

Looking for K2 warm Jupiters - Win some, lose some

Avi Shporer
MIT



Daniel Bayliss, Joao Bento, Rafael Brahm, Bill Cochran, Allyson Bieryla, Knicole Colon, Diana Dragomir, Mike Endl, Nestor Espinoza, BJ Fulton, Howard Isaacson, Andres Jordan, Dave Latham, Enric Palle, Rob Siverd, Andrew Vanderburg, George Zhou, and the LCO TECH collaboration

Las Cumbres Observatory (LCO) Key Project:

Transiting exoplanets with LCO -

The network awakens

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Michael Endl, UT Austin

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Kirstin Hay, University of St. Andrews

Keith Horne, University of St. Andrews

Daniel Huber, University of Hawaii

Marshall Johnson, Ohio State University

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Heather Knutson, Caltech

Ethan Kruse, University of Washington

David Latham, Harvard-Smithsonian CfA

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Joshua Pepper, Lehigh University

Steve Potter, SAAO

Markus Rabus, PUC and MPIA

Ramotholo Sefako, SAAO

Rob Siverd, LCO

Carolina von Essen, Aarhus University

Andrew Vanderburg, Harvard-Smithsonian CfA

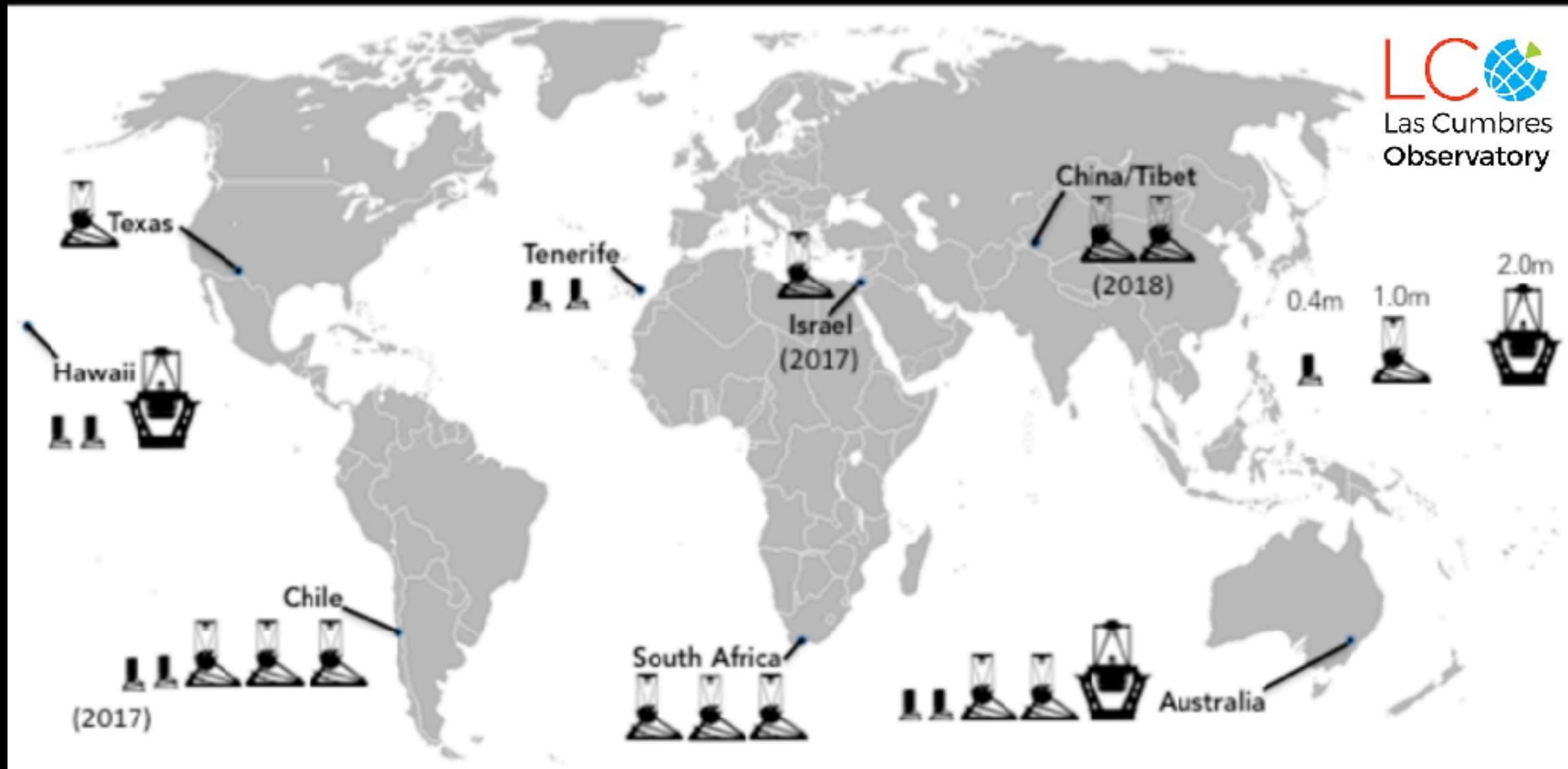
George Zhou, Harvard-Smithsonian CfA

The Transiting Exoplanet CHaracterizaton (TECH) team

Transiting exoplanets with LCO - The network awakens

3582.5 hours, April 2017 - May 2019

73% Photometry
27% Spectroscopy



Transiting exoplanets with LCO - The network awakens

Four parts:

