Recent Results from NPOI & CHARA

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Naval Research Laboratory

A Random Walk Through Some NPOI & CHARA Things

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Topics

- 2018 observing (NPOI)
- Phase nulling (NPOI)
- The problem with giants (CHARA)
- Last minute NPOI thing

Topics

- 2018 observing (NPOI)

2018 Observing

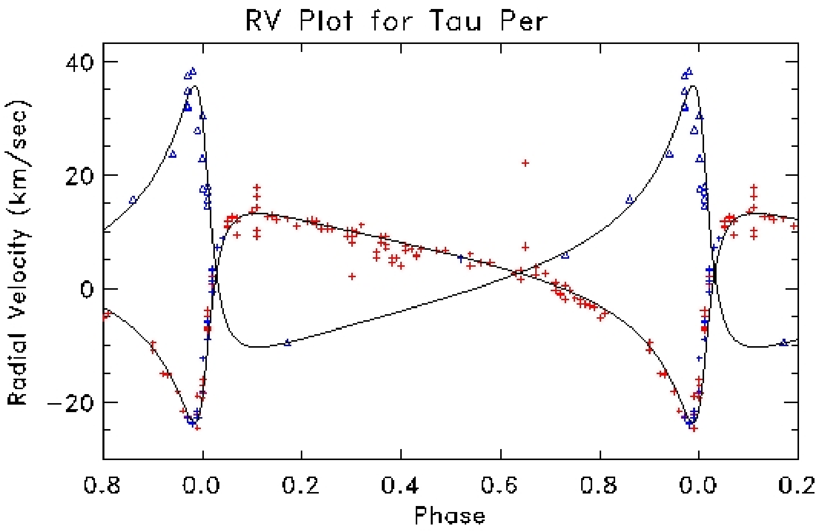
- USNO targets:
  - WDS binaries (26 observed)
  - Multiplicity survey (10 observed)
  - Other binaries (2 observed)

- F-star survey (2 observed)
- Stellar diameter (1 observed)
- Be star (1 observed)

Brian Mason

τ Per

- A rare η Aur-type binary
- During eclipse, we can see the chromosphere
- G8 III + A7 V
- a = 55 mas, P = 4.15 yr
- Eclipsed in 2018 but clouded out
- Try again in 2022



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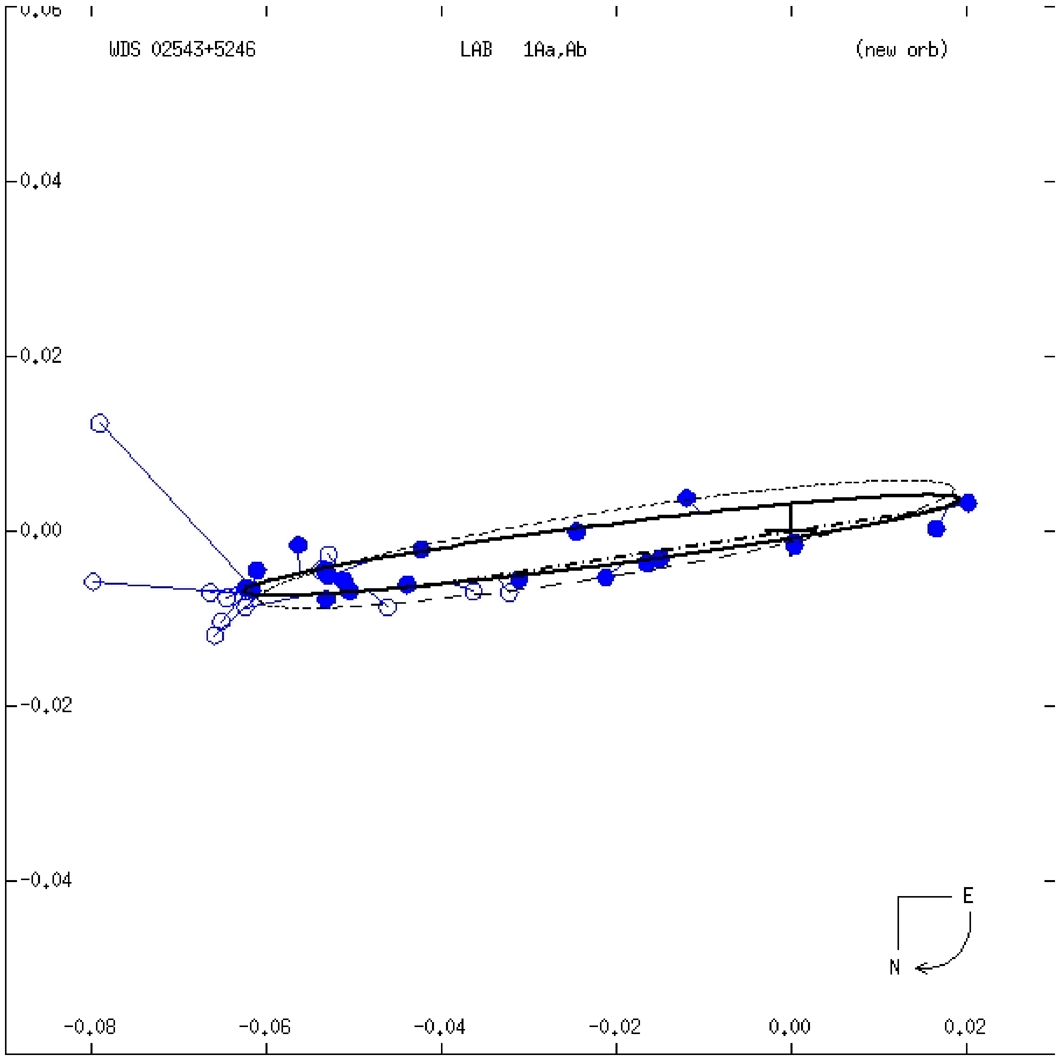


