interf}} = 2.07 \pm 0.05\ \mathrm{R}_{\odot}$

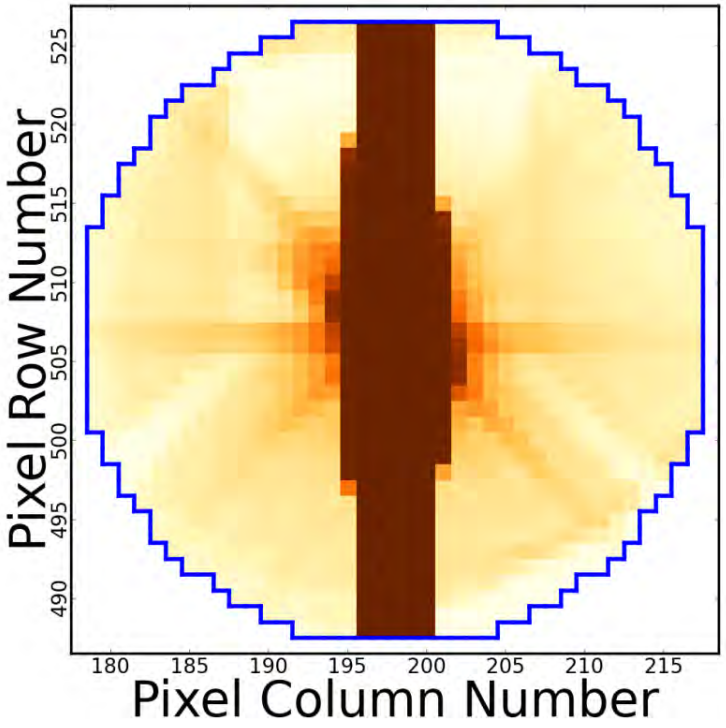
$T_{\mathrm{eff}} = 6204 \pm 96$ K



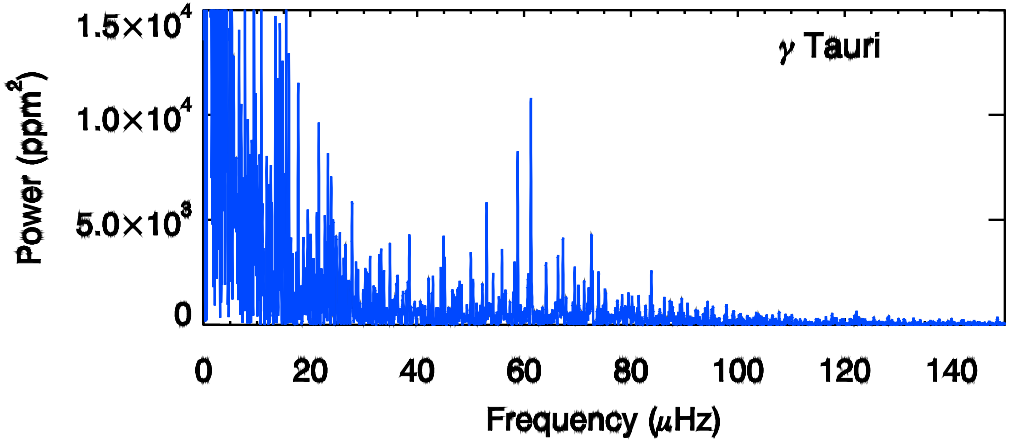
$R_{\mathrm{seism}} = 2.08 \pm 0.07\ \mathrm{R}_{\odot}$

$M = 1.40 \pm 0.09\ \mathrm{M}_{\odot}$

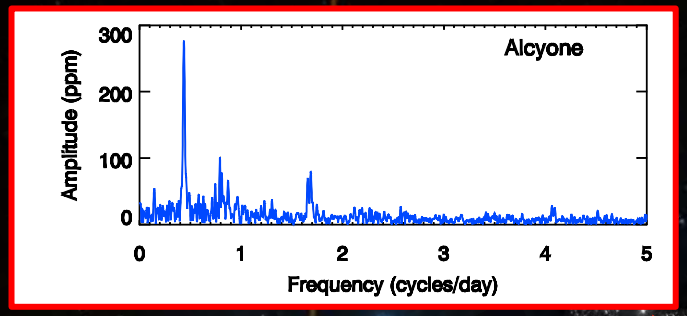
Bright Asteroseismic Targets

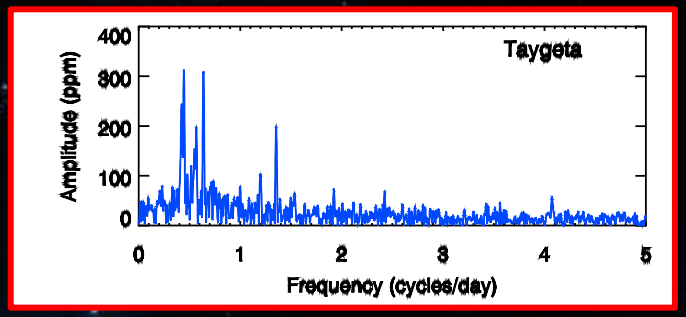


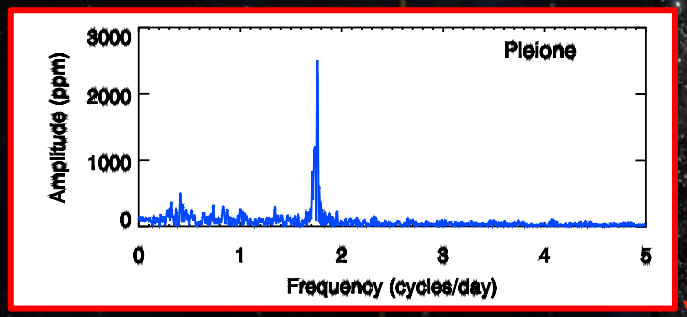
- γ Tauri
  - K0III
  - V = 3.65 mag
  - Hyades member

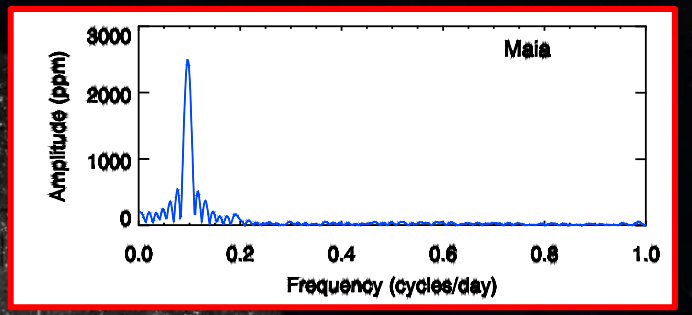


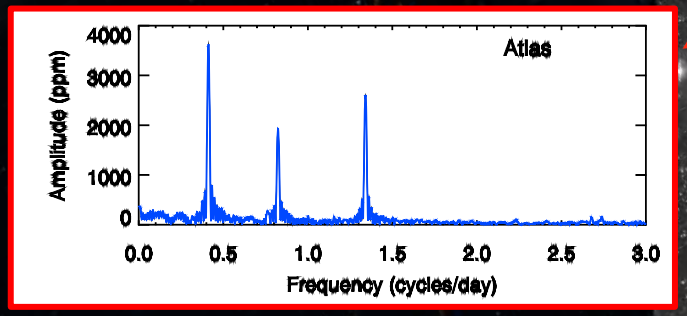
White et al. (in prep)