I. Warm Jupiters

Leader: Avi Shporer

II. Transit Timing Variations

Leader: Daniel Jontof-Hutter

III. Transiting candidates orbiting bright and quiet stars

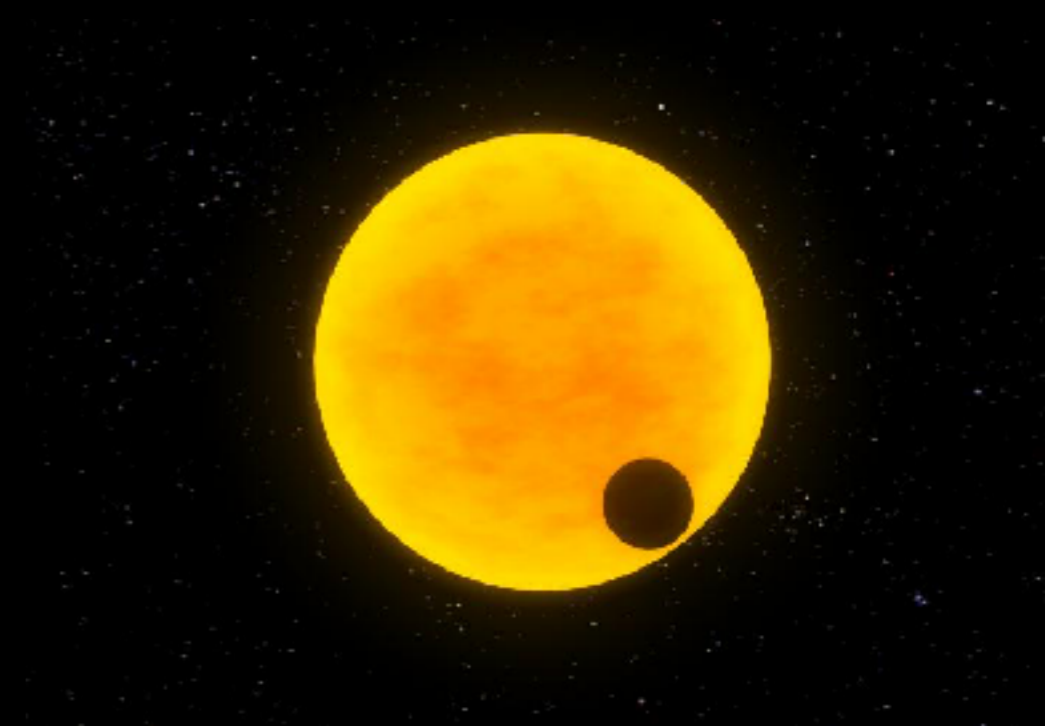
Leader: Dan Bayliss

IV. Snapshot photometry

Leader: Knicole Colon

And other exoplanet-focused small projects

Public webpage: space.mit.edu/~shporer/LCOKP



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Looking for K2 warm Jupiters - Win some, lose some

The good news:

We found new planets!



The bad news:

The total number of planets we have found is -1...