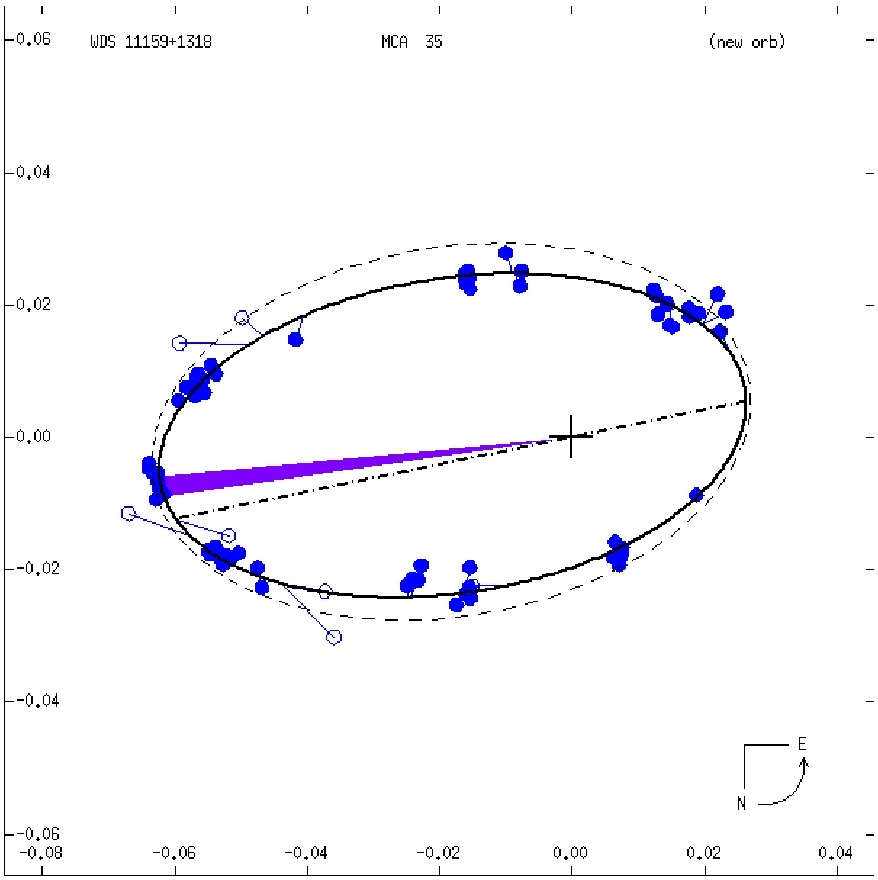
Open circles: speckle

Closed circles: NPOI

Brian Mason

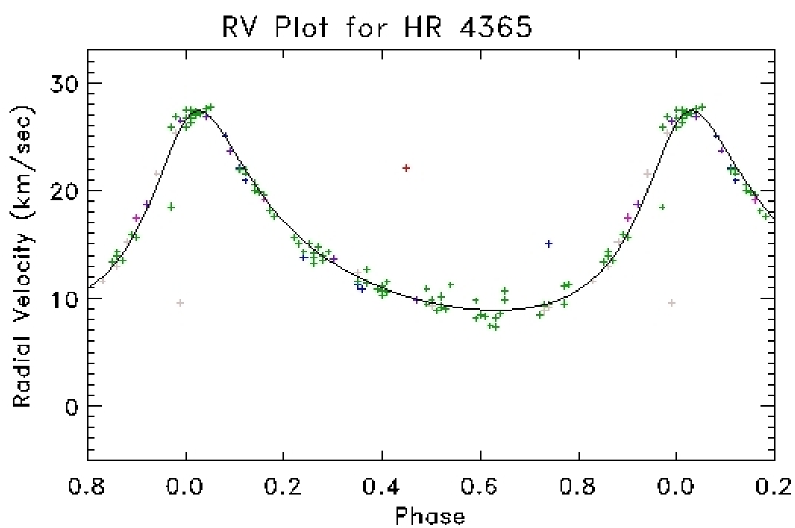
73 Leo

- Cool giant + hot dwarf



Open circles/dashed orbit: speckle

Closed circles/solid orbit: NPOI



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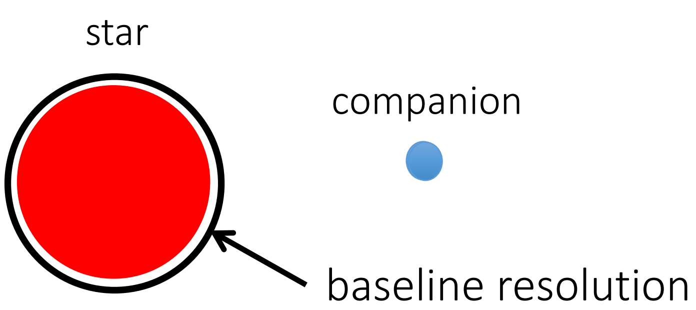
- 2018 observing – binaries (NPOI)
- Phase nulling (NPOI)

