

LI-RICH GIANTS WITH COMPANIONS

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LI-RICH GIANTS WITH COMPANIONS

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LI-RICH GIANTS WITH COMPANIONS

PLAN

1. PENNSTATE-TORUŃ PLANET SEARCH (PTPS)
2. OUR PLANETS
3. LI-RICH GIANTS IN PTPS (WITH AND WITHOUT COMPANIONS)
4. SUMMARY

PennState-Toruń Planet Search

RV search for planets around evolved stars.

Instrument: Hobby-Eberly Telescope (HET) and HRS ($R=60.000$),

Technique: I2 cell

Aim: planet detection and characterisation

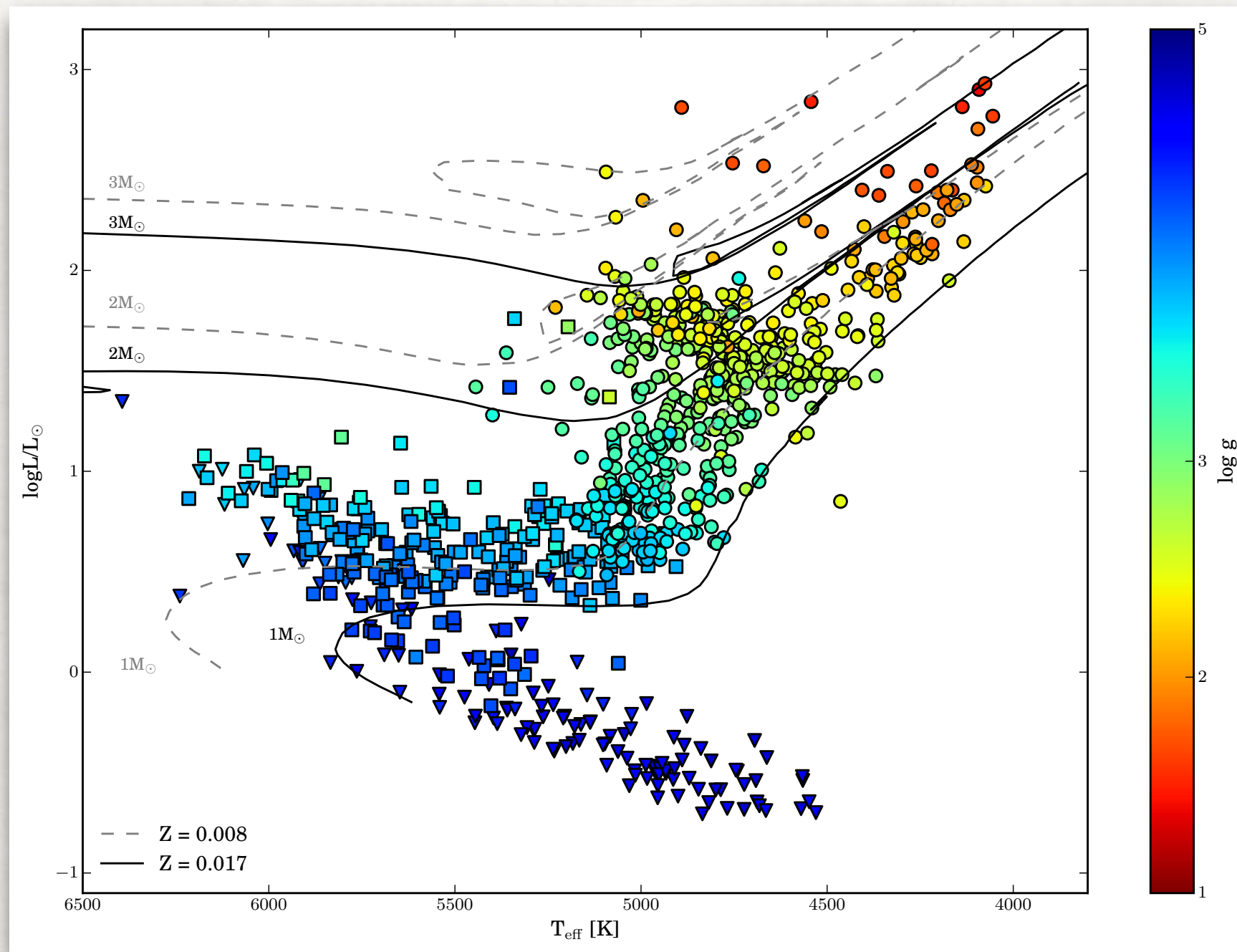
star-planet interactions

statistical analysis based on own uniform sample

Extention:

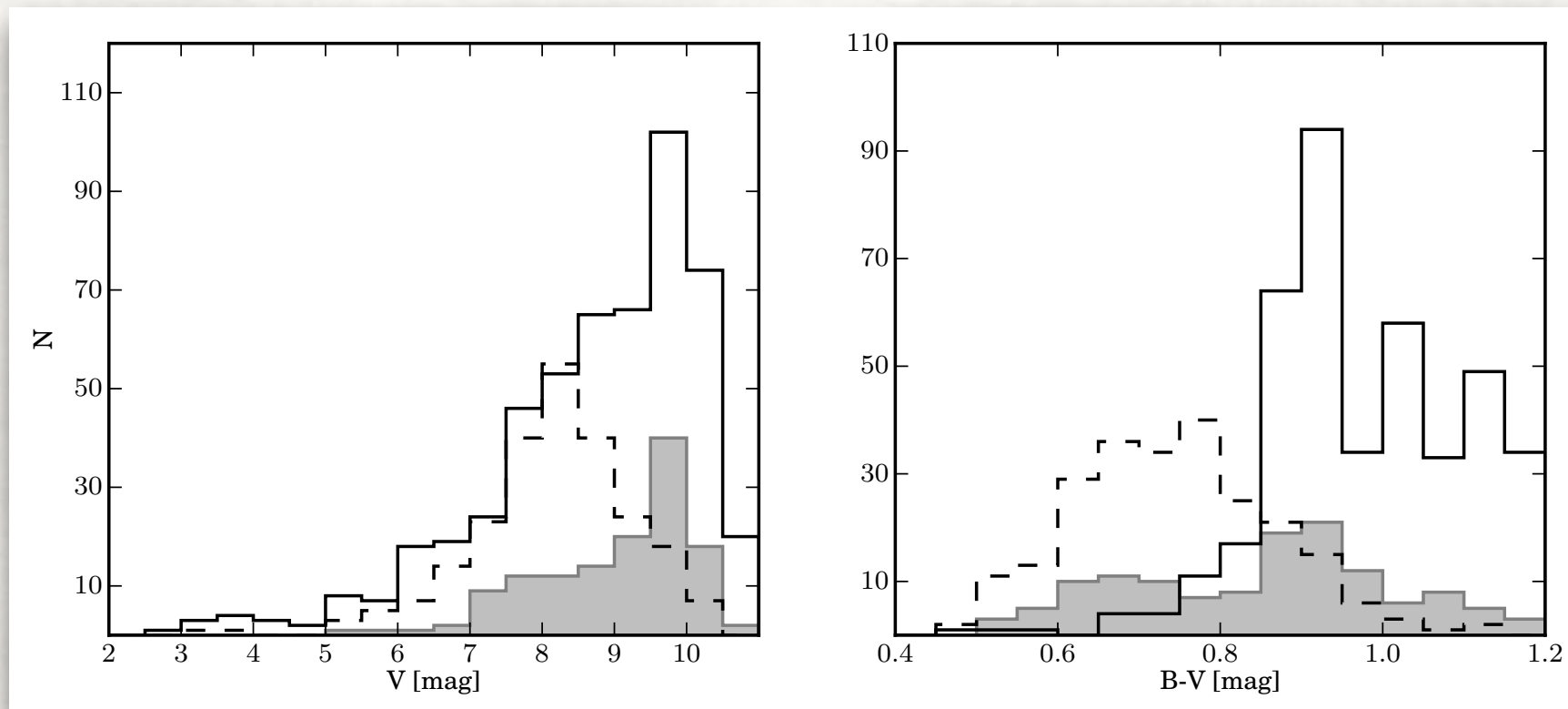
TAPAS - Tracking **Ad**vanced **Pl**Anetary **S**ystems with HARPS-N