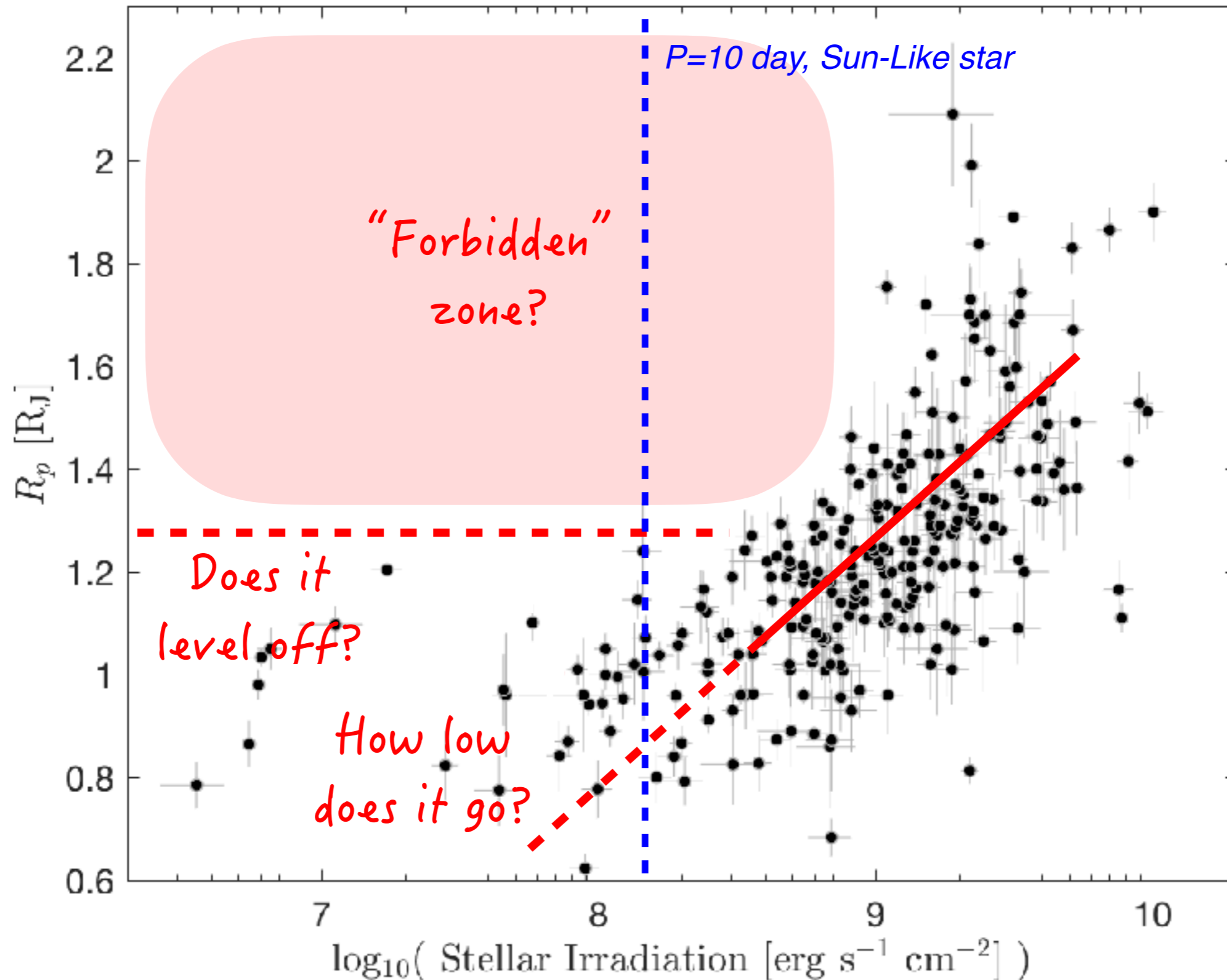


What is a Warm Jupiter?

- Gas giant planet
- Stellar Irradiation $< 2 \times 10^8 \text{ erg cm}^{-2} \text{ s}^{-1}$
- $P_{\text{orbit}} > 10$ days around a Sun-like star



Why should we care about Warm Jupiters?

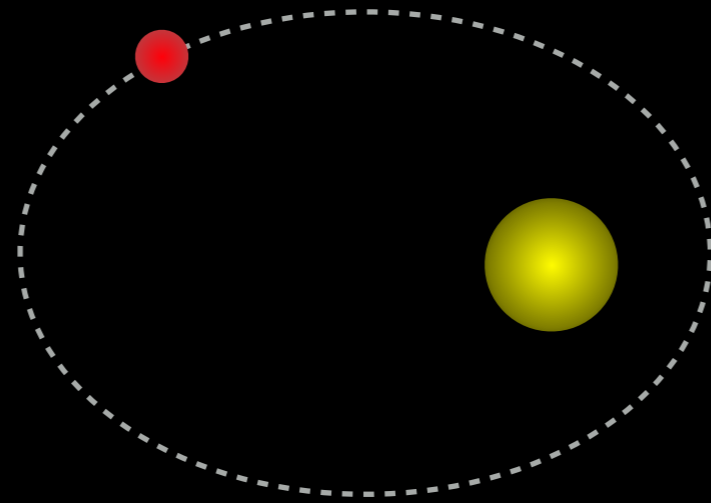


Why should we care about Warm Jupiters?

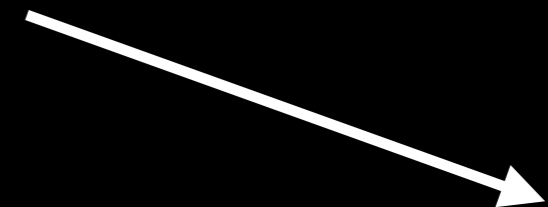
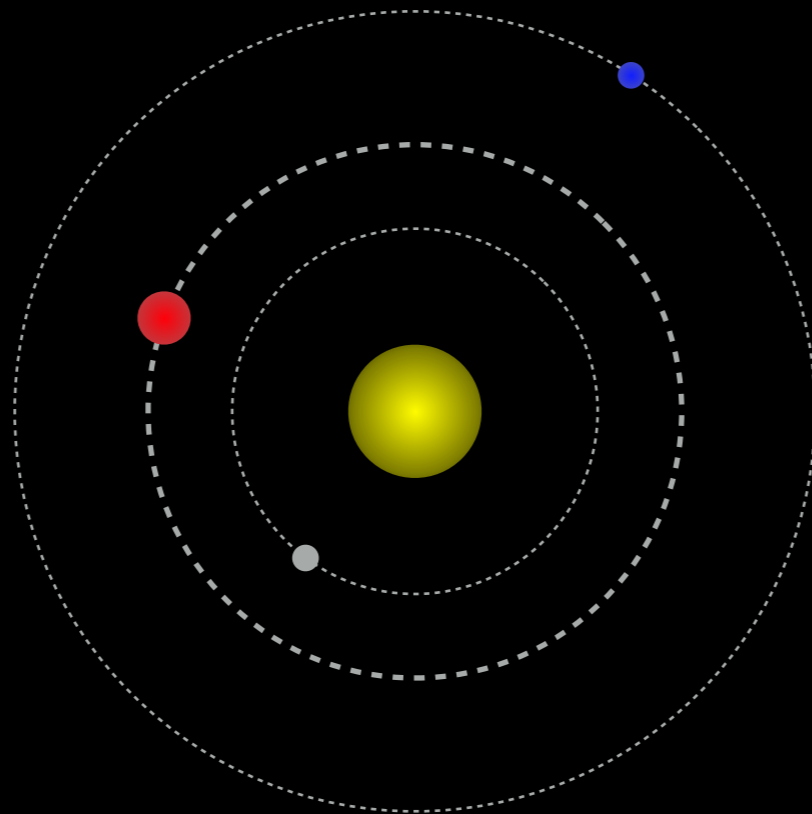
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Investigate hot Jupiter formation and evolution