Henrique Schmitt

Phase Nulling



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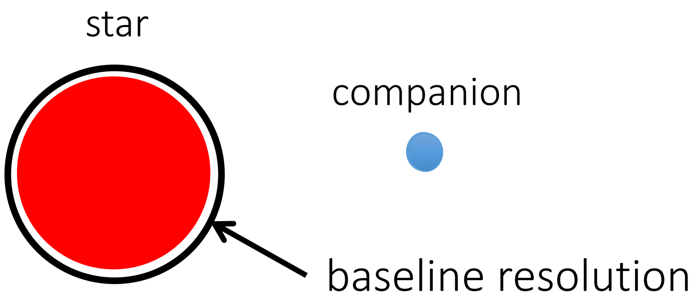
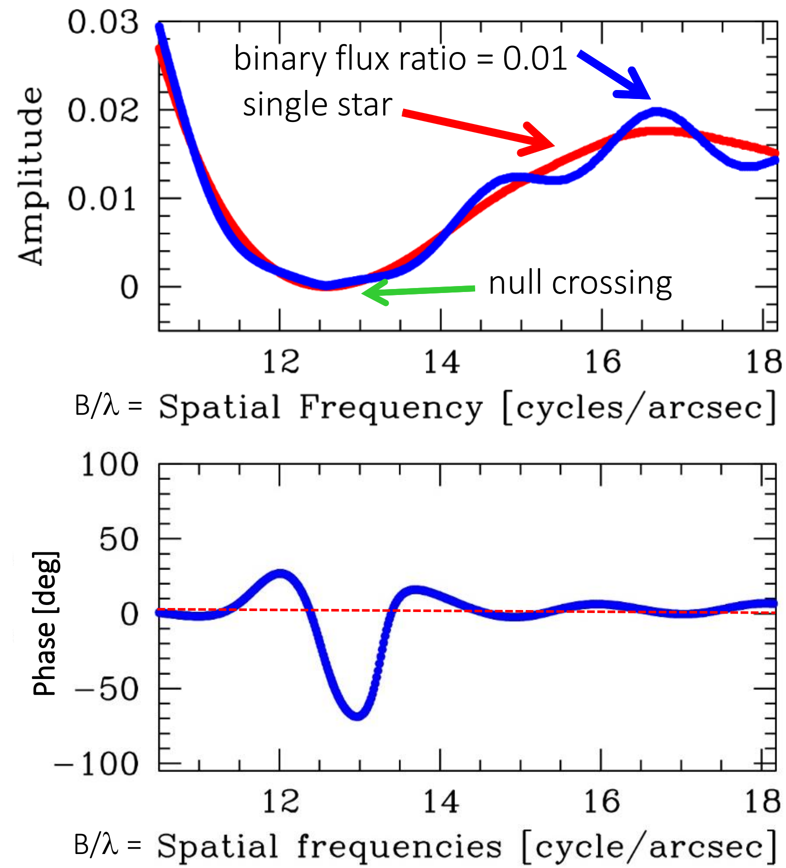
Phase Nulling



- Observe targets around the null crossing
- Contrast of the companion much lower around the null →phase signal much larger



Zhao et al. (2010)
Schmitt et al. (2017)

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η Aql

- F6 I (Cepheid) + B9.8 V
- *P* = 7.17 d, *a* = 660 mas secondary
- Close in tertiary

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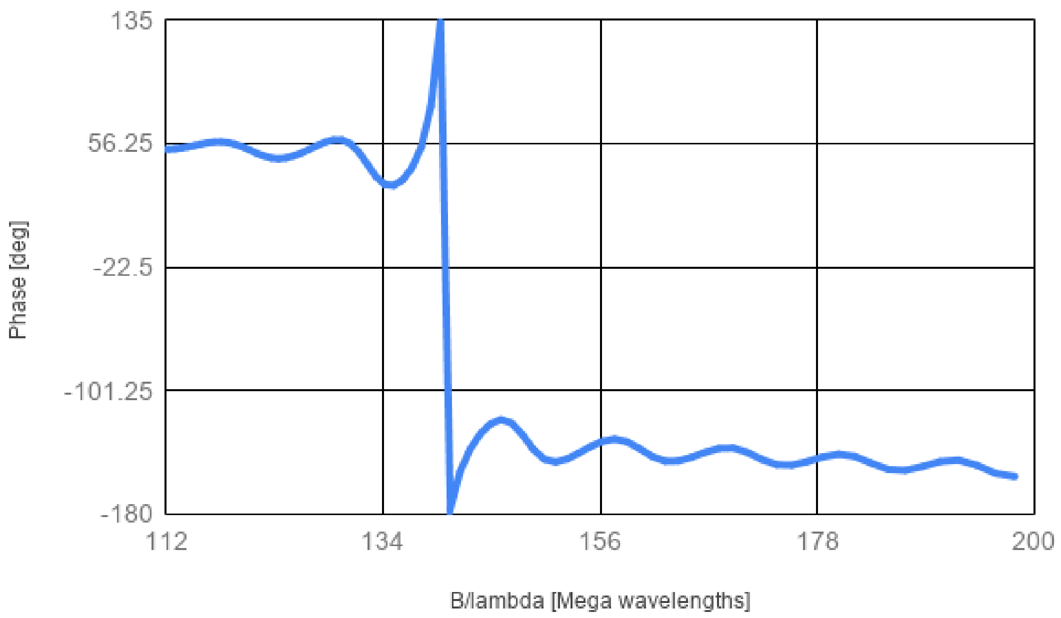