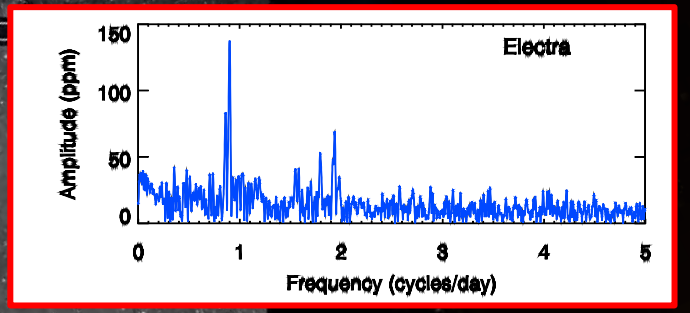


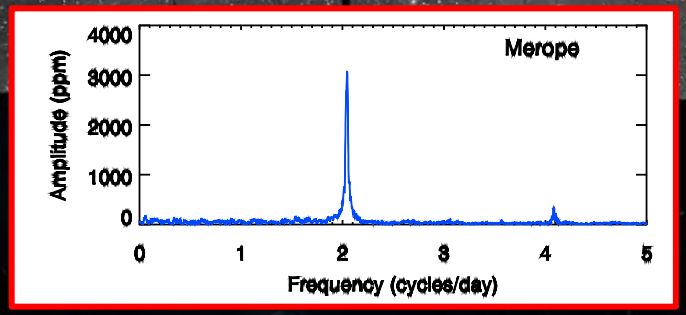










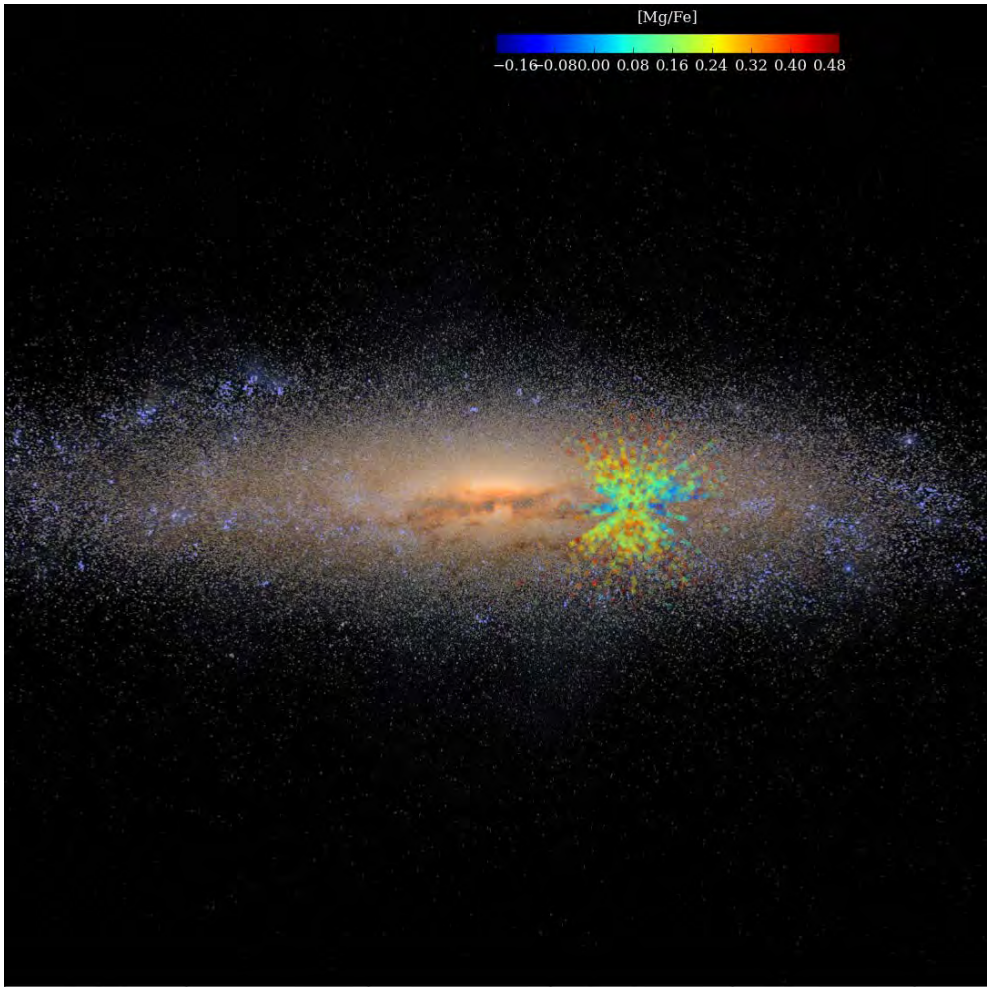


White et al. (in prep)

PAVO Science: Benchmark Stars

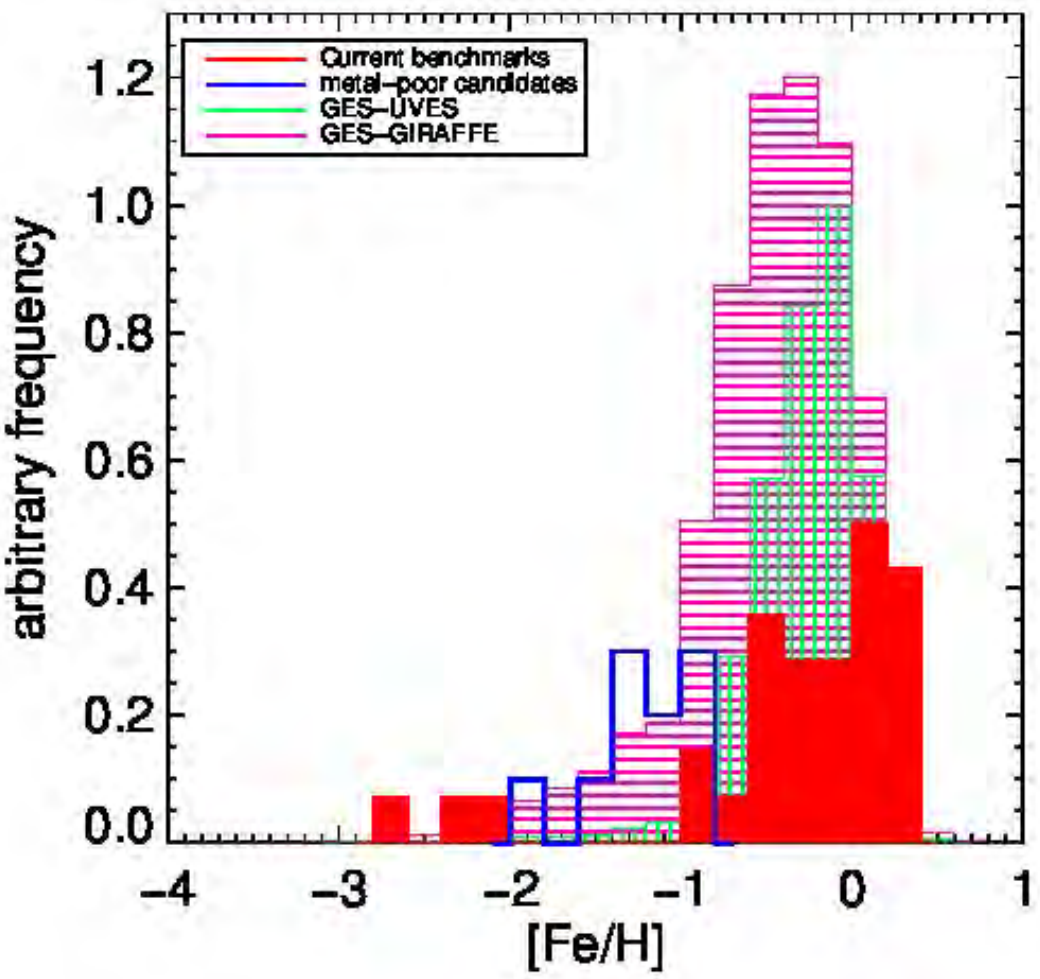
Karovicova, Ireland, White,
Huber, Ryan, et al.