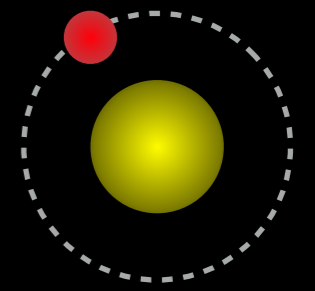
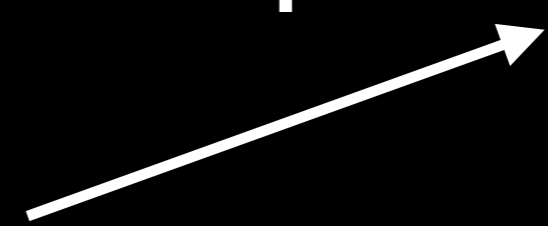
Eccentric orbit
Warm Jupiter



Circular orbit
Warm Jupiter
with planetary
companion(s)



?



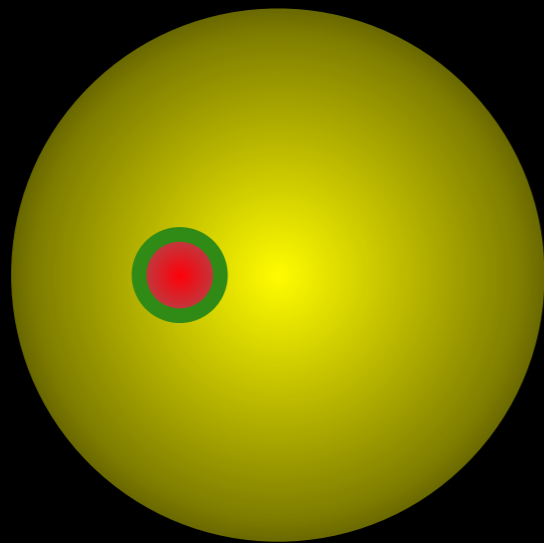
Hot Jupiter

Why should we care about Warm Jupiters?

III

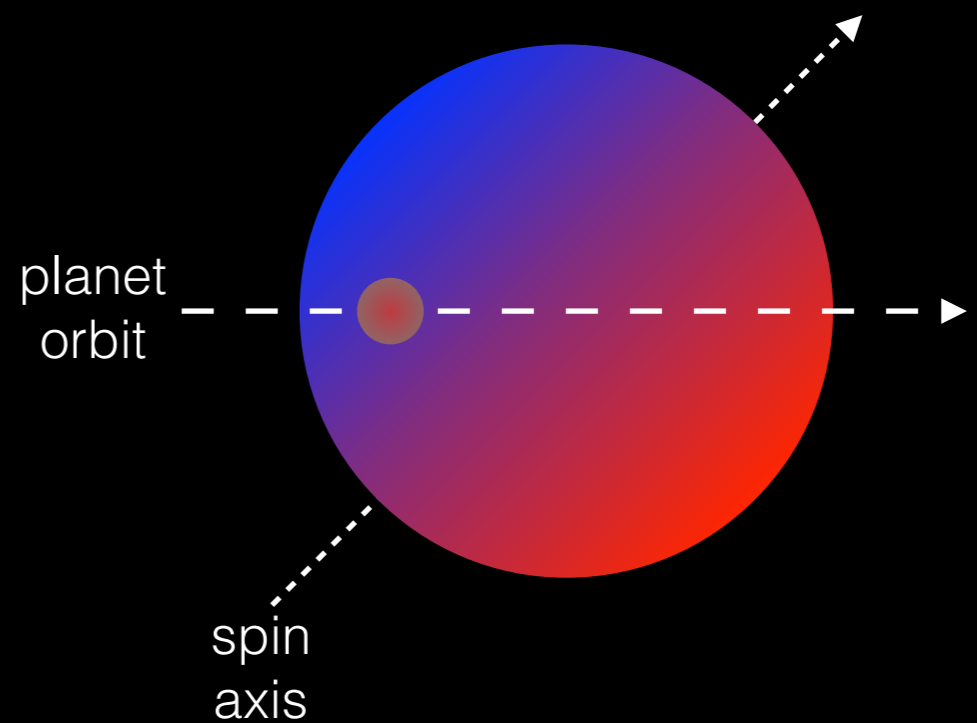
Provide long(er) period targets for:

Atmospheric characterization
(cooler atmospheres)



$$T_{\text{eq}} \lesssim 1300 \text{ K}$$

Obliquity measurements
(weaker tidal interaction)



$$a \gtrsim 0.1 \text{ au}$$

LCO TECH K2 Warm Jupiters Project

Who?

- The LCO Transiting Exoplanet Characterization (TECH) group.

Why?

- Inflated gas giants enigma.
- Hot Jupiter formation and evolution.
- Long(er) period targets for atmospheric and obliquity studies.

What?