Phase oscillations for a Δm=5 mag binary observed with a baseline that resolved the primary.

For a single star, the jump would be a clean 180°

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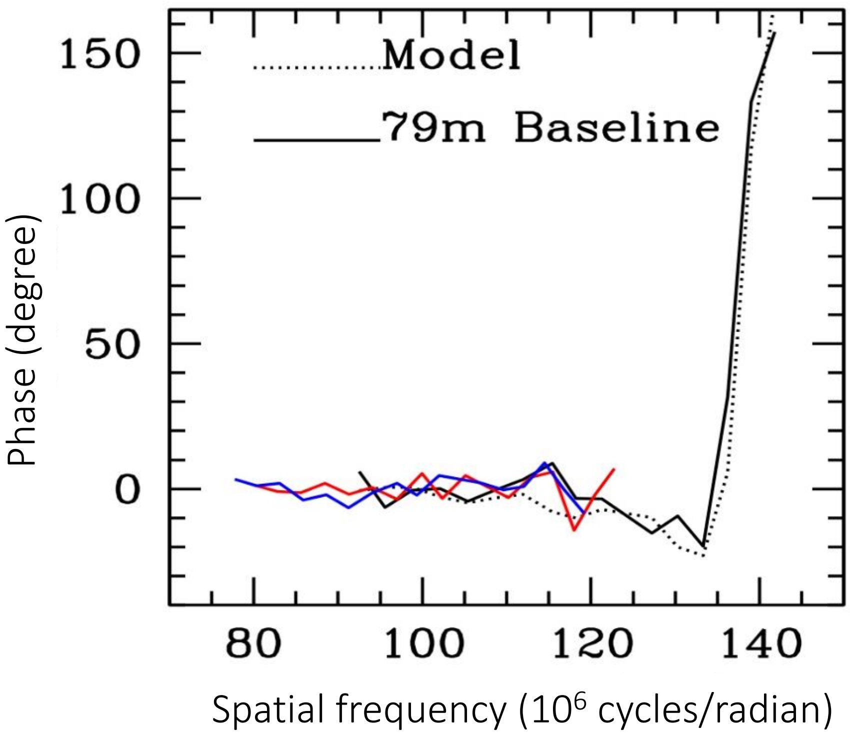

NPOI fringe phases obtained with a 79 m baseline.

Solid lines: 3 different scans, obtained with the target in 3 different positions in the sky.

Dotted line: model consisting of a primary star with a diameters of 1.8 mas and a Δm = 5 mag companion (1:100 flux ratio) separated by 18 mas (Schmitt et al. 2018).

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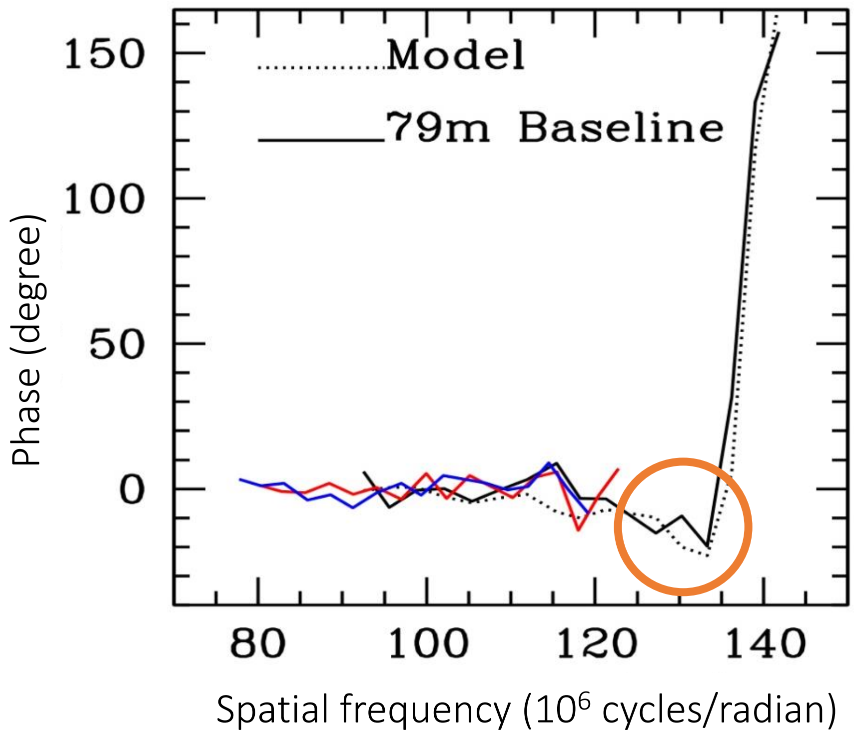