Gaia-ESO Survey



Greg Stinson and Maria Bergemann, MPIA.

Gaia-ESO Survey



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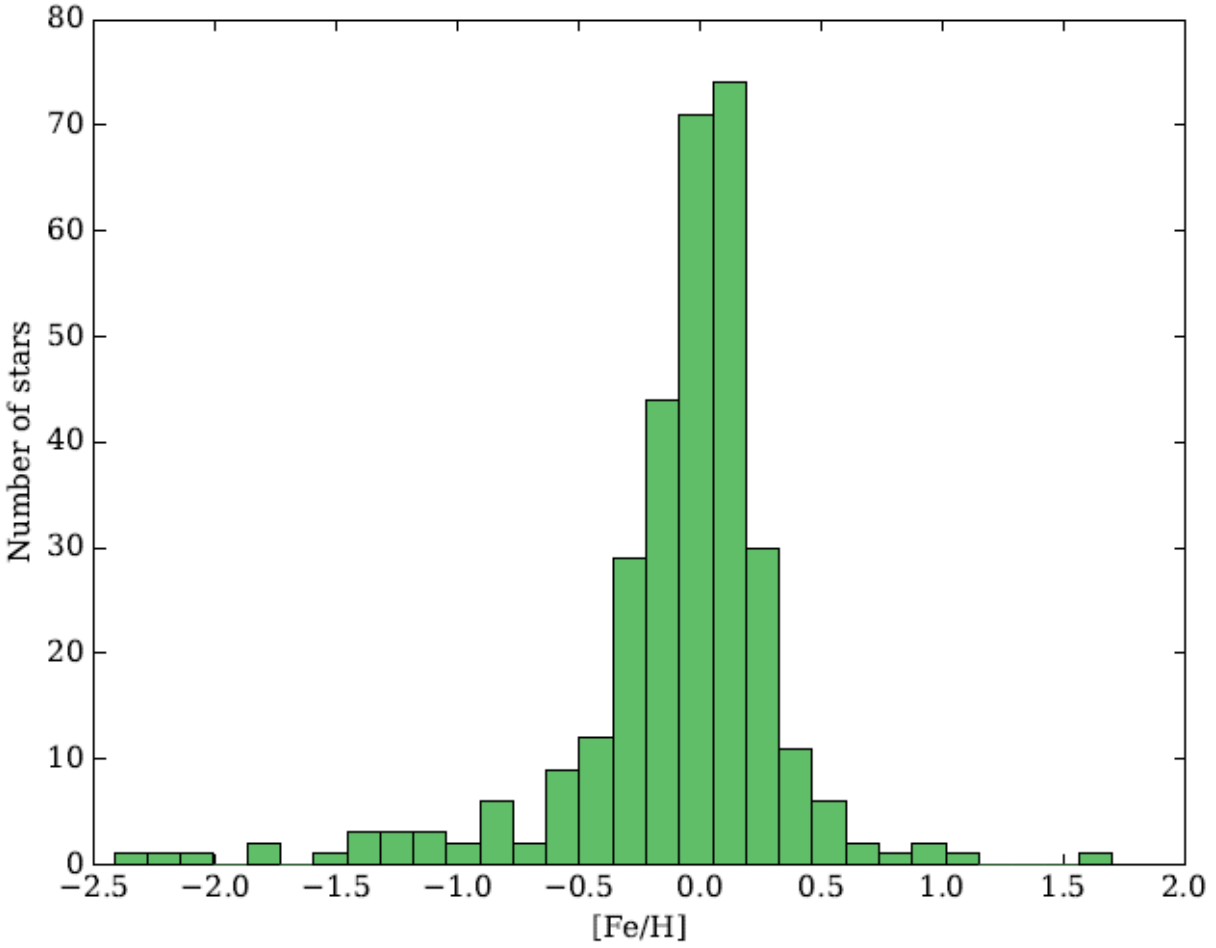