PennState-Toruń Planet Search



Sample: 547 giants, 246 subgiants, 132 dwarfs

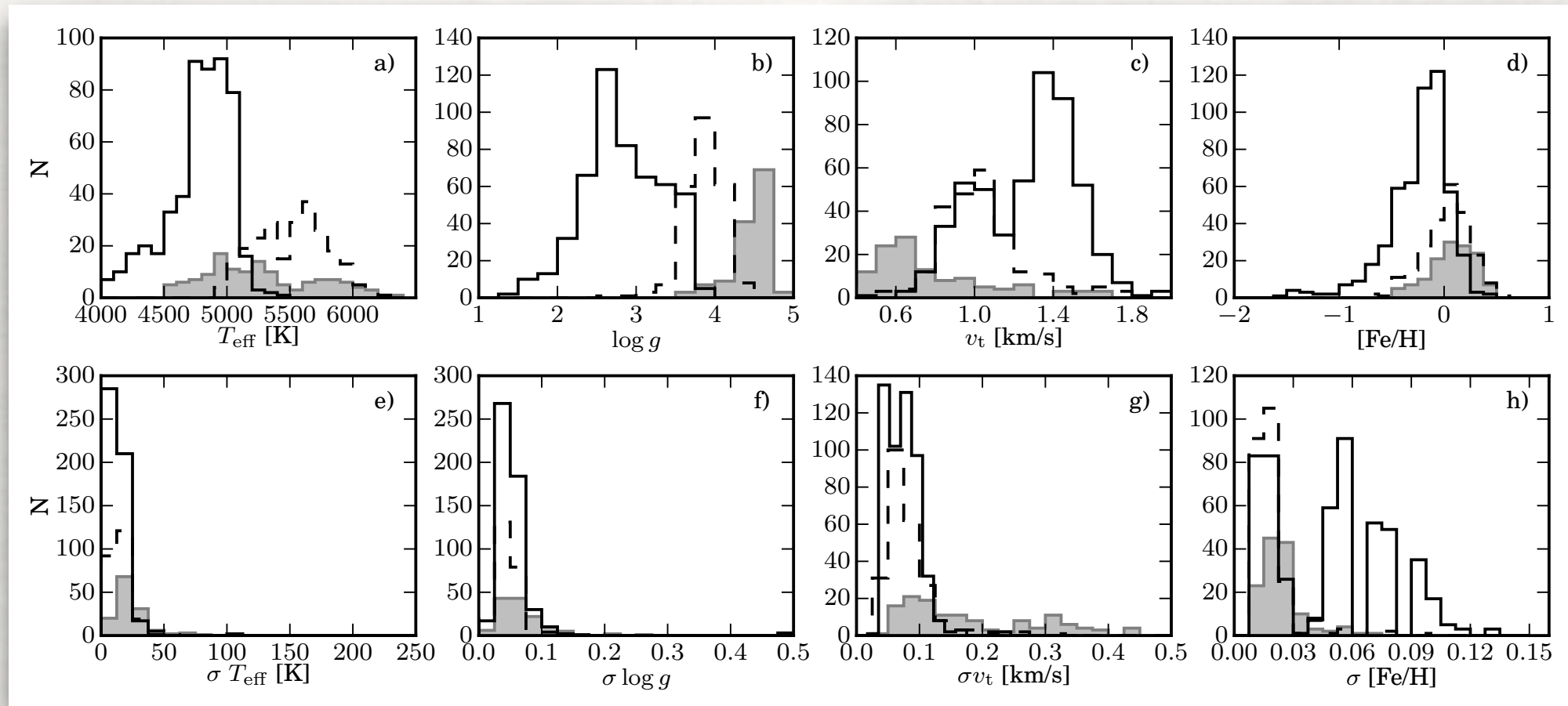
PennState-Toruń Planet Search



Sample: uniformly distributed bright northern hemisphere targets

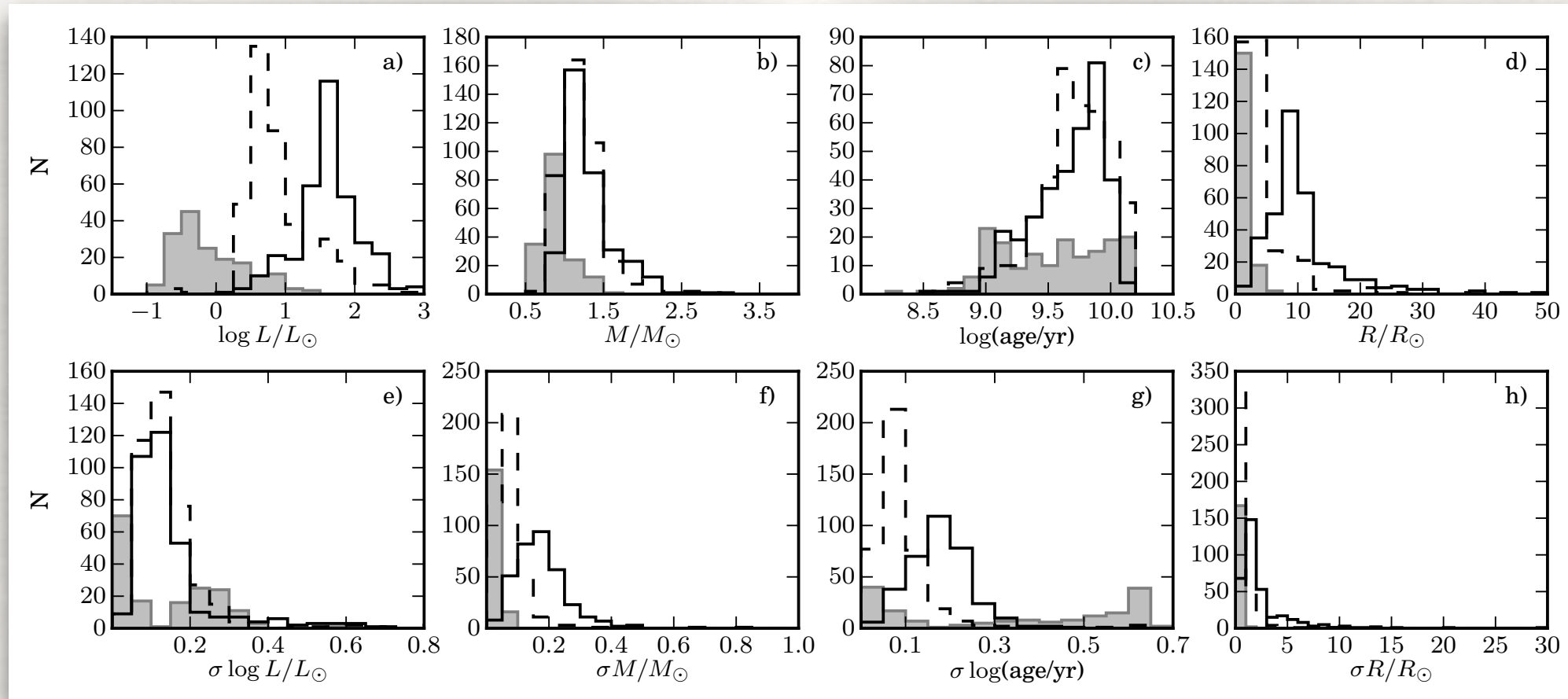
Zieliński et al (2012), Niedzielski et al. (2016), Adamczyk et al. (2016), Deka-Szymankiewicz et al. (in prep.)

PennState-Toruń Planet Search



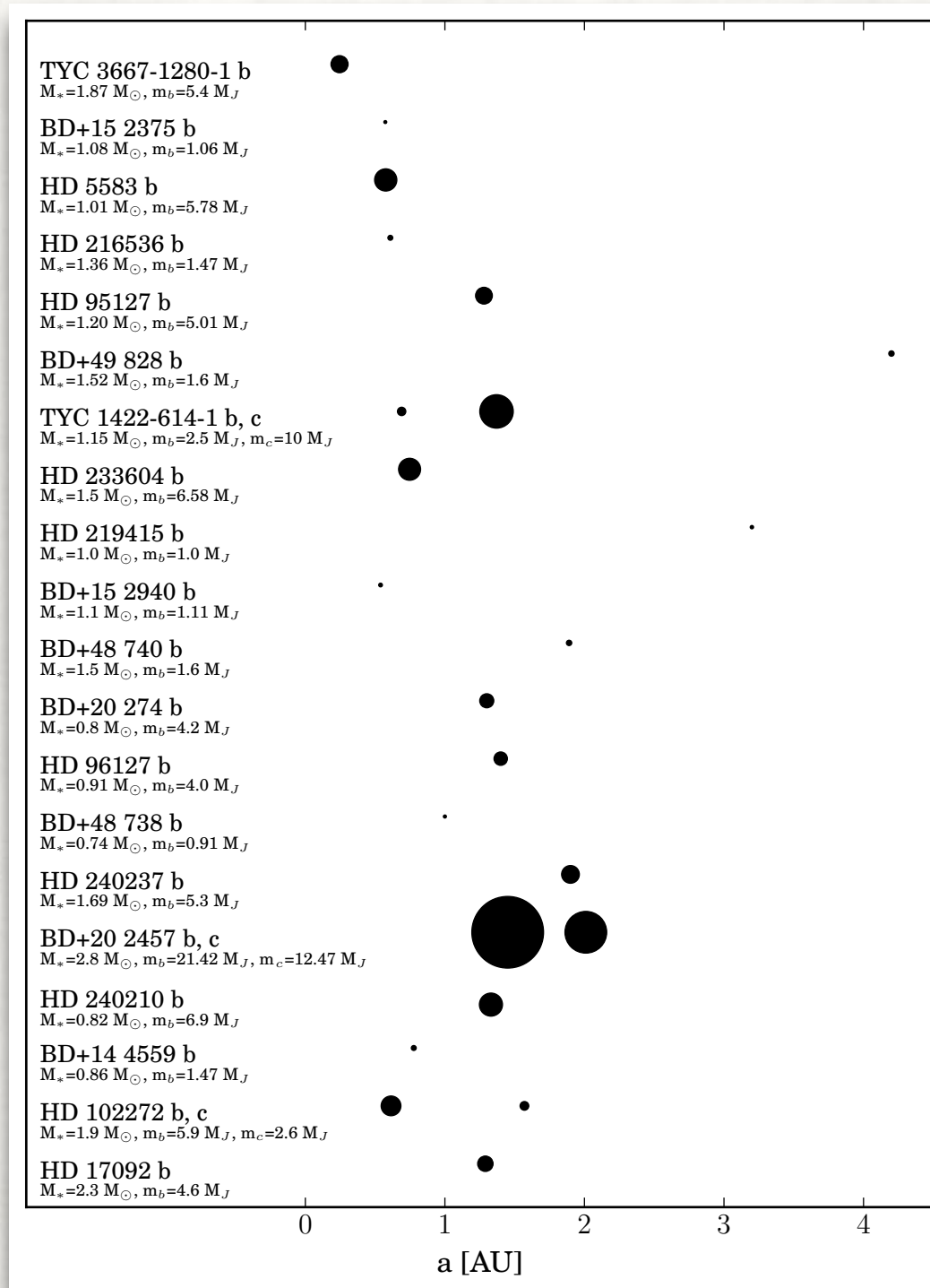
Sample: 3 subsamples with well constrained stellar parameters

PennState-Toruń Planet Search



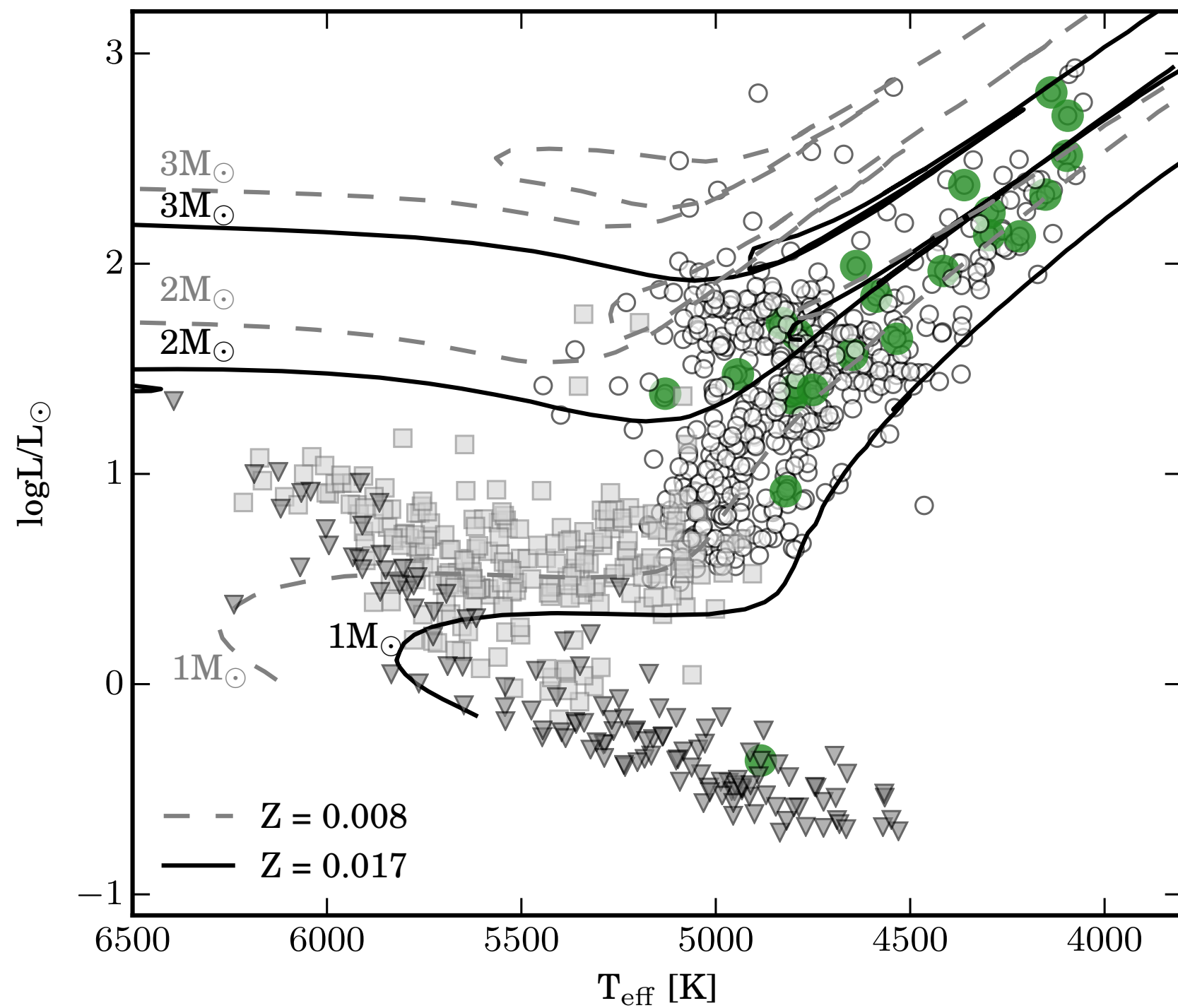
Sample: 3 subsamples with well constrained stellar parameters