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The problem with giants

- Red giant stars lie in a crowded, complicated part of the H-R diagram
- Determining evolutionary state difficult from spectra because it's indirect and model-dependent
- When trying to find exoplanets around giant stars, this all gets worse
- Orbital properties and minimum mass are based on the host star's mass, so errors compound
- The stars are also variable
- Adds up to something of a mess

Niedsielski et al. 2016 A&A, 585, 73

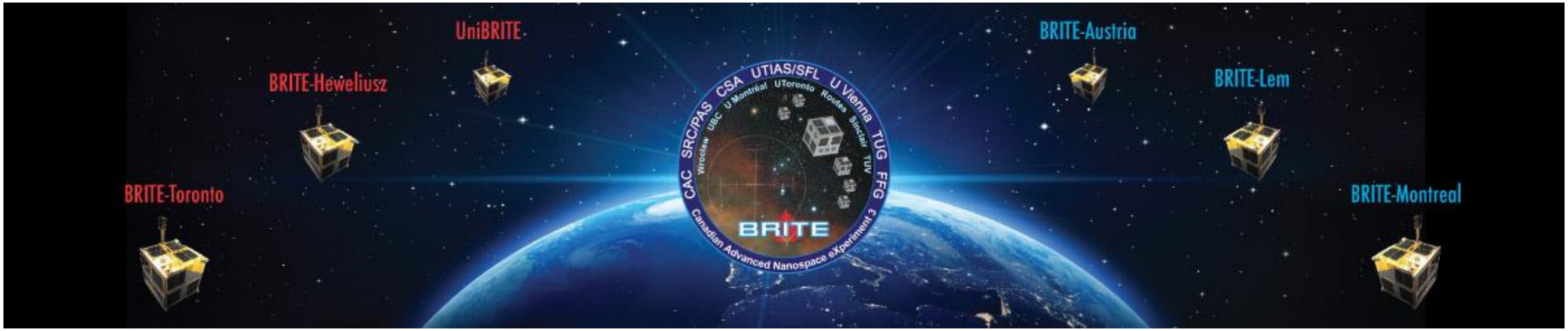
PTPS Stars

- Penn State – Toruń Centre for Astronomy Planet Search (PTPS)
- Used the 9.2-m Hobby-Eberly Telescope to get spectra of 455 stars
- Target evolved stars to find and study evolved planetary systems
- Masses 0.5 $M_\odot$ to 3.2 $M_\odot$
- Radii 0.7 $R_\odot$ to 36 $R_\odot$ (mostly 2-4 $R_\odot$)
- Confirmed the apparent increase of companion masses for evolved stars and lack of close companions

Pawel Zielinksi, Martin Vanko, Ernst Paunzen, Jan Janik

PTPS + BRITE

- BRITE-Constellation satellites:
  - 5 nanosatellites to study structure and evolution of bright stars and their interaction with the local environment
  - 2 color photometry: red and blue
  - Low-Earth orbit



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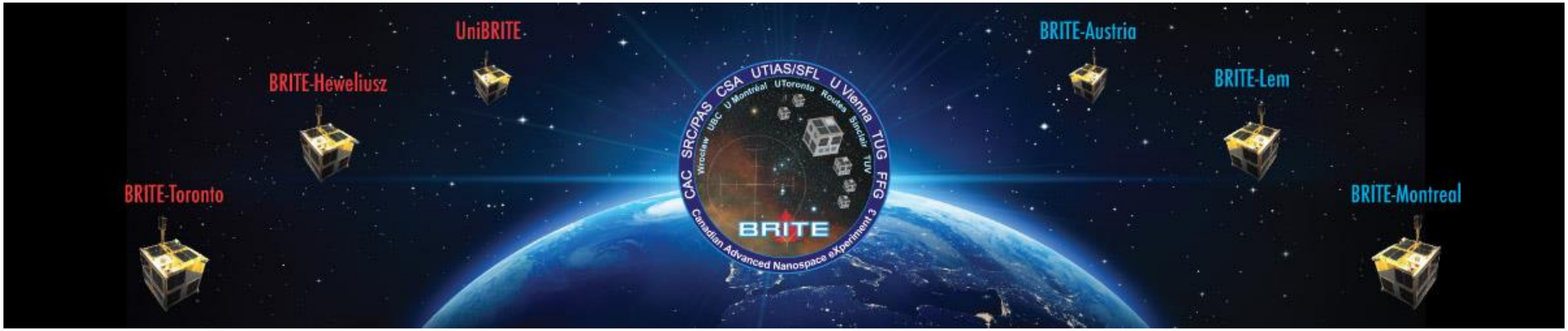

- Study 39 PTPS red giants' short- and long-term variability

Pawel Zielinksi, Martin Vanko, Ernst Paunzen, Jan Janik

PTPS + BRITE

- Use BRITE-Constellation satellites to study 39 PTPS red giants' short- and long-term variability
- Four main science goals:
  - Search for and characterize transiting planets, obtain physical and orbital properties
  - Long-term study of red giant variability associated with stellar rotation and/or another stellar- or substellar-mass companion in a binary system
  - Analyze stellar activity and inhomogeneities (e.g., starspots) and their impact on RV variability that could mimic an exoplanet
  - Calibrate empirical scaling relations with directly measured interferometric diameters

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- If only we had an interferometer!