- Gas giant planets
- $P_{orbit} > 10$ days

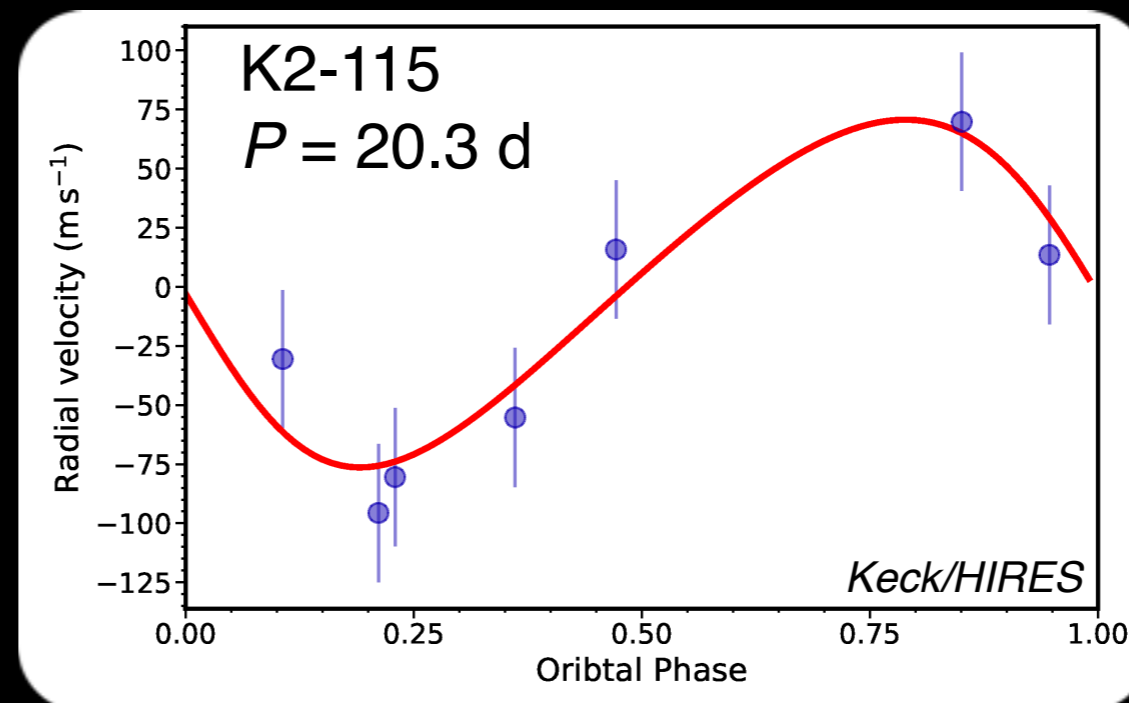
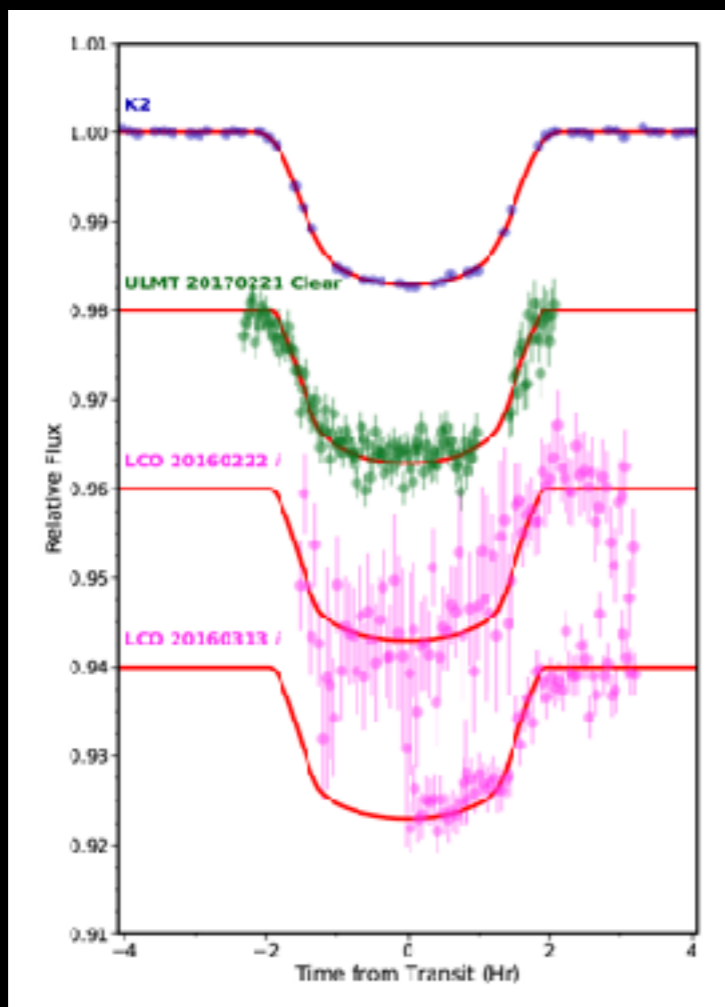