PennState-Toruń Planet Search planets



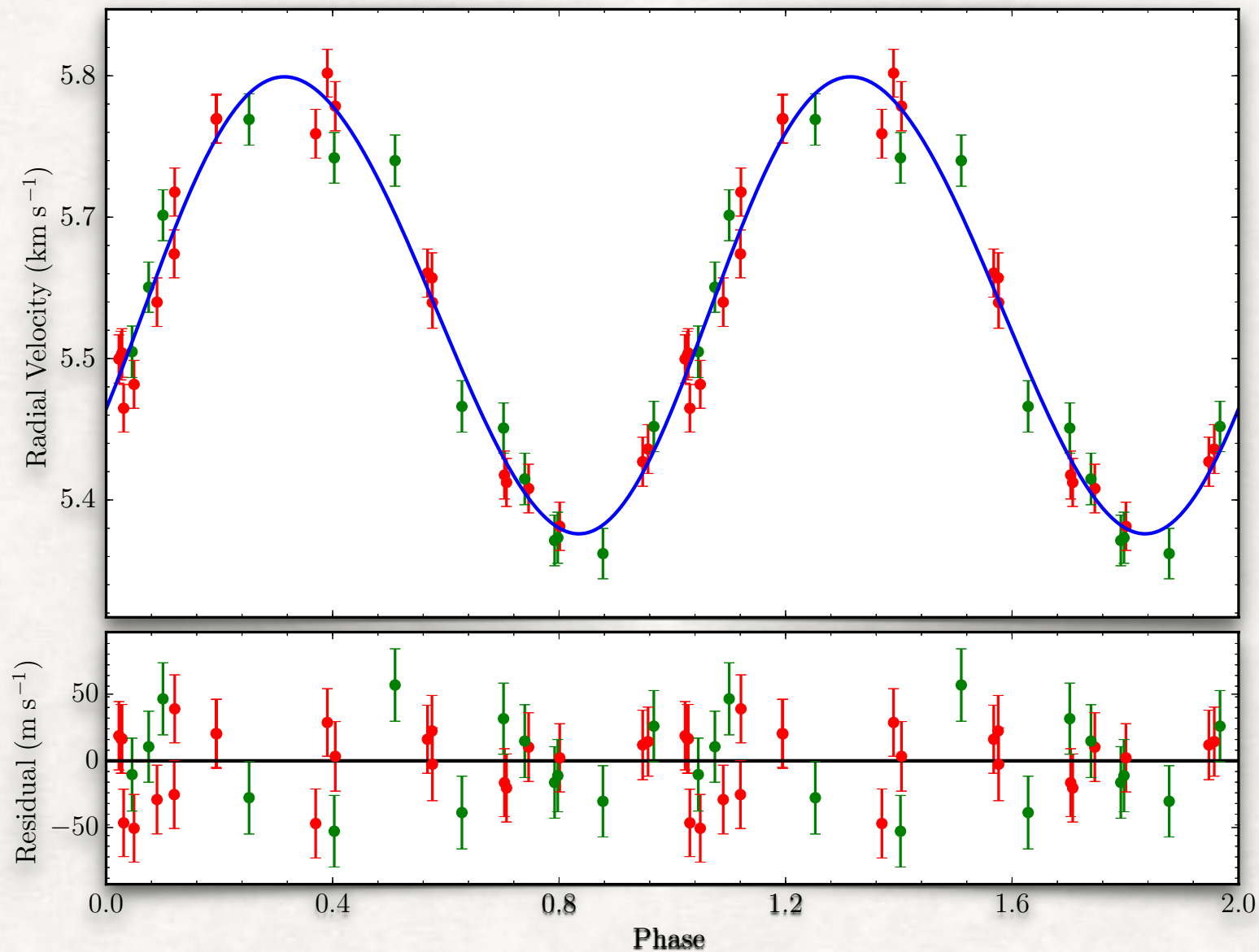
20 planetary systems with 23 planets

PennState-Toruń Planet Search planets



20 planetary systems with 23 planets

PennState-Toruń Planet Search planets

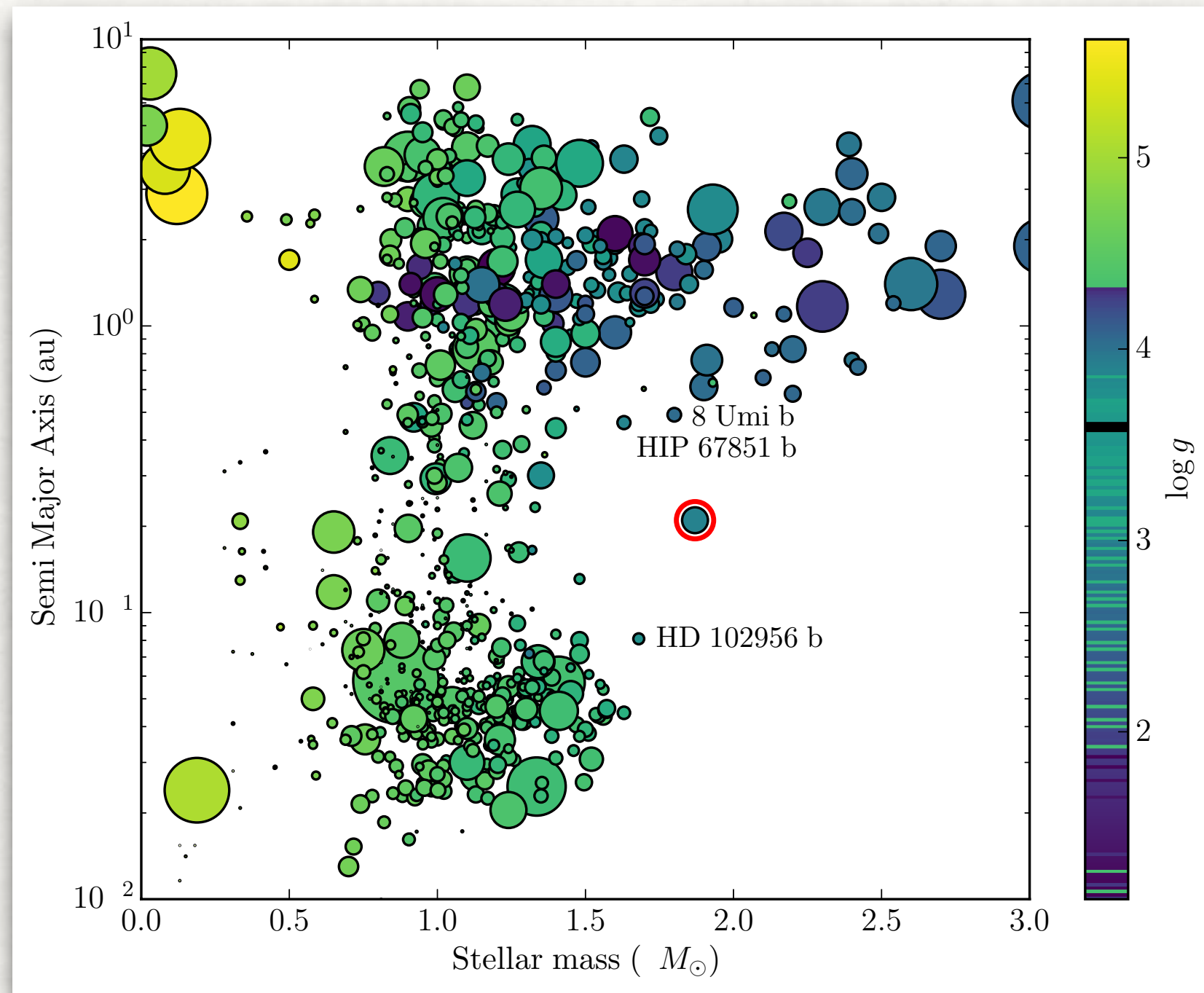


TYC 3667-1280-1b - Niedzielski, Villaver et al (2016) - TAPAS IV

$M_{\star}/M_{\odot}=1.87\pm0.17$, $R_{\star}/R_{\odot}=6.26\pm0.86$, $\log g=3.11\pm0.09$, $[\text{Fe}/\text{H}]=-0.08\pm0.05$