PTPS + BRITE

- 4 nights on CHARA in Sept 2018 (NOAO)

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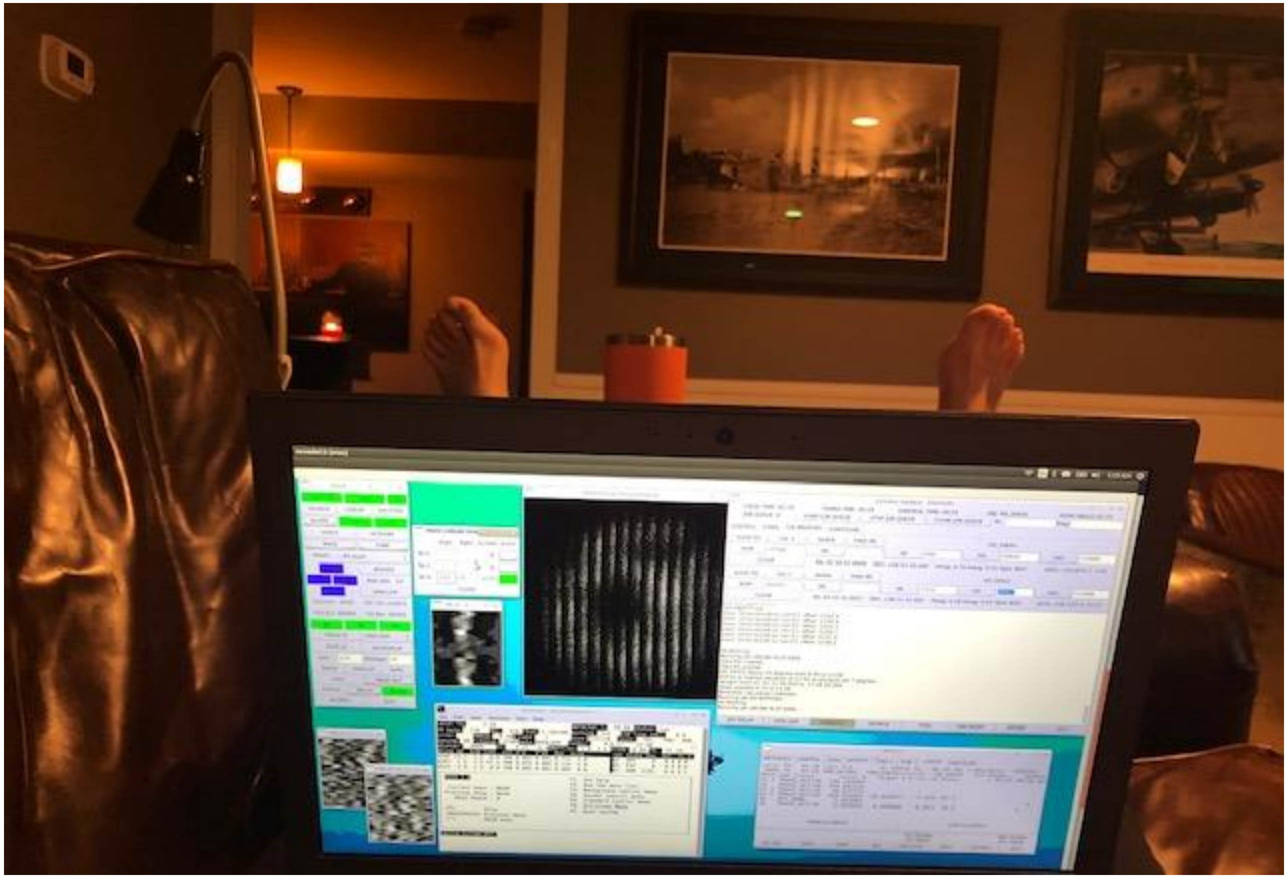