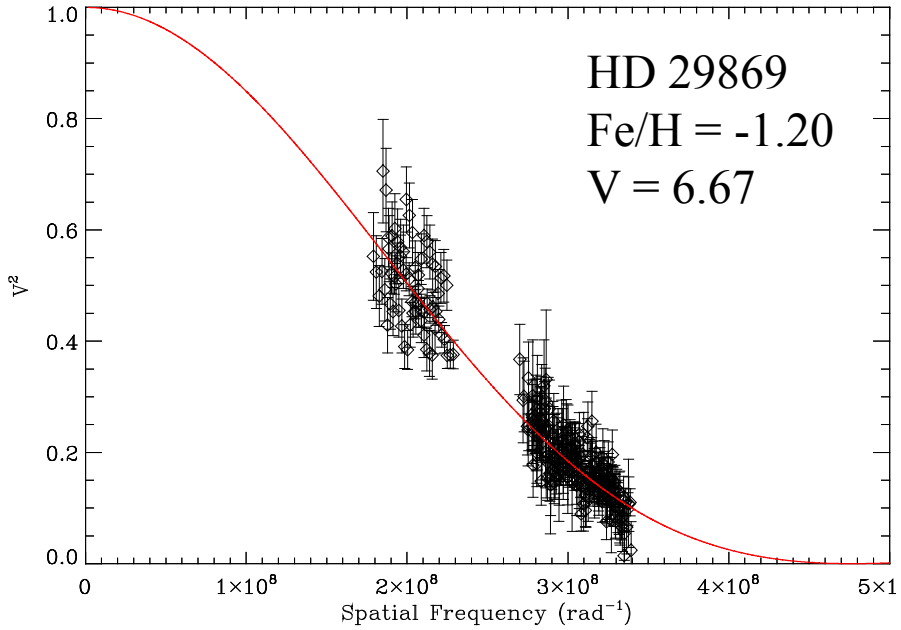
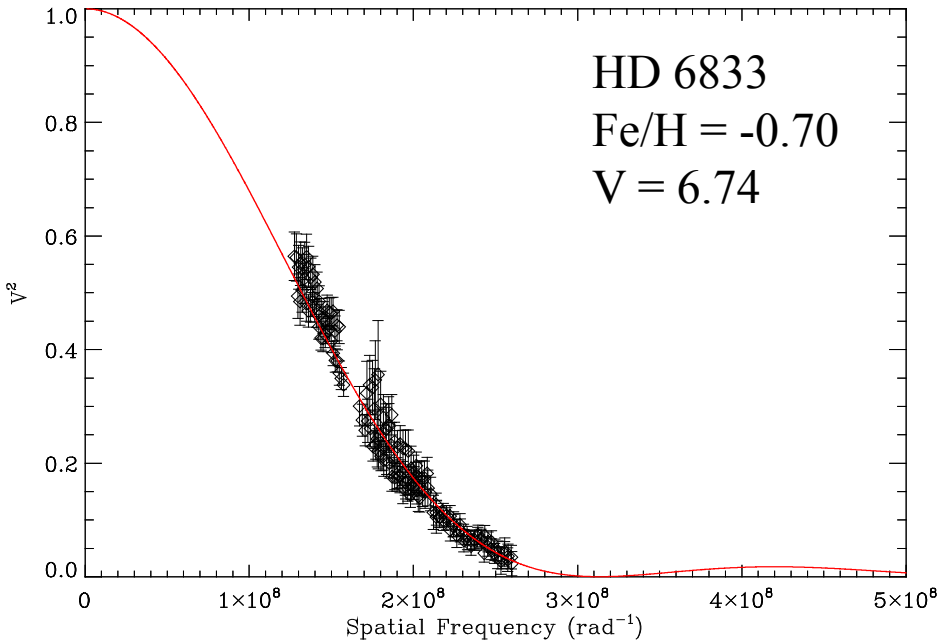
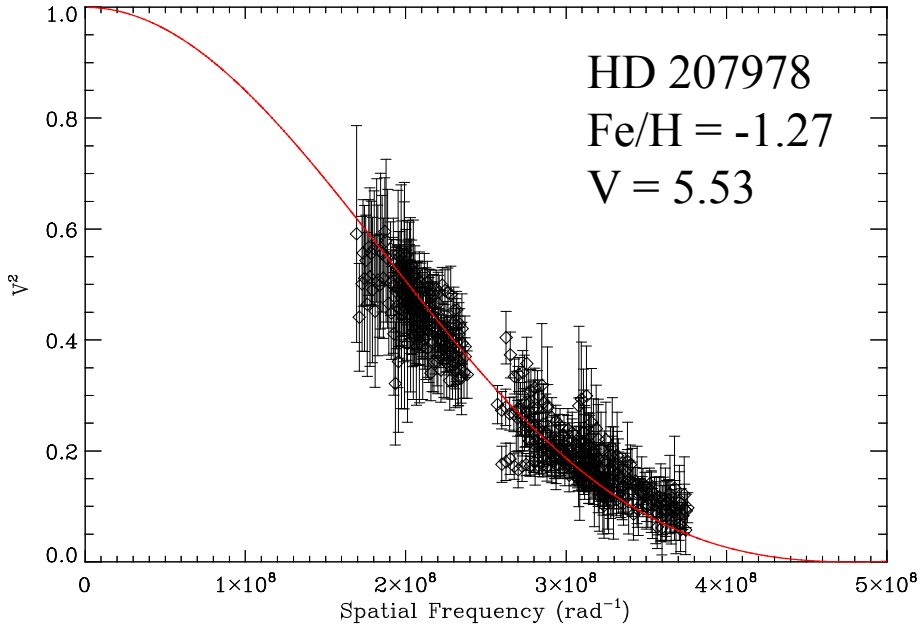
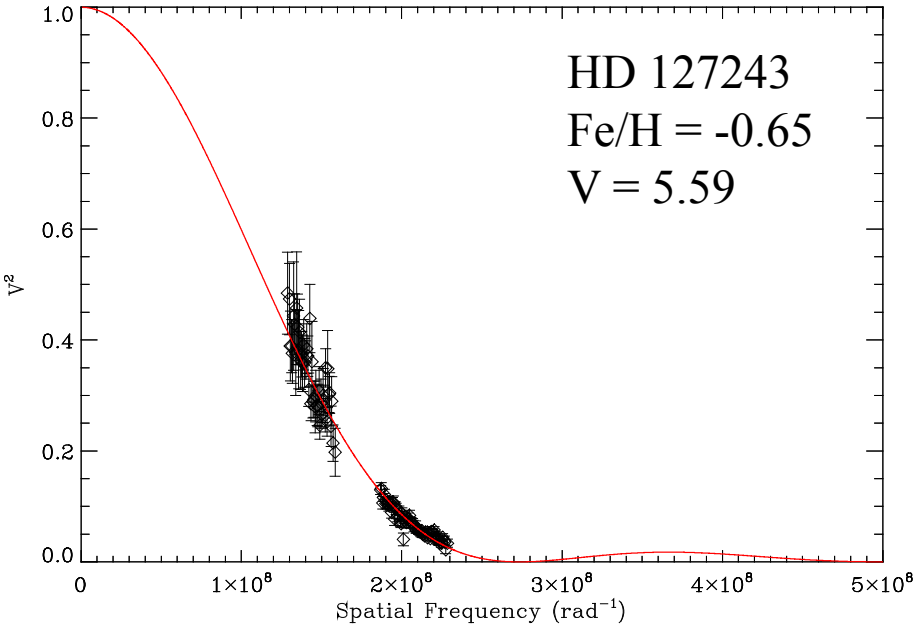