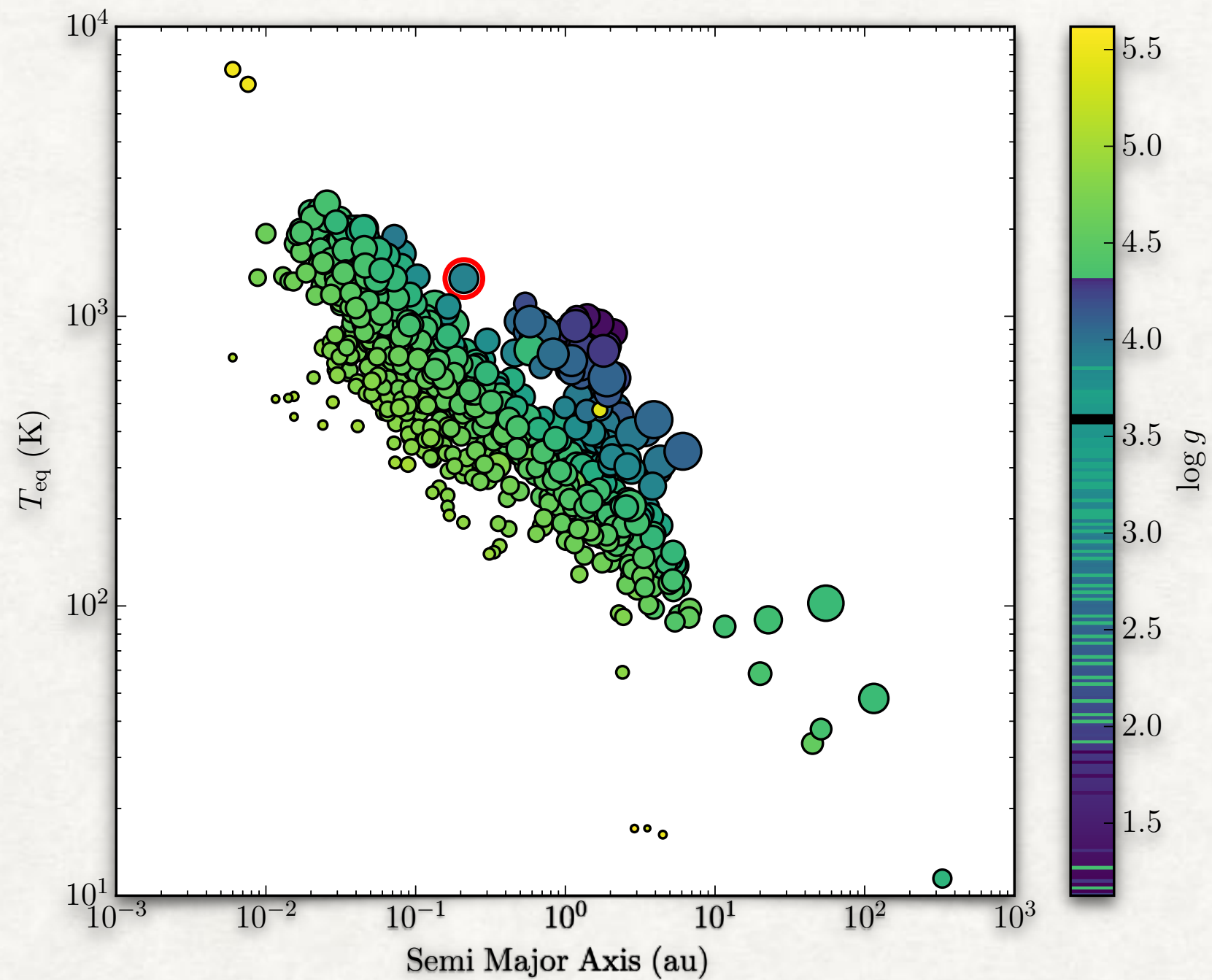
$P=26.468\pm0.005$ d, $m_p \sin i=5.4\pm0.4$ m_J, $a=0.21\pm0.01$ au, $e=0.036\pm0.04$

PennState-Toruń Planet Search planets



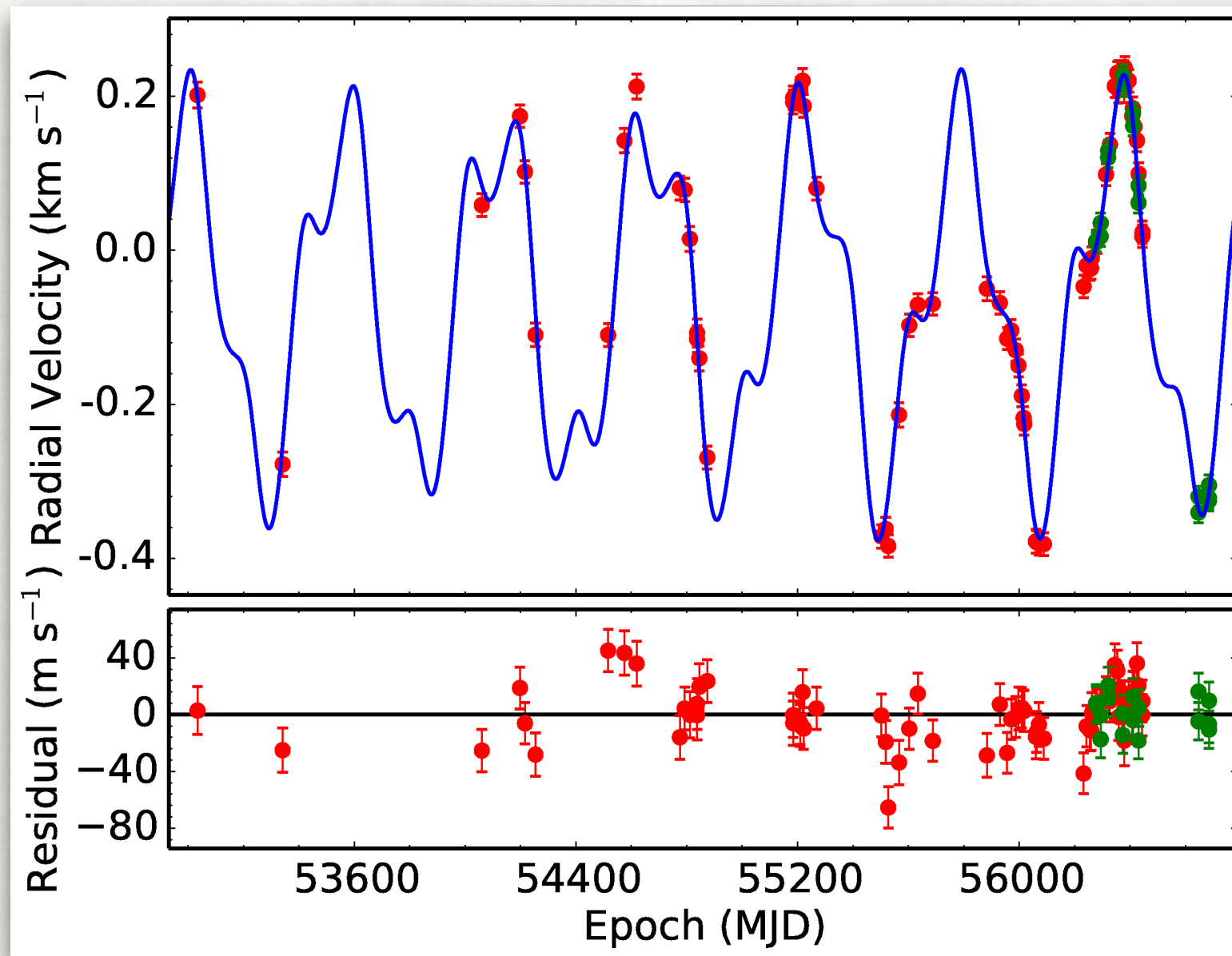
TYC 3667-1280-1b - Niedzielski, Villaver et al (2016)

PennState-Toruń Planet Search planets



TYC 3667-1280-1b - Niedzielski, Villaver et al (2016)

PennState-Toruń Planet Search planets



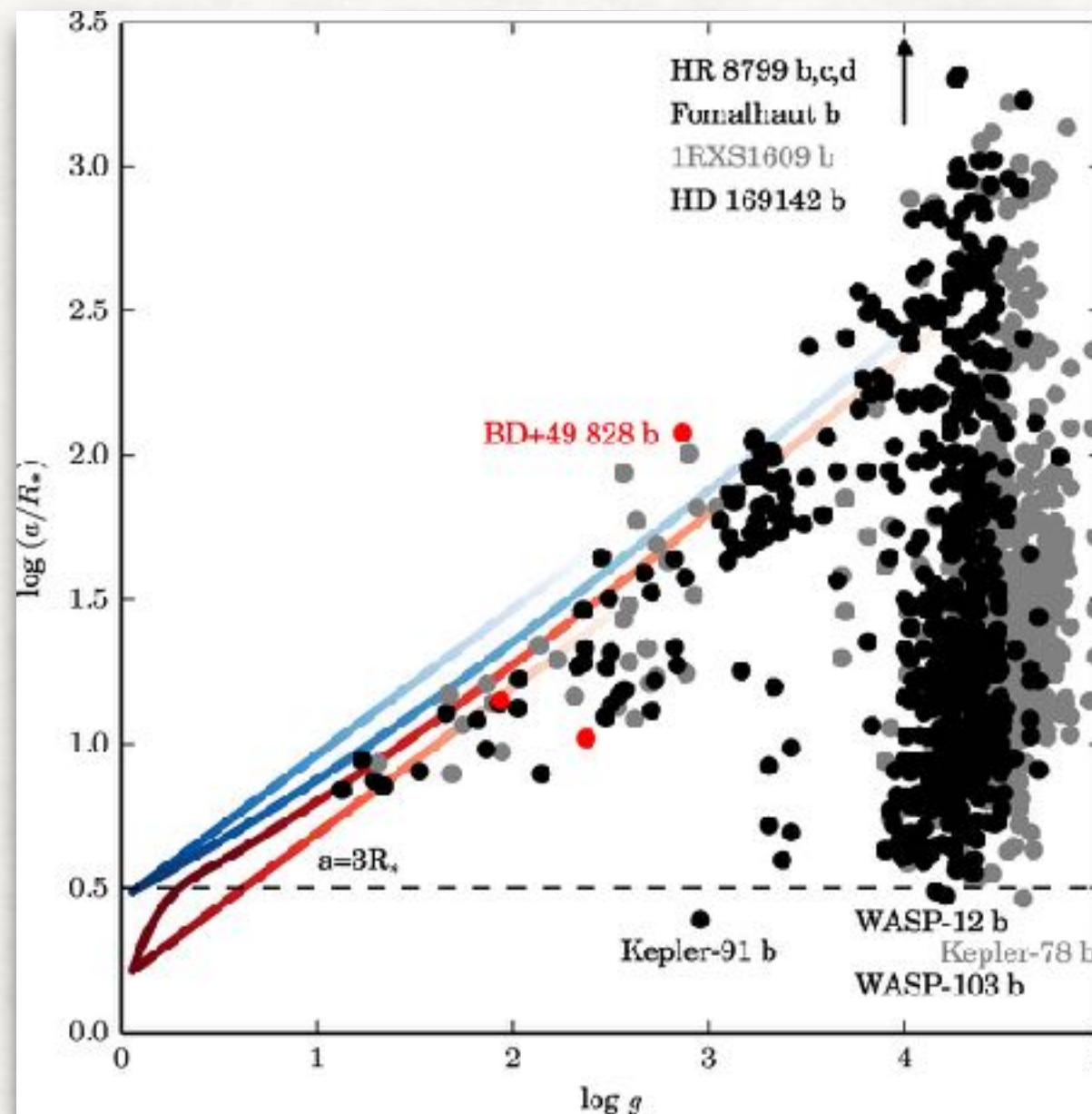
TYC 1422-614-1 b, c - Niedzielski, Villaver et al (2015) - TAPAS I

$M_{\star}/M_{\odot}=1.15\pm0.18$, $R_{\star}/R_{\odot}=6.85\pm1.38$, $\log g=2.85\pm0.18$, $[\text{Fe}/\text{H}]=-0.10\pm0.08$

$P_b=198.4\pm0.4$ d, $m_b \sin i=2.5\pm0.4$ m_J , $a_b=0.69\pm0.03$ au, $e_b=0.06\pm0.06$

$P_c=559.3\pm1.3$ d, $m_c \sin i=10\pm1$ m_J , $a_c=1.37\pm0.06$ au, $e_c=0.048\pm0.02$