PTPS + BRITE

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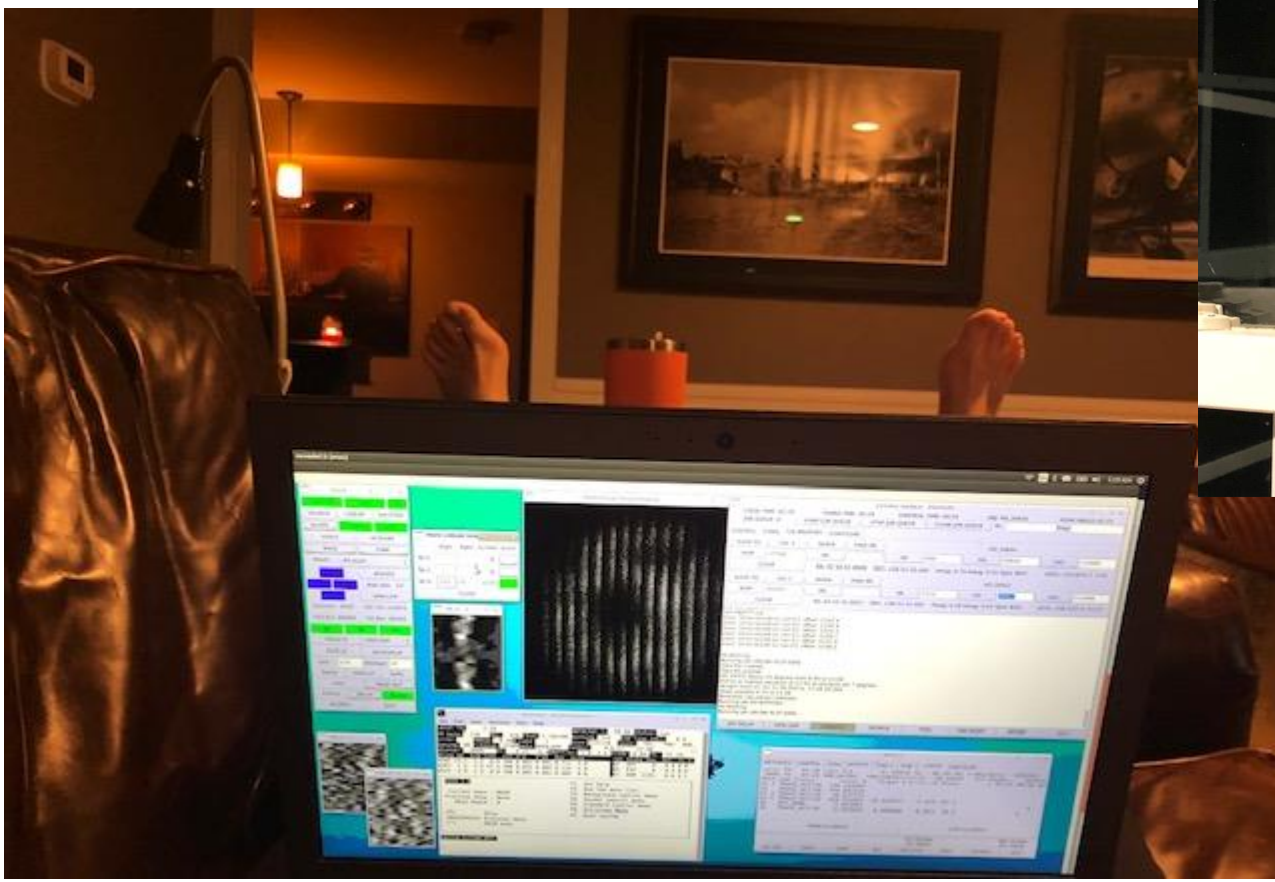
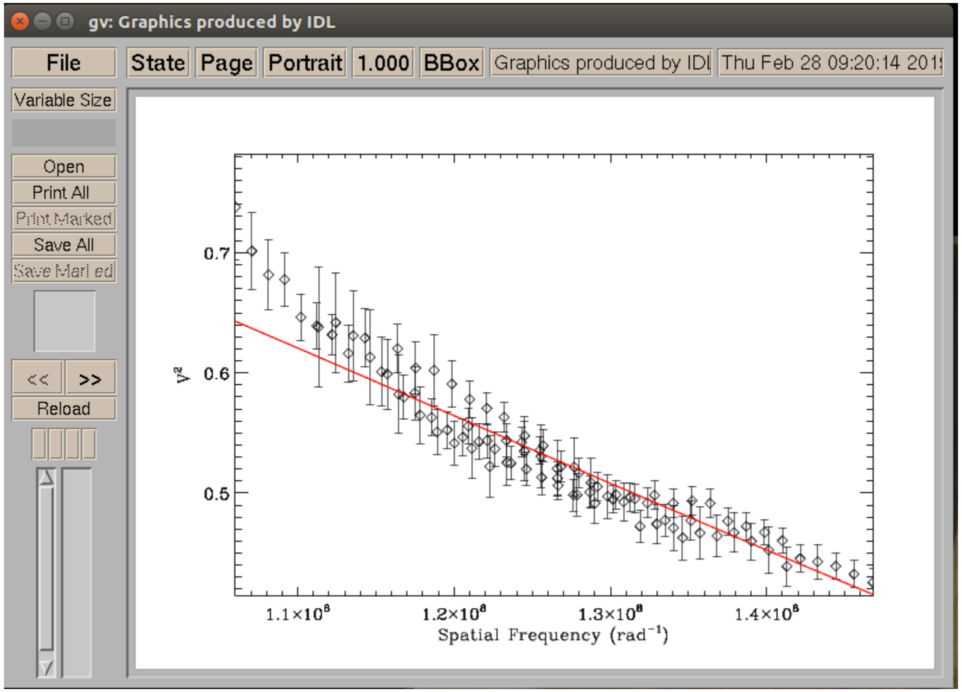


CHARA Results

- 11 stars observed with PAVO
- Some already had Classic data, too
- Brings total of PTPS stars observed to 32 (23 CHARA, 8 NPOI, 1 both)