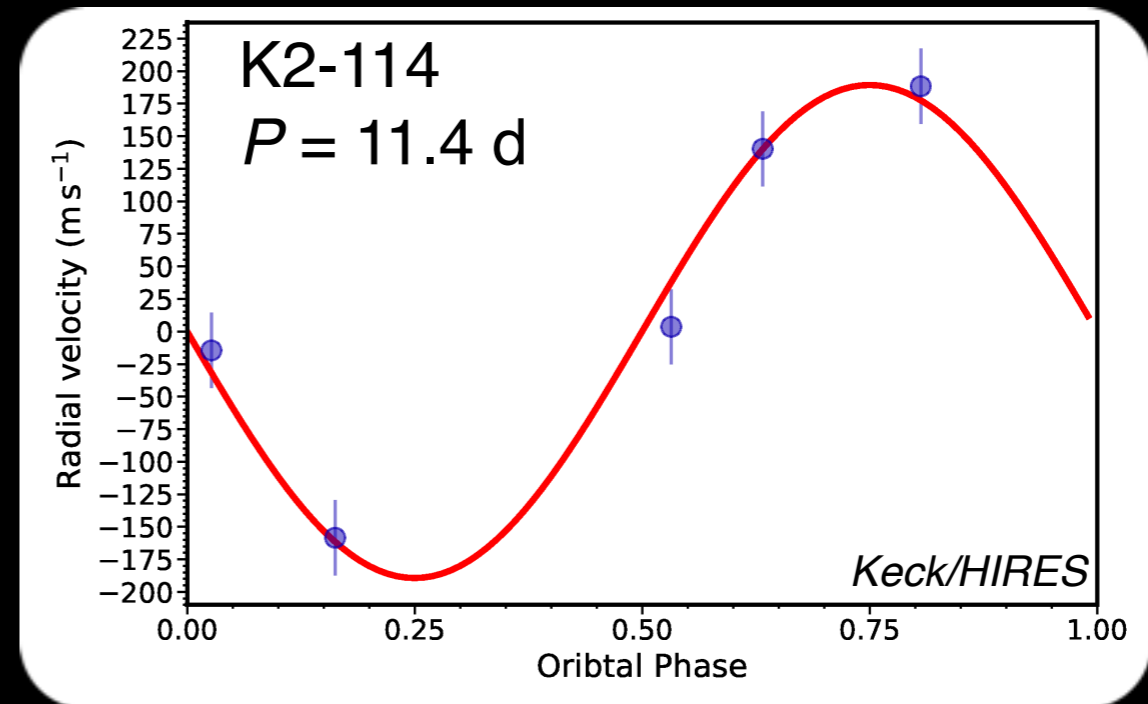
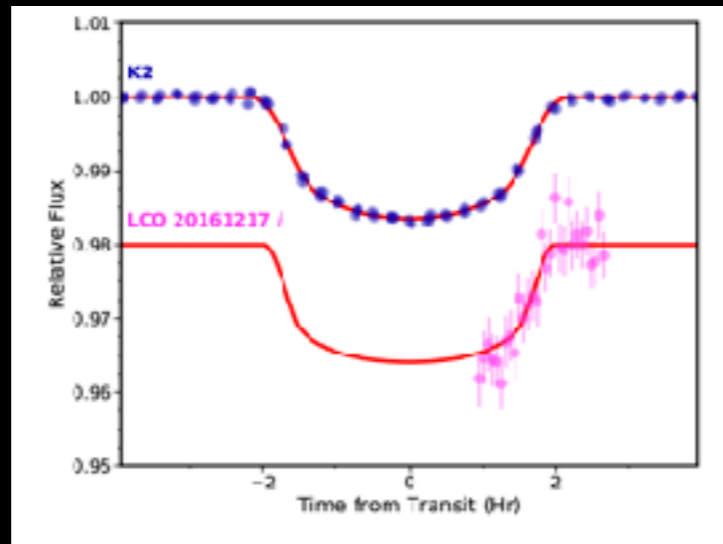
How?