PennState-Toruń Planet Search planets

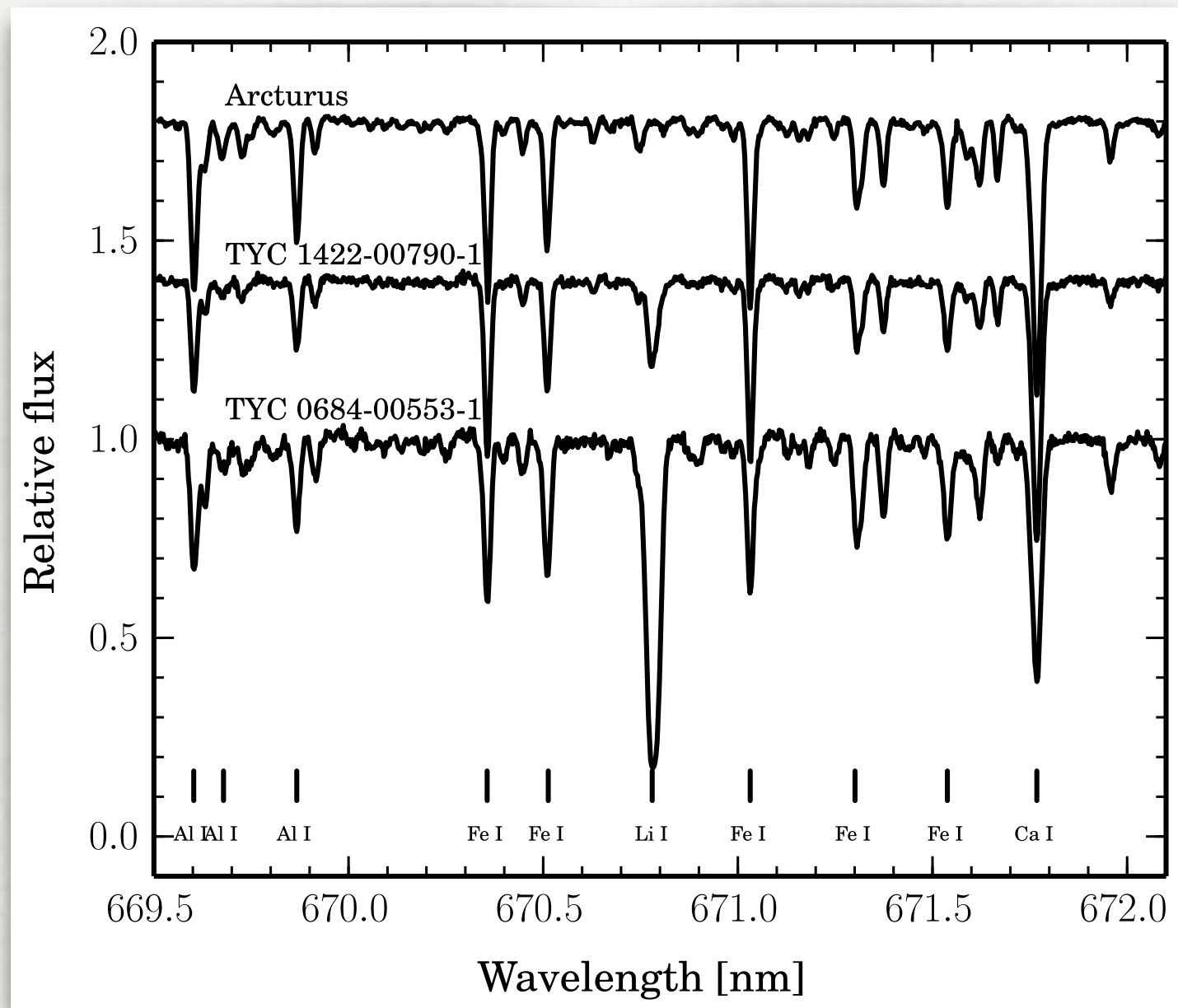


BD+49 828 b - Niedzielski, Wolszczan et al (2015)

$M_{\star}/M_{\odot}=1.52\pm0.22$, $R_{\star}/R_{\odot}=7.6\pm1.3$, $\log g=2.85\pm0.09$, $[\text{Fe}/\text{H}]=-0.19\pm0.06$

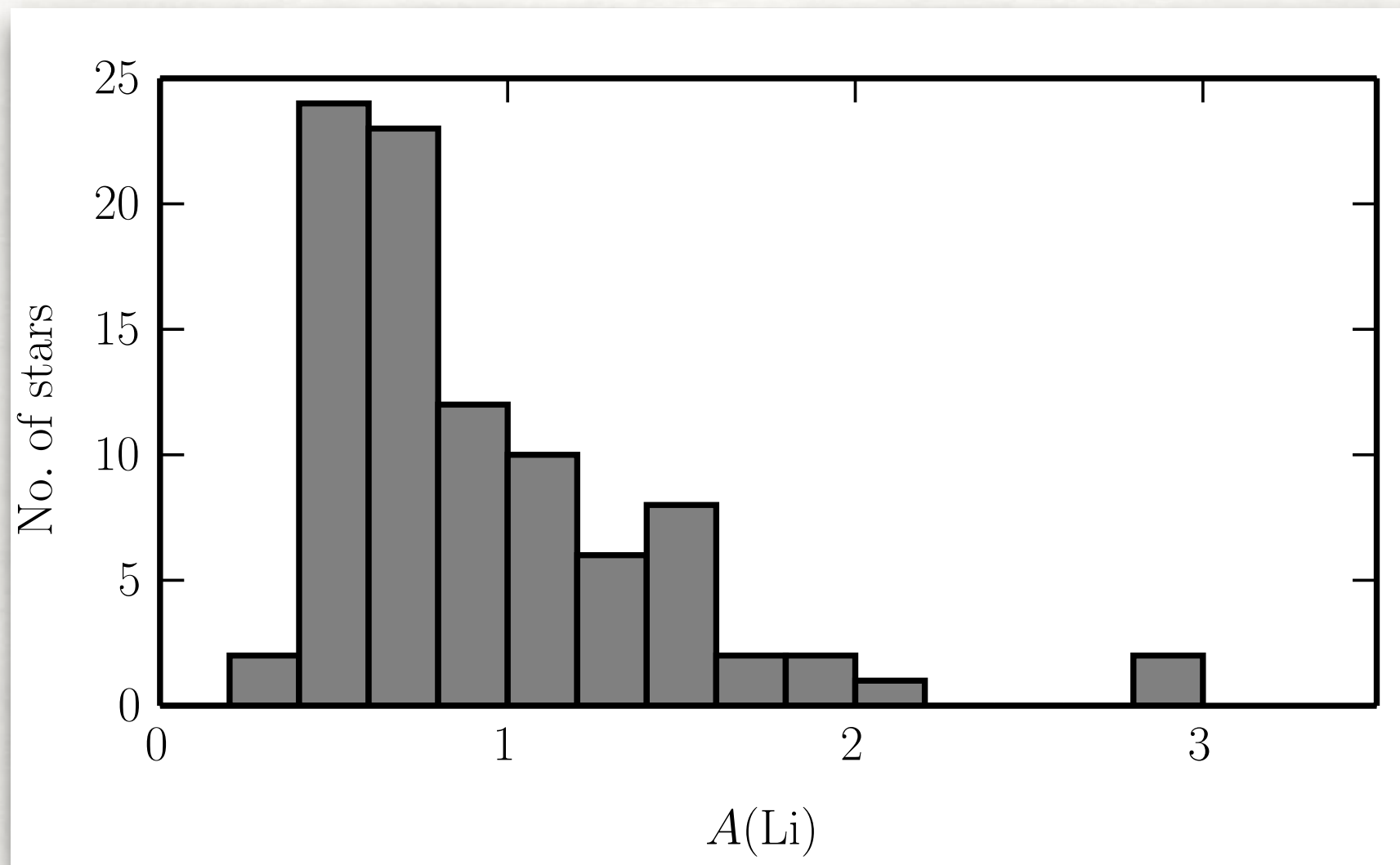
$P=2590\pm300$ d, $m_p \sin i=1.6\pm0.4 m_J$, **$a=4.2\pm0.3$ au**, $e=0.35\pm0.24$

Li-rich giants in PTPS



Adamów, Niedzielski et al (2014) - 82 giants with Li detected
11 with $A(\text{Li}) > 1.4$ (seven with $A(\text{Li}) > 1.5$).

Li-rich giants in PTPS



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Li-rich giants in PTPS

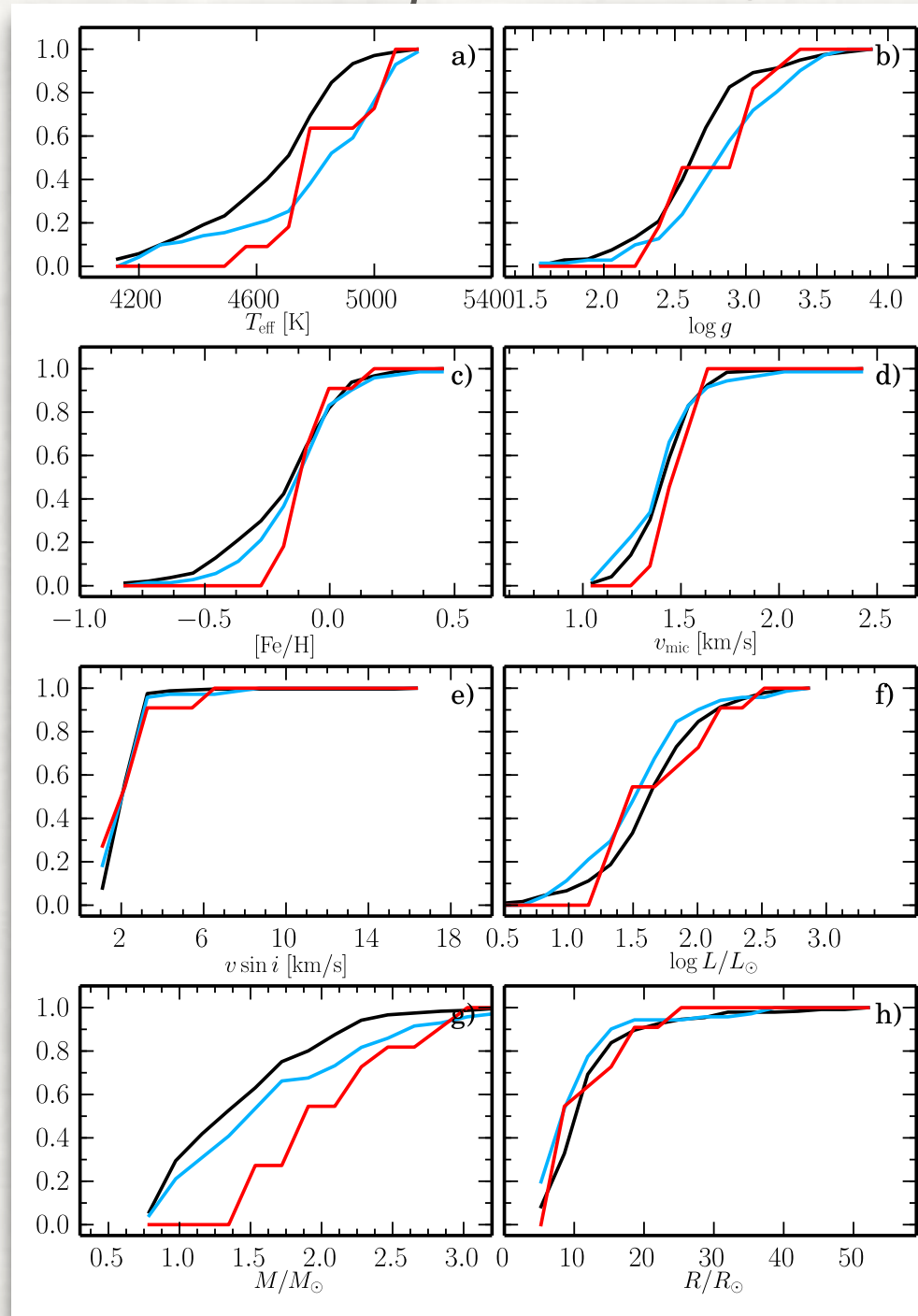


Fig. 9. Cumulative distributions of available stellar parameters. Color coding is the same as in Fig. 7.