Diameter fit,

HD 196755

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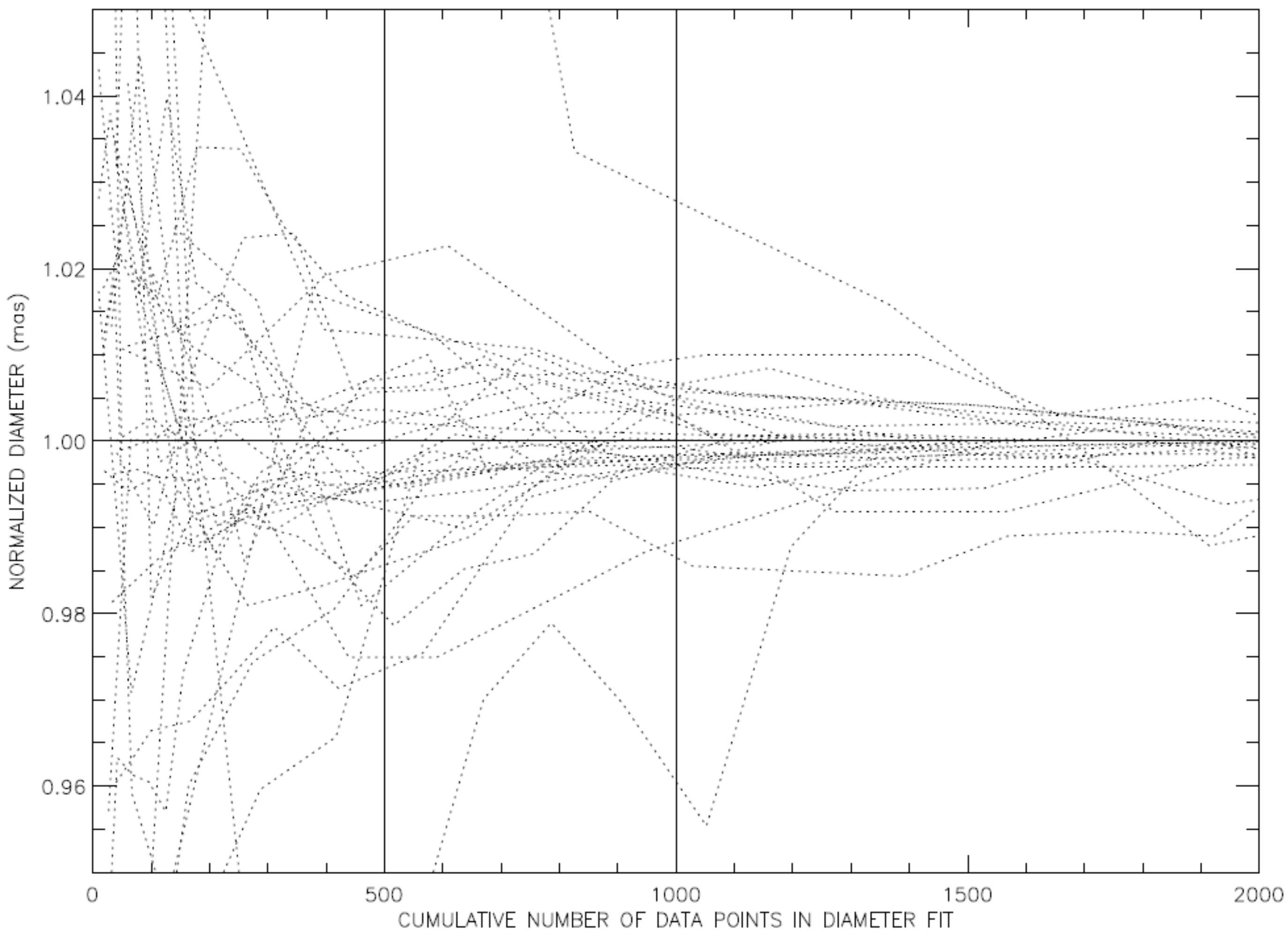
Last Minute NPOI Thing

- Consider the archive
- For a given star, calculate the diameter based on an ever-increasing number of data points

Date	# pts	θ	err	Σ # pts
2012 May 11	29	2.137	0.052	29
2007 Sep 27	37	2.145	0.040	66
2012 May 17	39	2.202	0.037	105
2005 Aug 28	40	2.171	0.029	145
2005 Sep 17	40	2.170	0.015	185
2012 May 20	40	2.167	0.016	225
2005 Sep 12	42	2.166	0.011	267
2005 Sep 13	49	2.144	0.013	316
2004 Aug 26	50	2.149	0.014	366
2012 Apr 19	56	2.145	0.014	422
2005 Jul 29	60	2.146	0.013	482
2005 Aug 26	60	2.135	0.012	542
2004 Aug 23	65	2.141	0.013	607
2005 Aug 21	79	2.140	0.012	686
2012 Apr 22	84	2.136	0.011	770
2005 Sep 15	100	2.138	0.010	870
2012 May 4	151	2.130	0.009	1021
2005 Aug 18	178	2.131	0.008	1199
2005 Sep 14	180	2.124	0.008	1379
2012 May 13	229	2.123	0.007	1608
2005 Aug 25	240	2.123	0.007	1848
2012 Apr 21	246	2.122	0.006	2094
2012 May 7	272	2.121	0.006	2366
2012 Apr 29	376	2.121	0.006	2742
2012 May 6	470	2.123	0.006	3212
2012 May 15	565	2.123	0.005	3777

Last Minute NPOI Thing



Last Minute NPOI Thing