Work in progress…

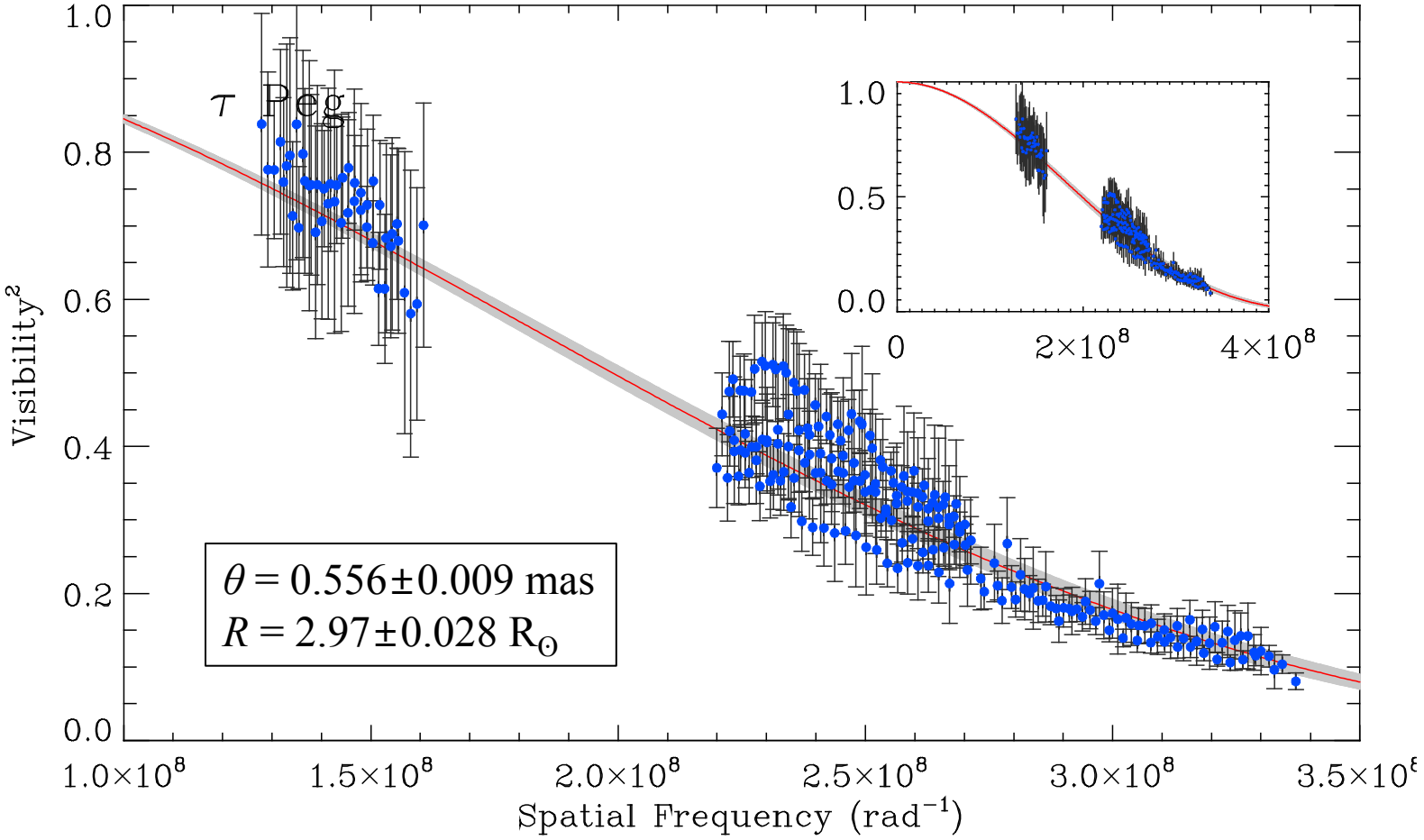




PAVO Science: λ Boo Stars

Murphy, Huber, Bedding, Tuthill

τ Pegasi

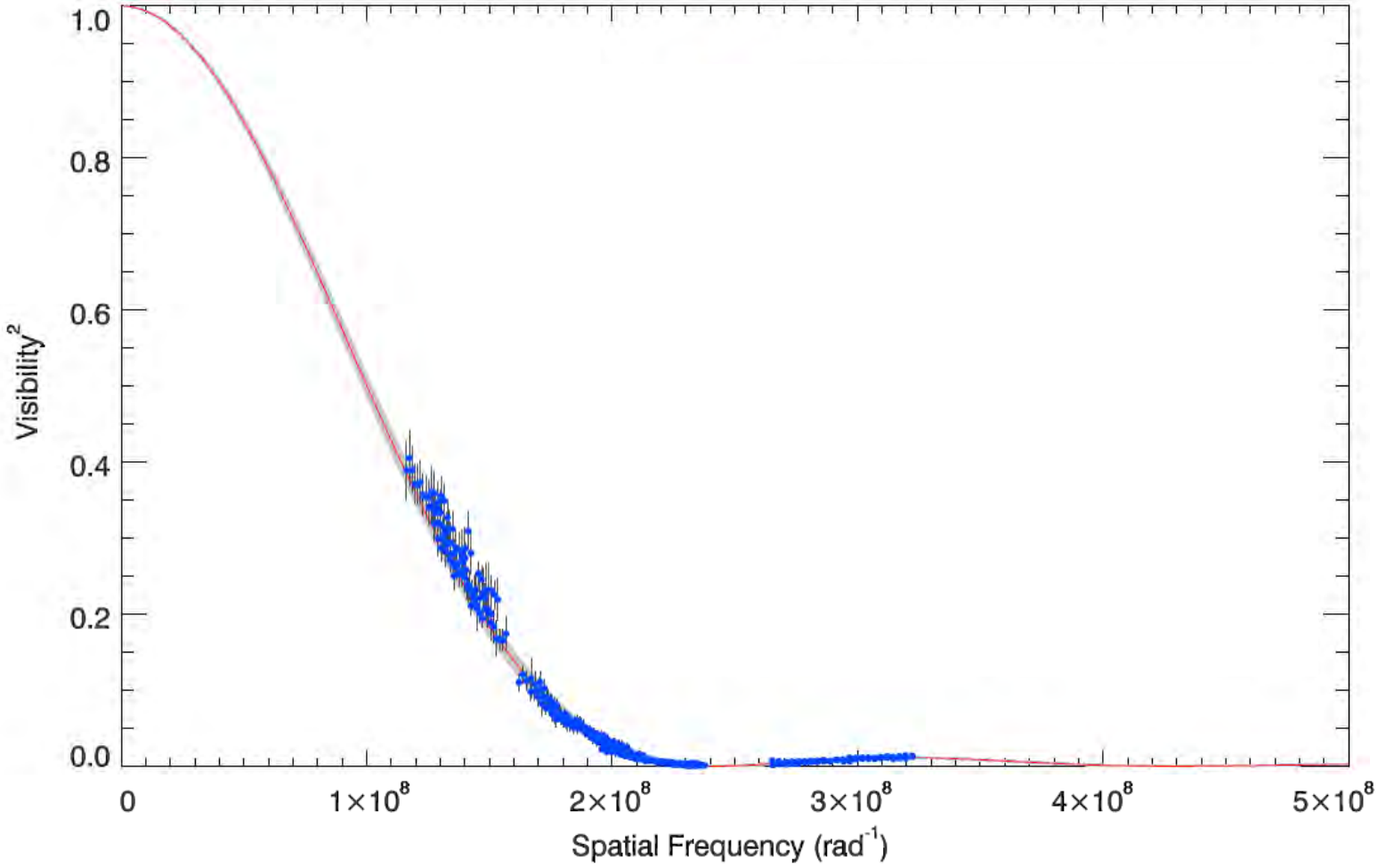

τ Peg
Visibility²
Spatial Frequency (rad⁻¹)
θ = 0.556±0.009 mas
R = 2.97±0.028 R⊙
1.0
0.8
0.6
0.4
0.2
0.0
1.0×10⁸
1.5×10⁸
2.0×10⁸
2.5×10⁸
3.0×10⁸
3.5×10⁸
1.0
0.5
0.0
0
2×10⁸
4×10⁸

PAVO Science: Limb-darkening

White, Huber, Ireland, Tuthill, Bedding

υ Andromedae

White et al. (submitted)