Adamów, Niedzielski et al (2014)

Li-rich giants show normal stellar parameters

Li-rich giants in PTPS

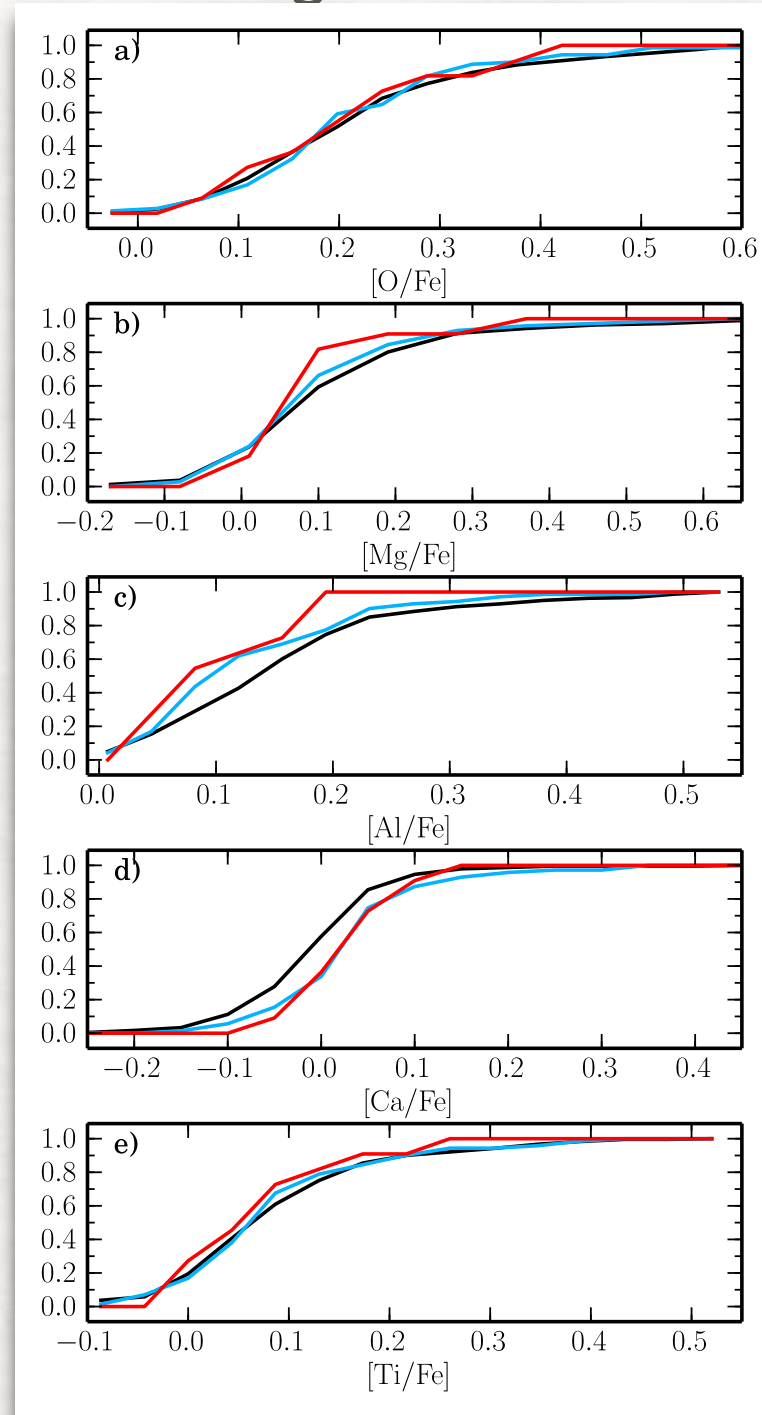
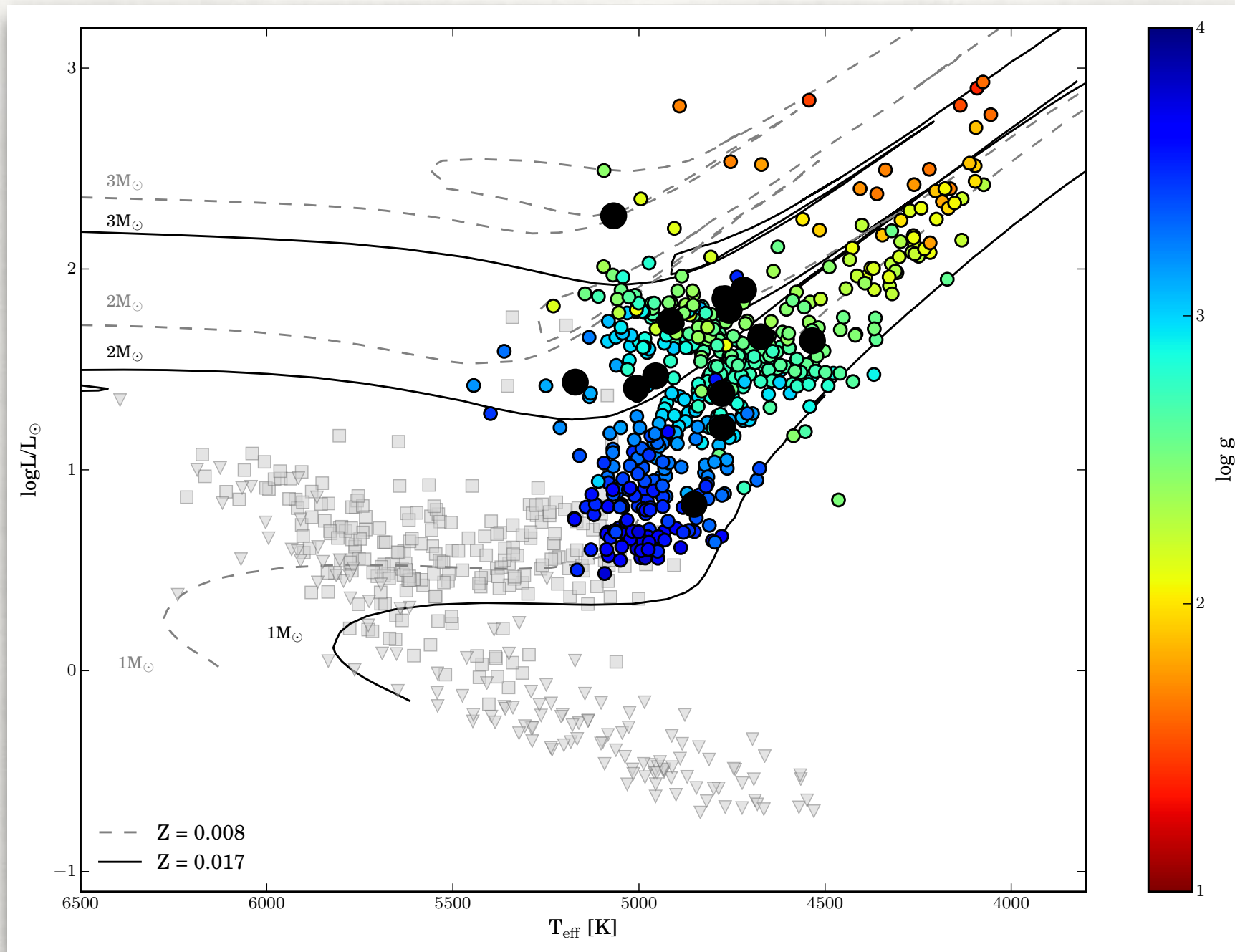


Fig. 11. Cumulative distributions of $[X/Fe]$ values. Color coding is the same as in Fig. 7.

Adamów, Niedzielski et al (2014)

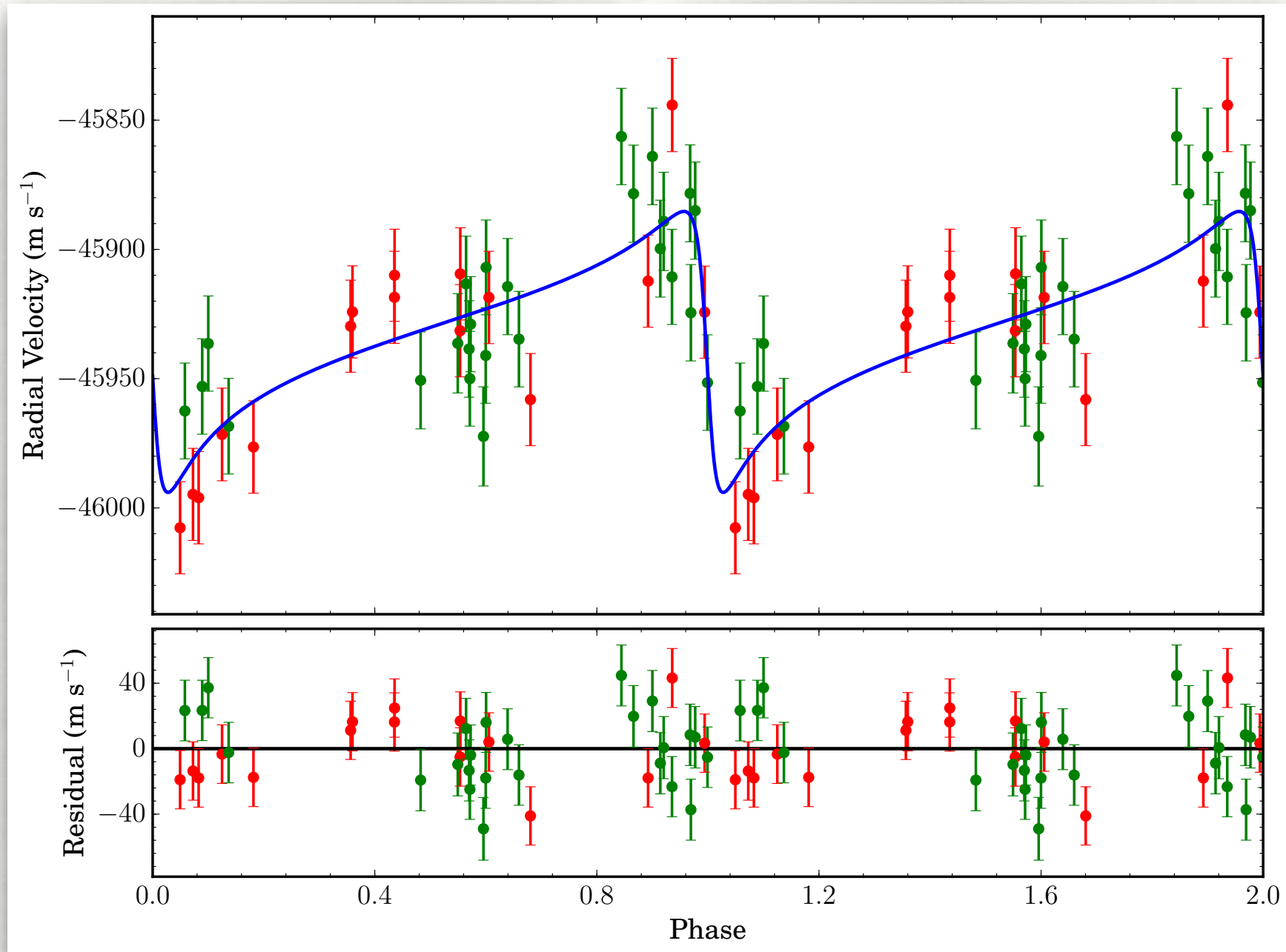
Li-rich giants show normal stellar abundances

Li-rich giants in PTPS



TAPAS - Li-rich giants sample. 13 giants with $A(\text{Li}) > 1.4$.