- Candidates: K2, TESS (future)
- Photometry: LCO
- Spectroscopy: LCO (future), Keck, McDonald, TRES, CORALIE, FEROS,...
- Imaging: Robo-AO

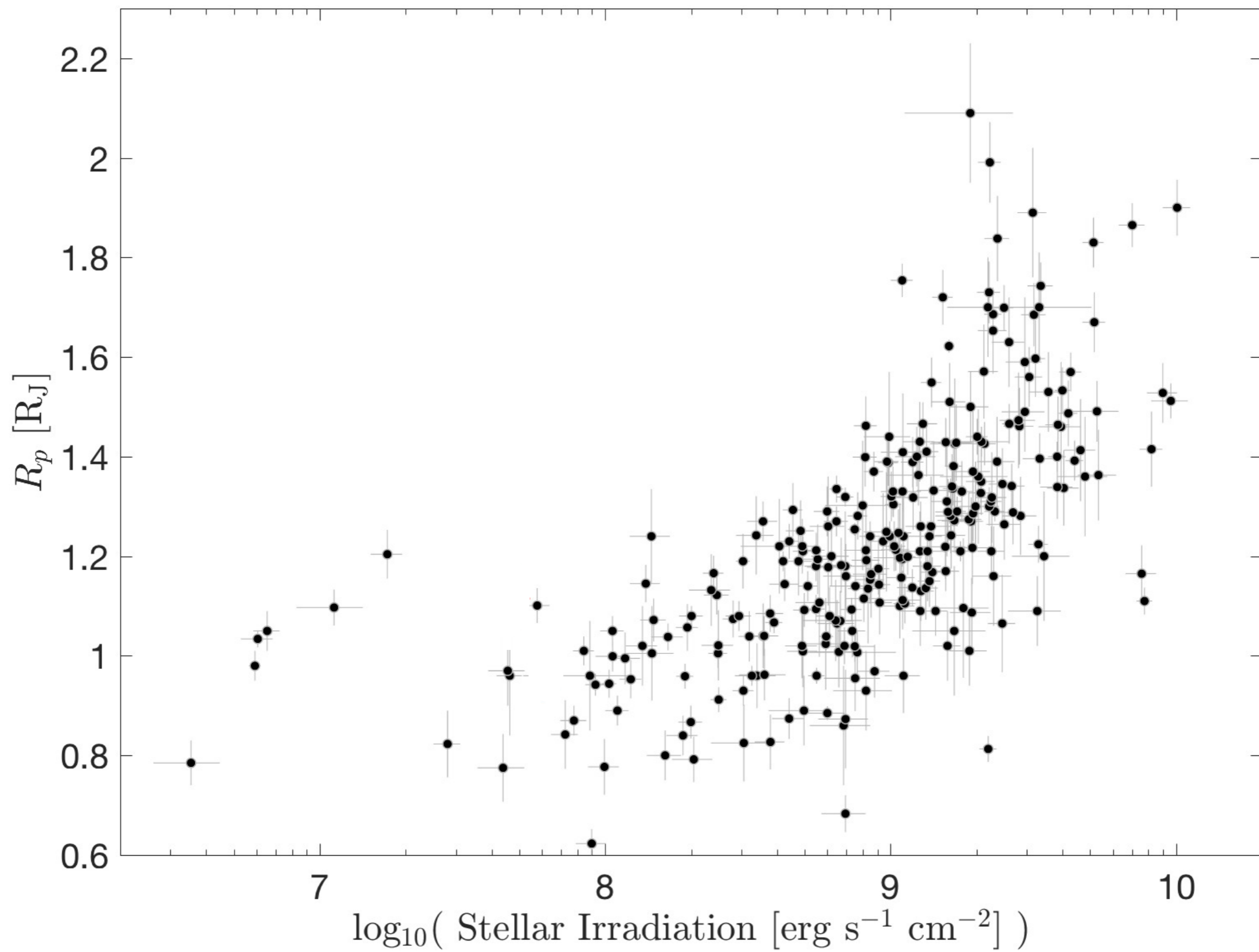


Confirmed K2 Warm Jupiter planets