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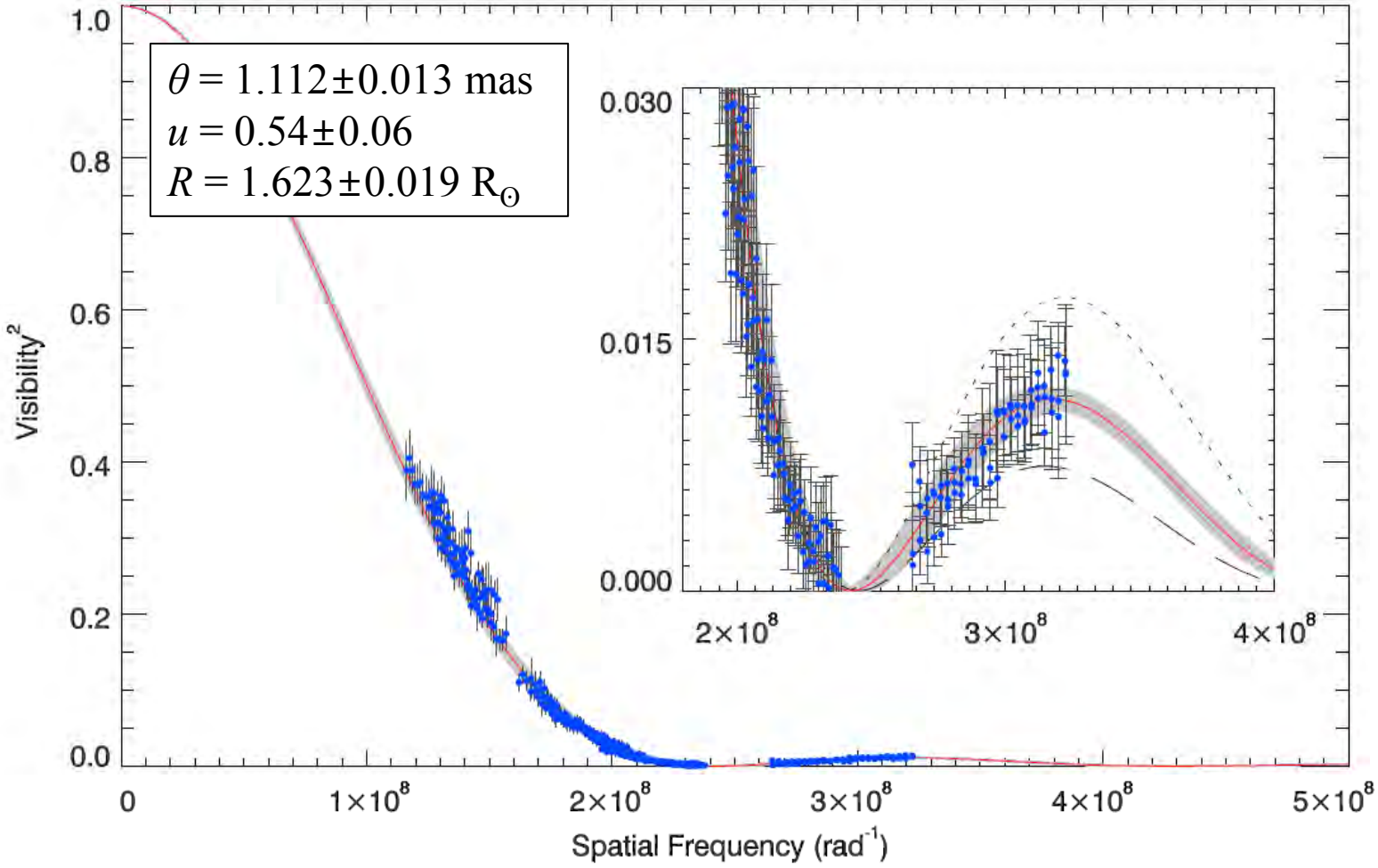