Li-rich giants in PTPS

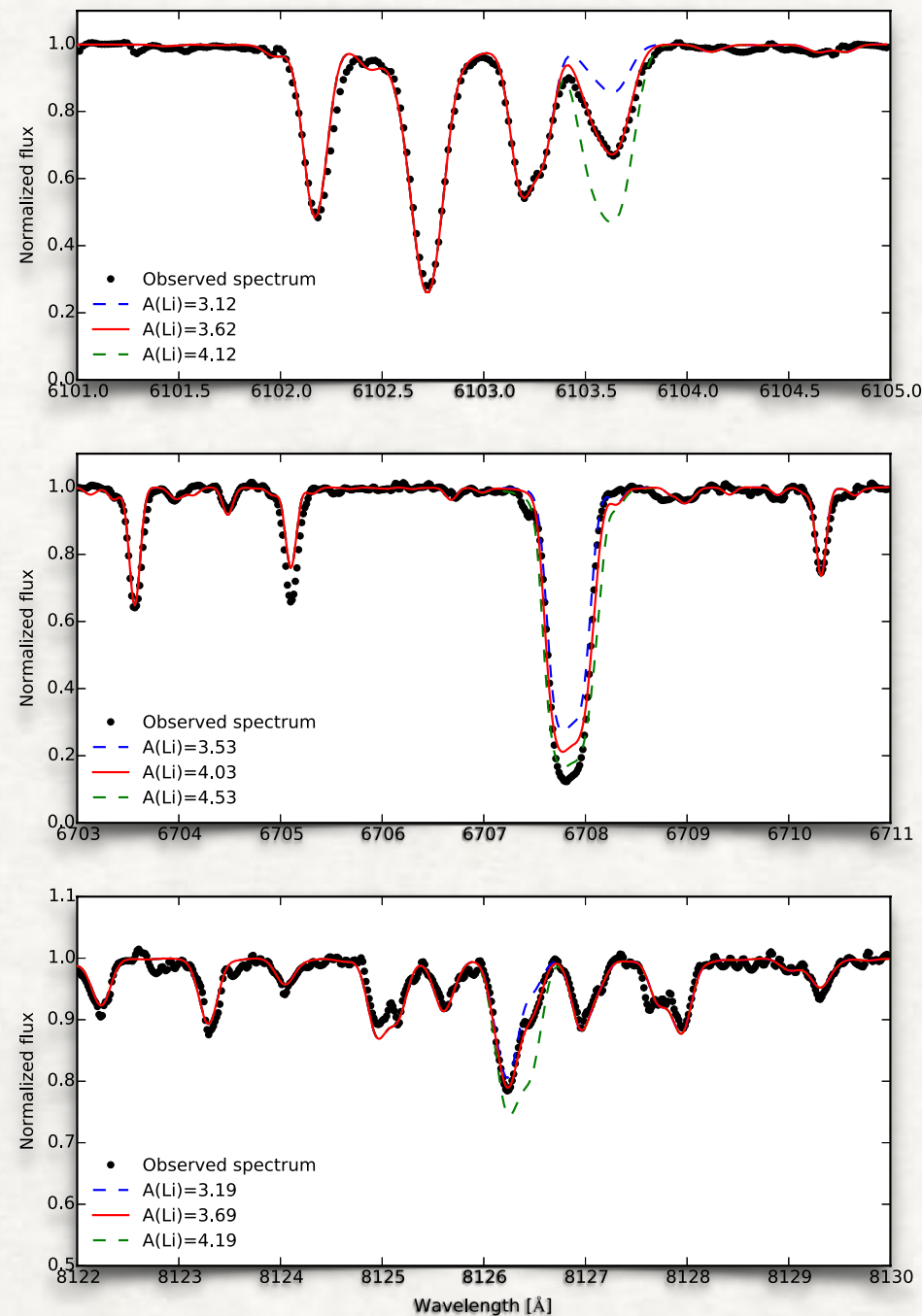


BD+48 740 b - Adamów, Niedzielski et al (2012)

$M_{\star}/M_{\odot}=1.5\pm0.3$, $R_{\star}/R_{\odot}=11.4\pm0.7$, $\log g=2.48\pm0.12$, $[\text{Fe}/\text{H}]=-0.13\pm0.06$, **$A(\text{Li})=2.33\pm0.04$.**

$P=771.3\pm7.4$ d, $m_p \sin i=1.6 m_J$, $a=1.89$ au, $e=0.67\pm0.17$

Li-rich giants in PTPS

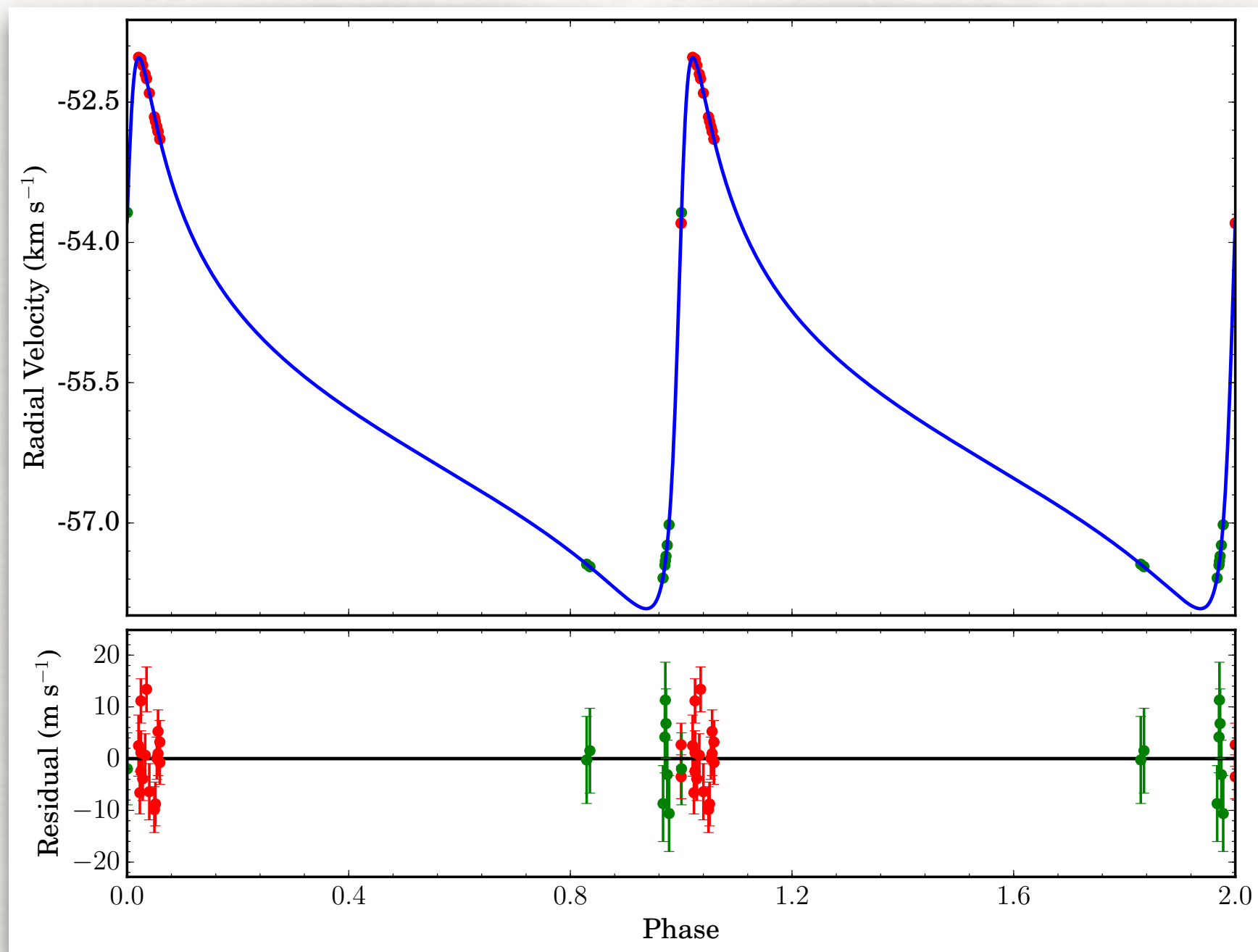


HD 107028 - Adamów, Niedzielski et al (2015)

$M_{\star}/M_{\odot}=1.72\pm0.21$, $R_{\star}/R_{\odot}=6.6\pm1$, $\log g=2.97\pm0.09$, $[\text{Fe}/\text{H}]=-0.13\pm0.06$, **$A(\text{Li})>3.3$** .

Single. RV variations $<22\text{m/s}$

Li-rich giants in PTPS



PTPS 1509 b - Adamów, Niedzielski et al (in prep)

$P=12977.6\pm0.3$ d, $m_p \sin i=0.4\pm0.03$ M_\odot , $a=14.8\pm0.5$ au, **$e=0.7524\pm0.002$**

Li-rich giants in PTPS

Of 13 stars monitored with HARPS-N:

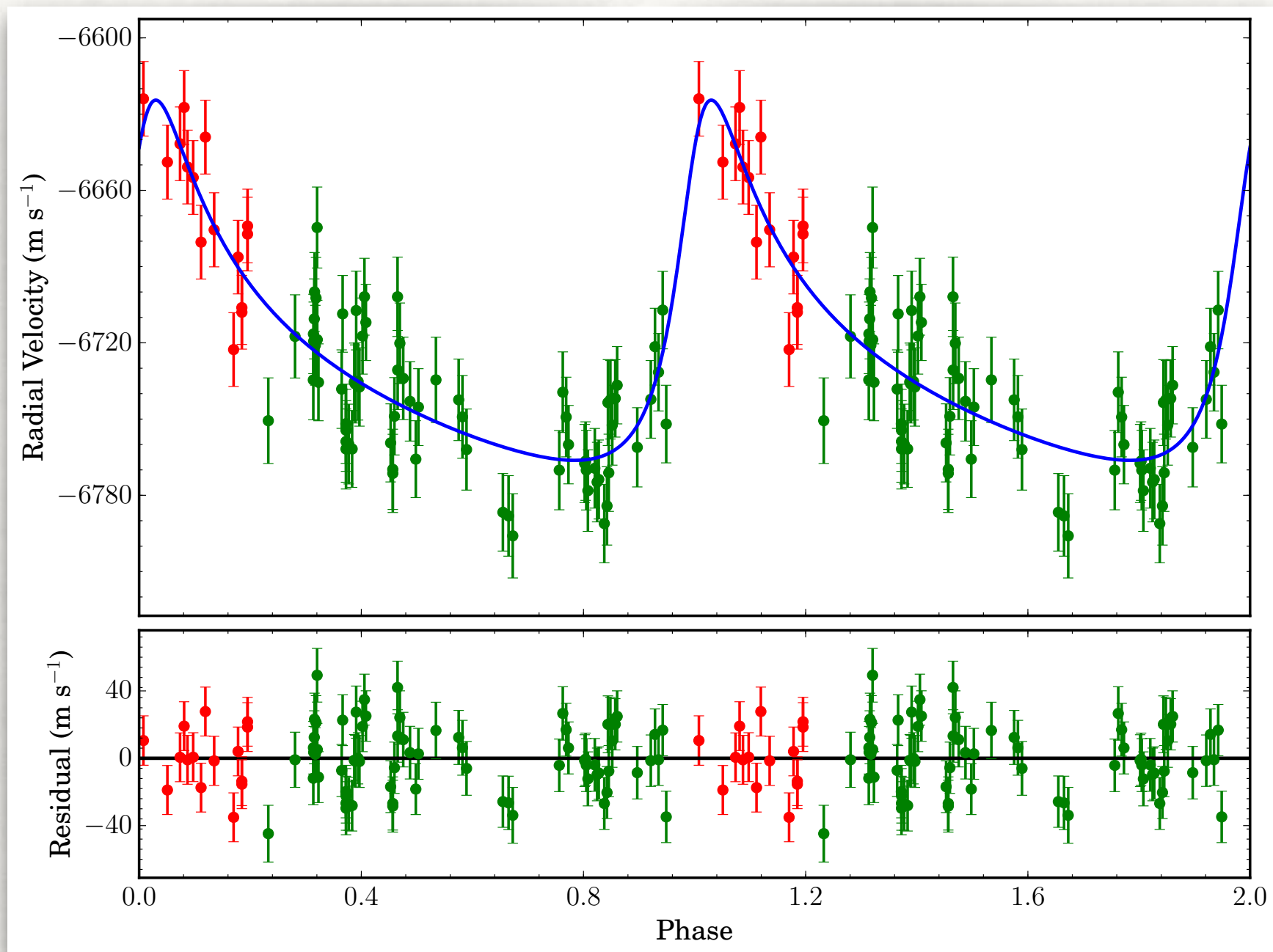
5 (38%) with planetary-mass companions

1 (8%) stellar binary

6 (46%) single

PTPS 1509 b - Adamów, Niedzielski et al (in prep)

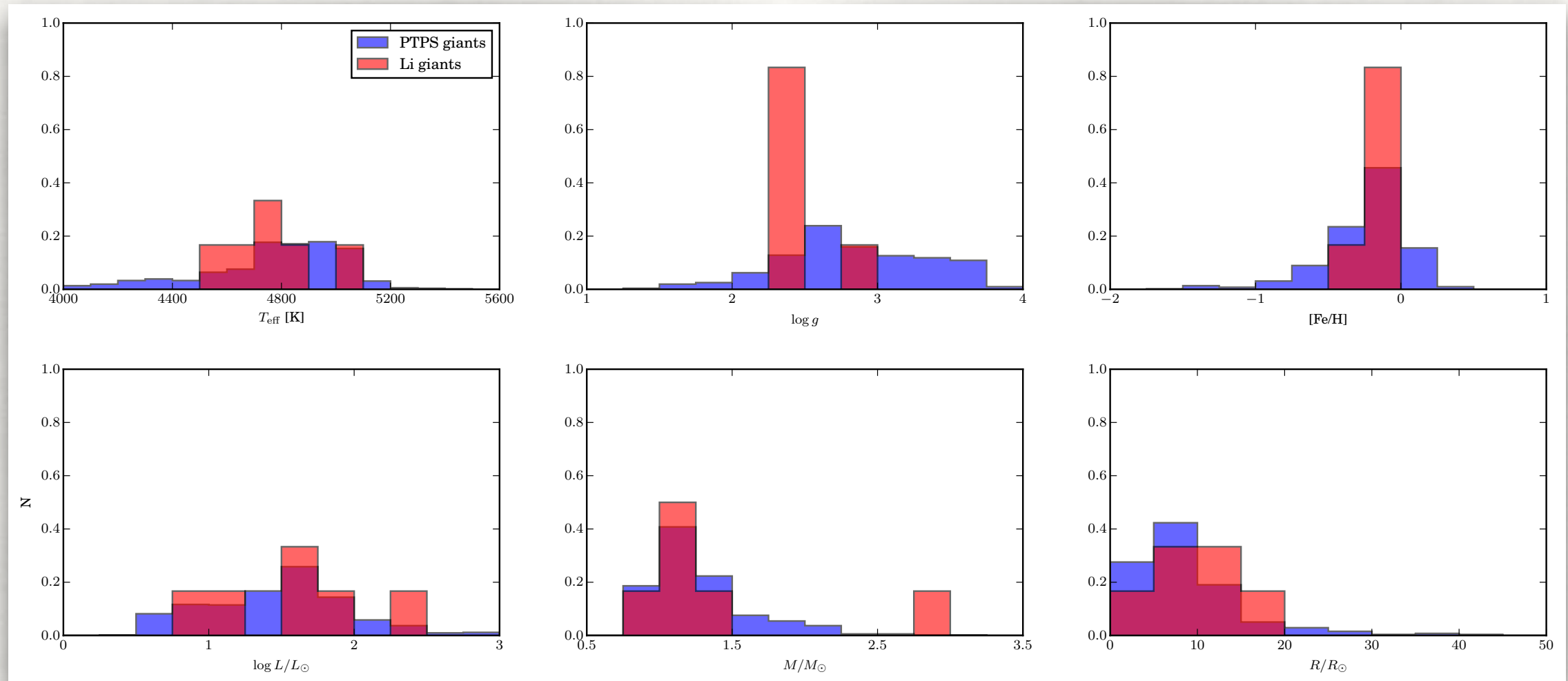
Li-rich giants in PTPS



PTPS 1254 b - Adamów, Niedzielski et al (in prep)

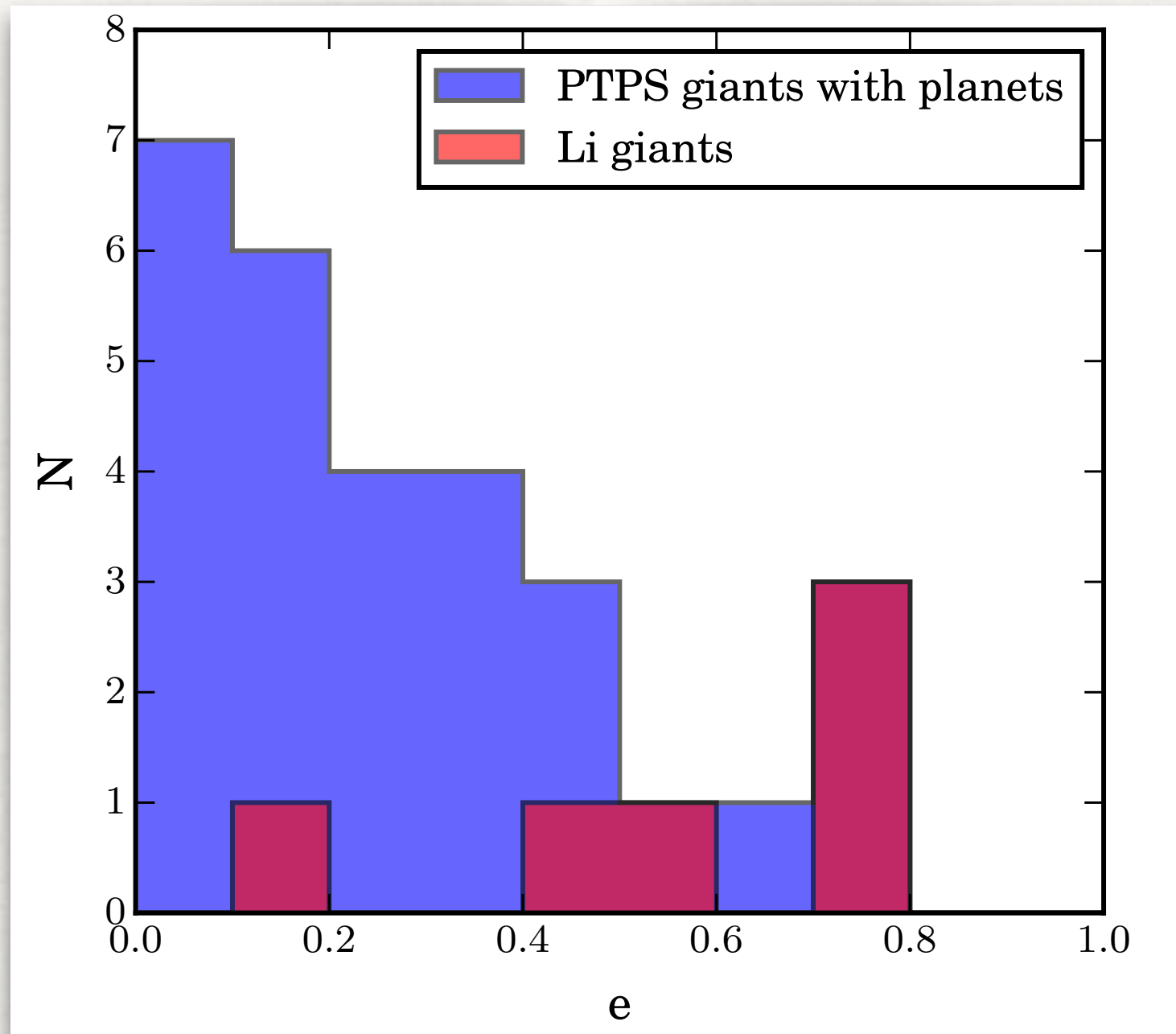
$P=4100\pm210$ d, $m_p \sin i=6.0\pm2.7$ m_J , $a=5.7\pm0.9$ au, $e=0.56\pm0.07$

Li-rich giants in PTPS



TAPAS - Li-rich giants with companions

Li-rich giants in PTPS



TAPAS - Li-rich giants with companions

Summary

13 out of 547 giants ($\sim 2\%$) with $A(\text{Li}) \geq 1.4$

5 out of 13 (38%) with planetary-mass companions

1 out of 13 (8%) - stellar binary

6 out of 13 (46%) - single

most of companions in eccentric orbits