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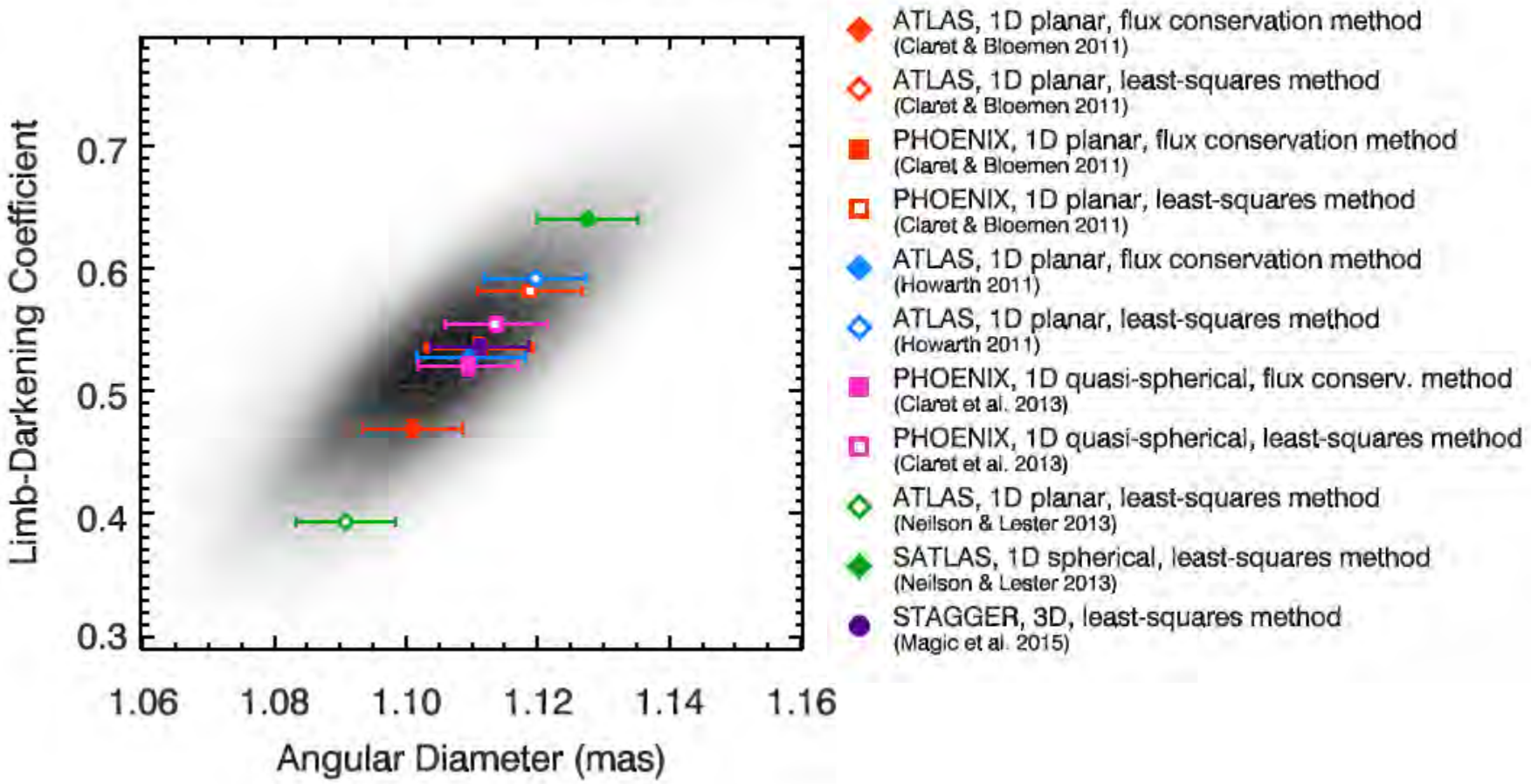
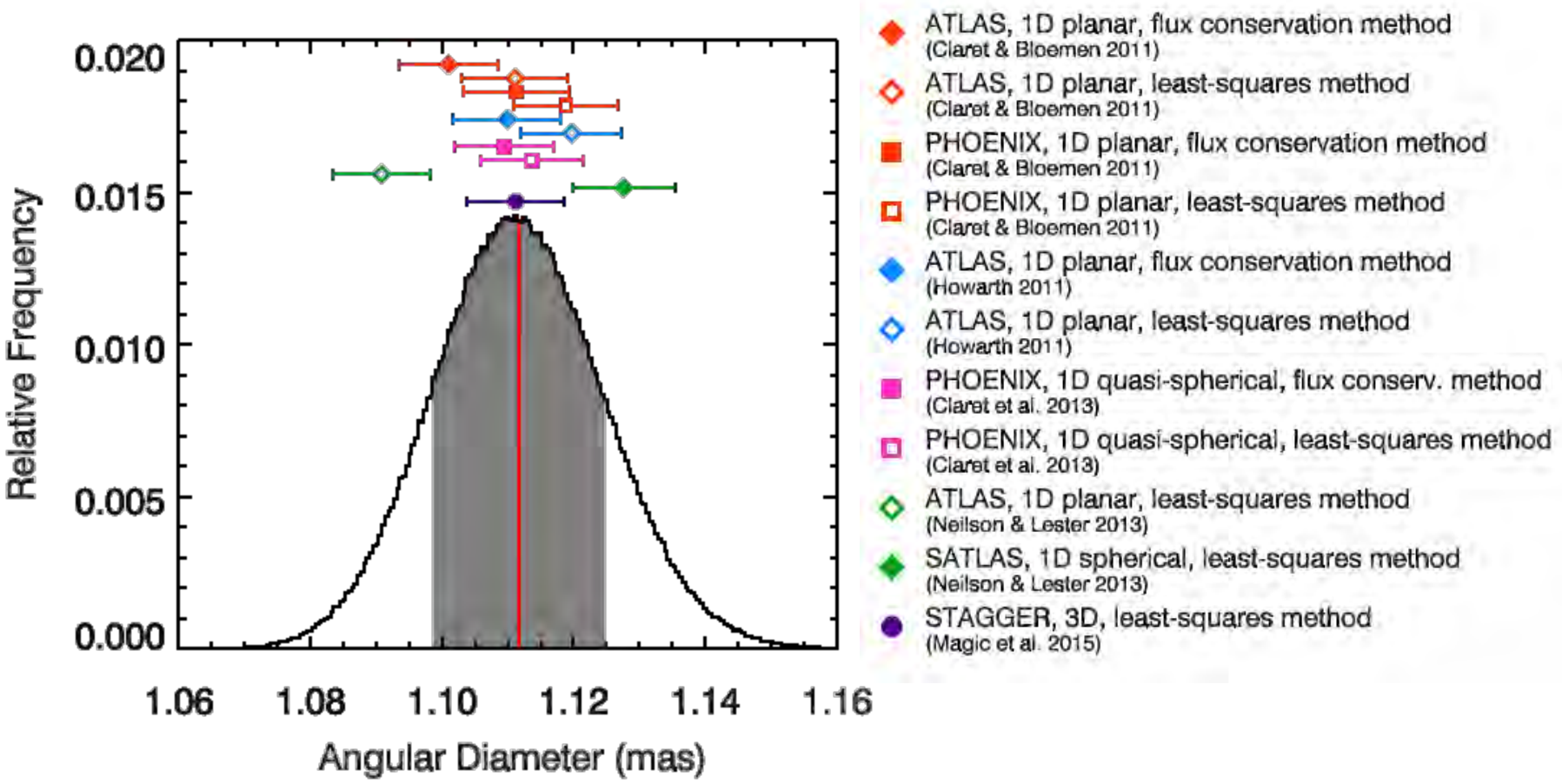
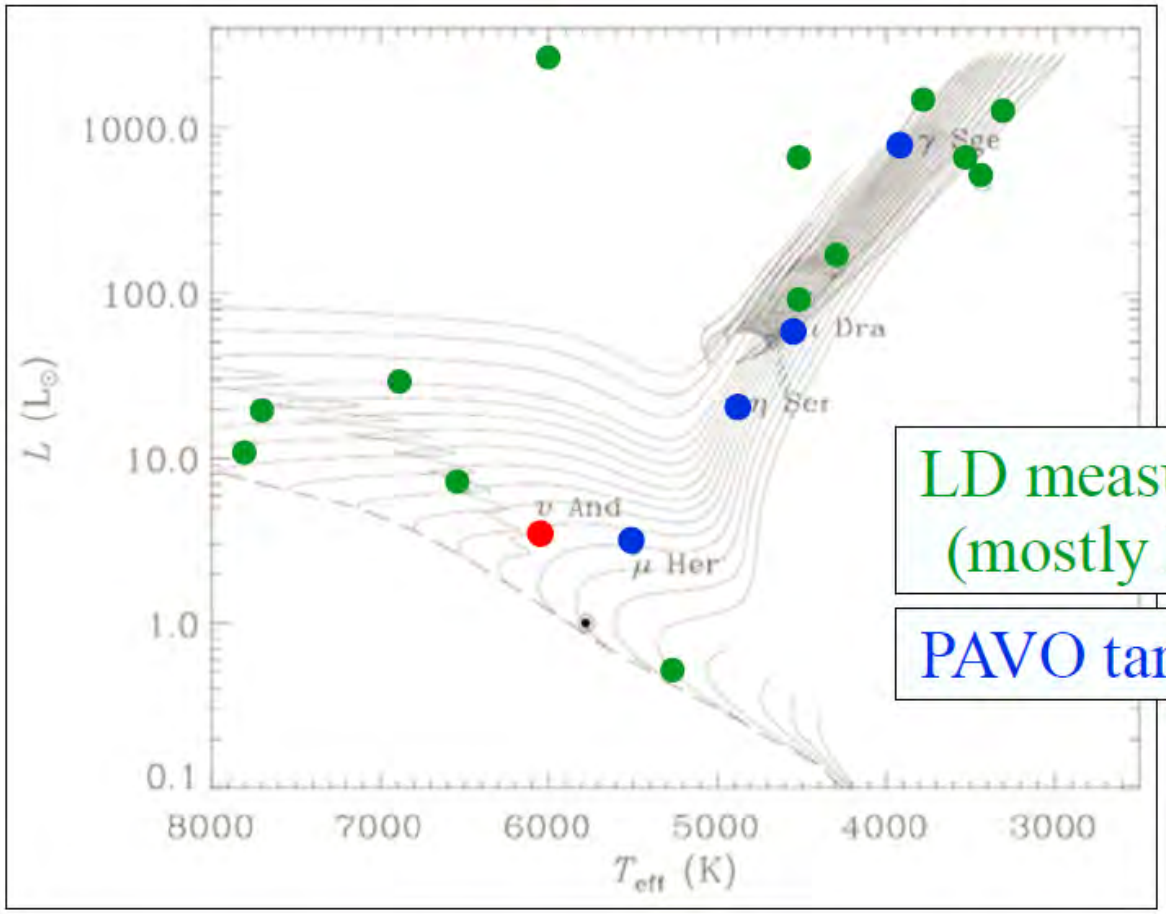


υ Andromedae

White et al. (submitted)

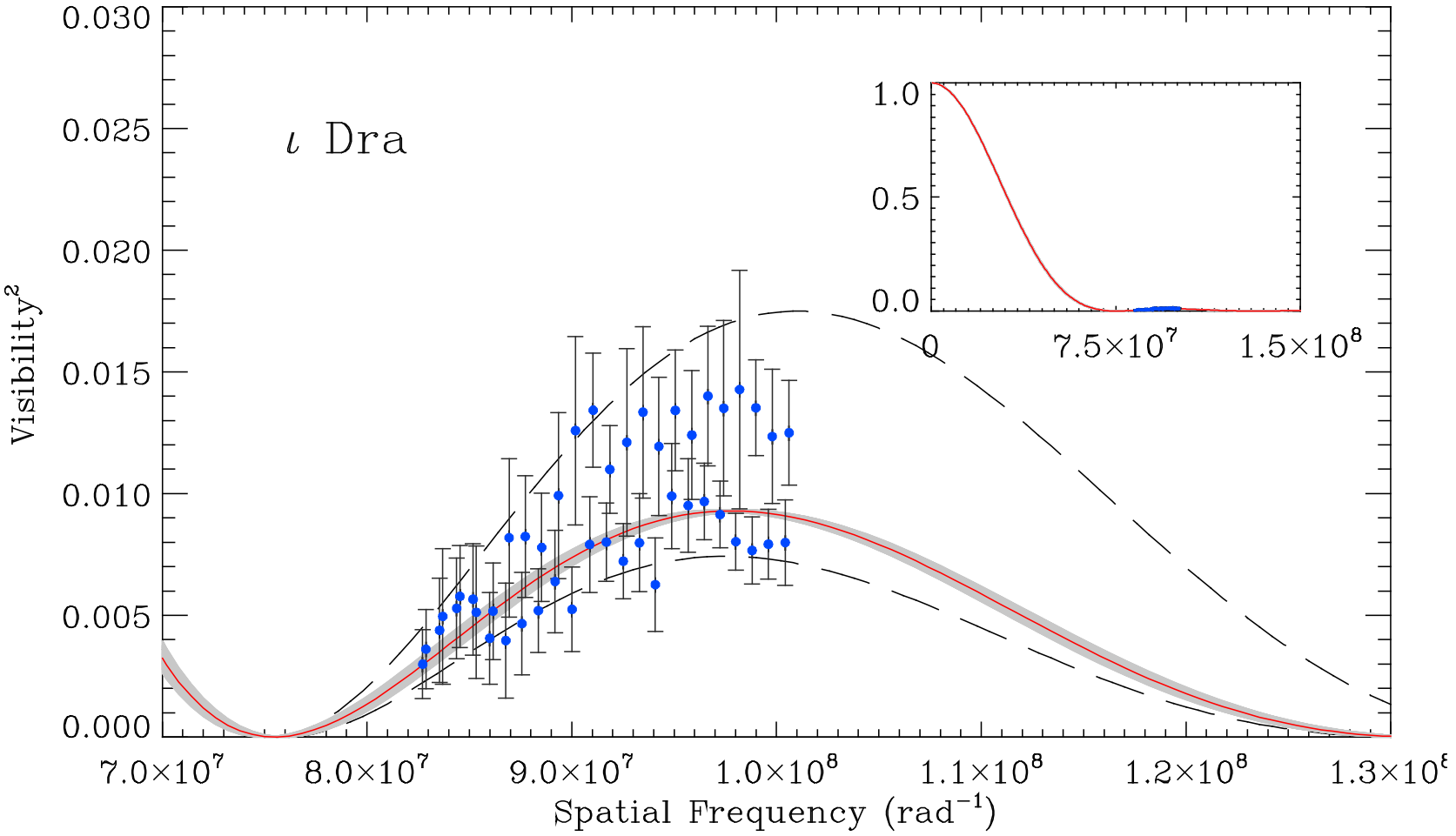


2T LD Pilot Study



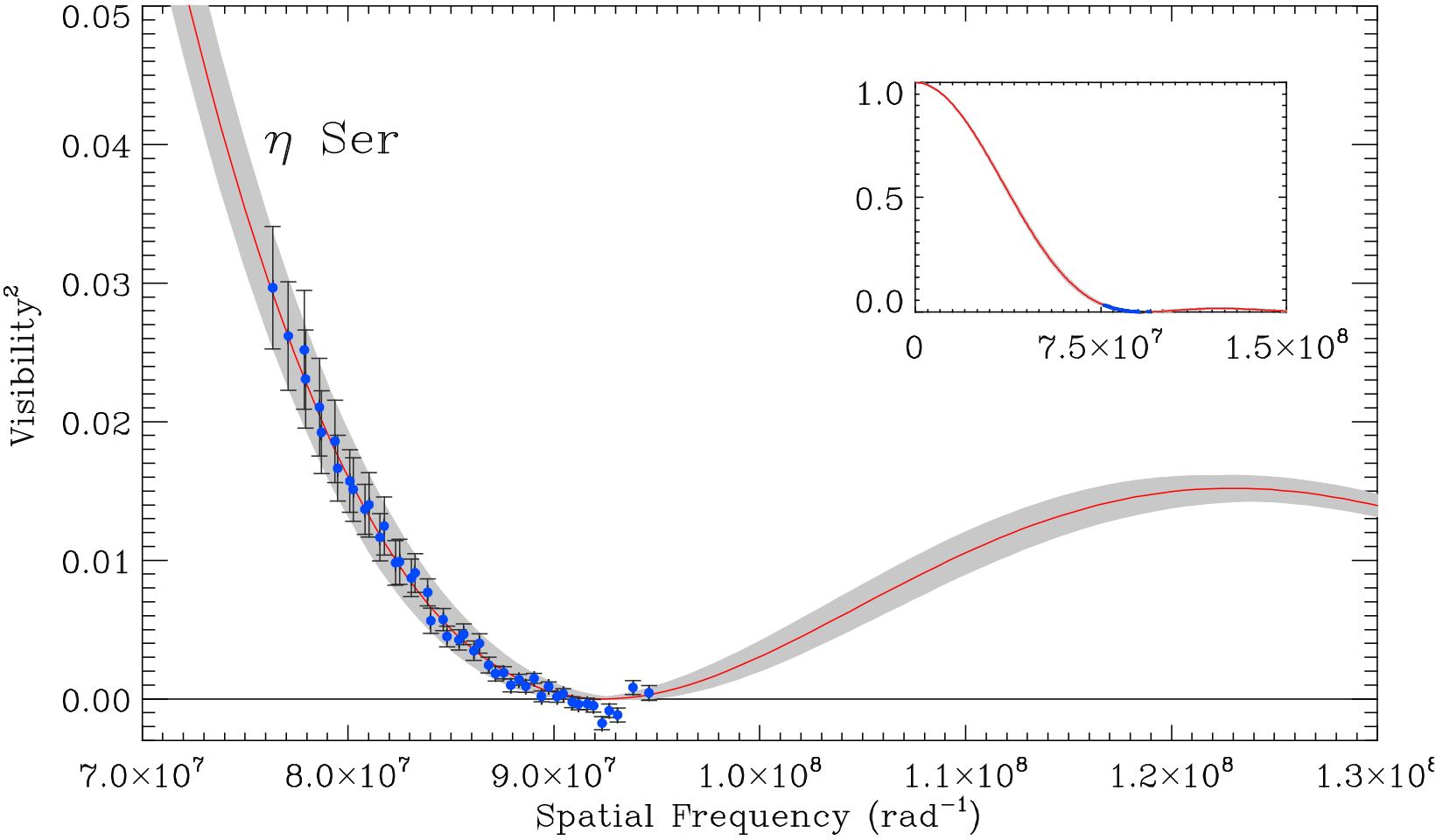
ι Draconis

V = 3.29 mag



η Serentis

V = 3.26 mag



Summary

- 2T PAVO/CHARA is producing routine science output –make sure to update the software!
- Key PAVO Science at Sydney:
  - Asteroseismology
  - Benchmark stars
  - λ Boo stars
  - Limb darkening
  - YSOs (Guillaume Schworer)
- Looking forward to Gaia parallaxes