Shporer et al. 2017a

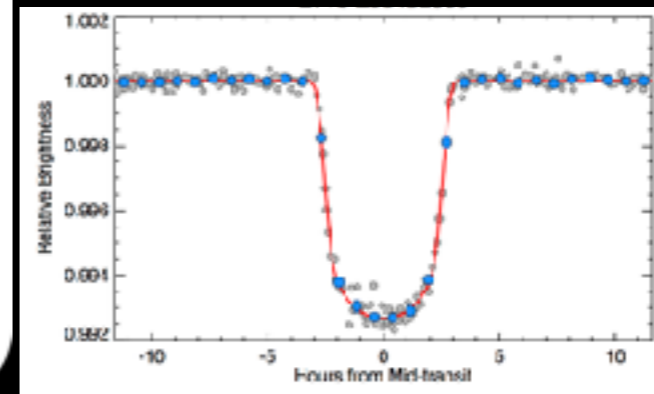
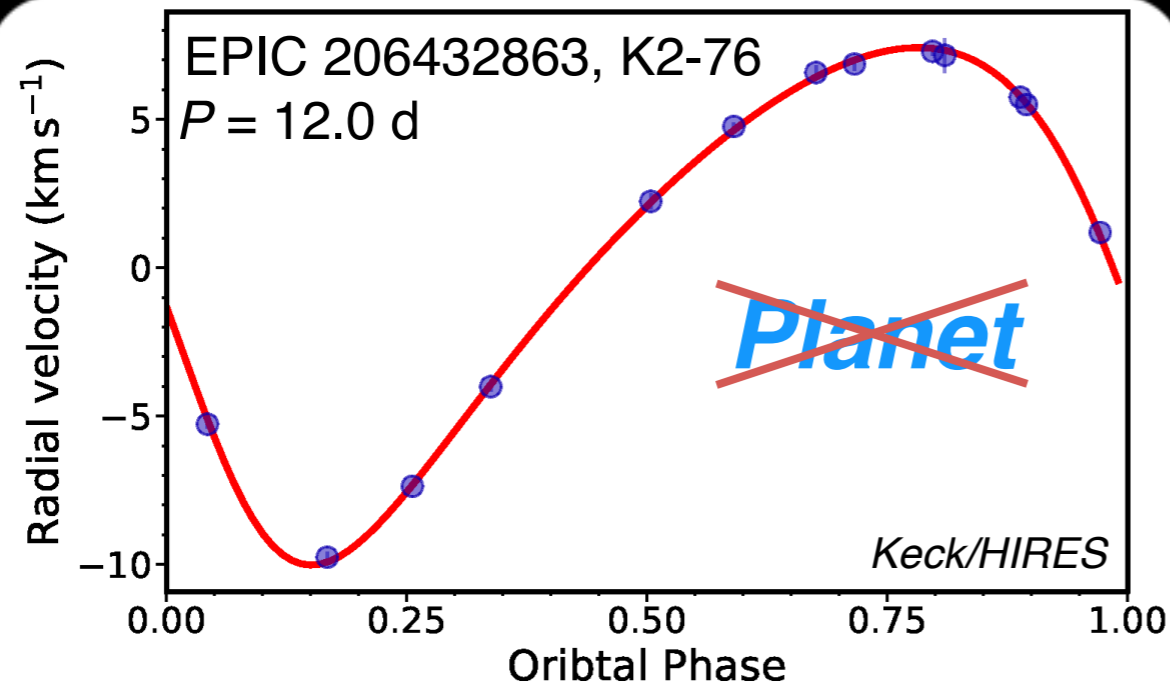
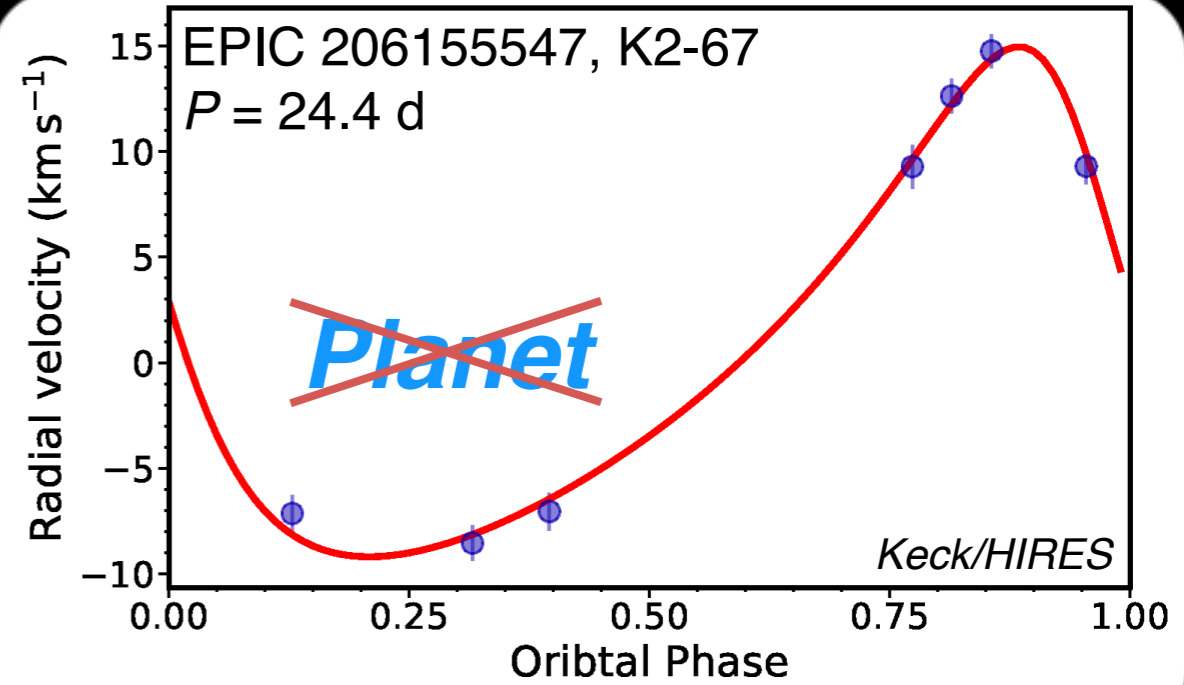
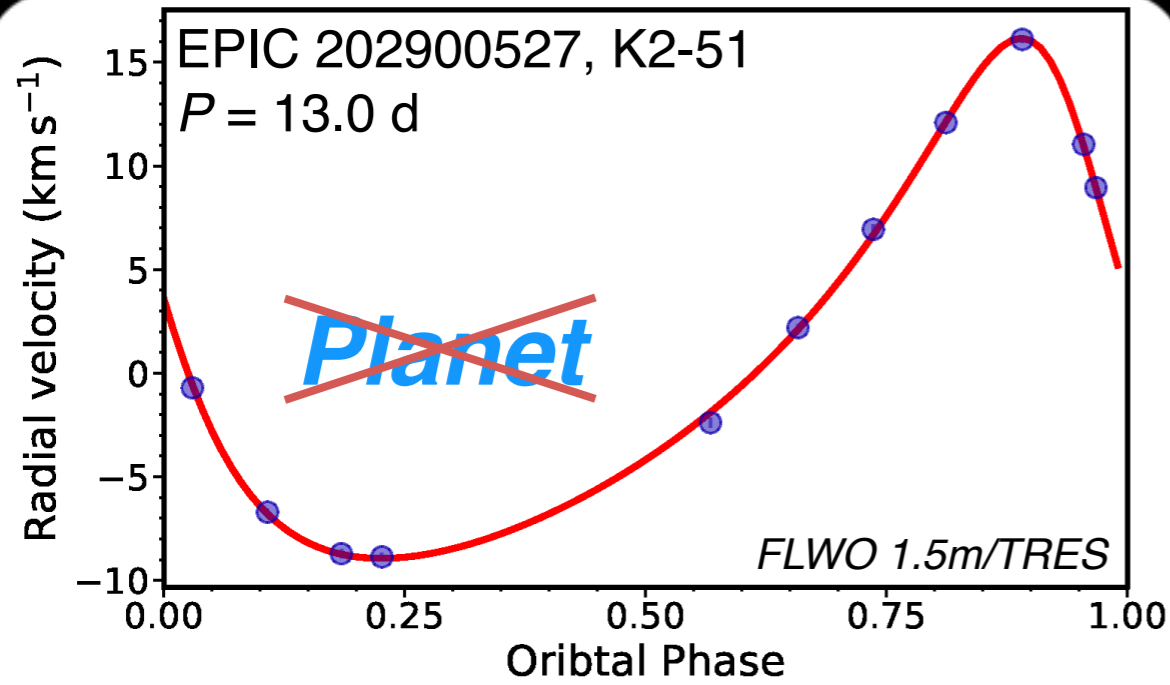
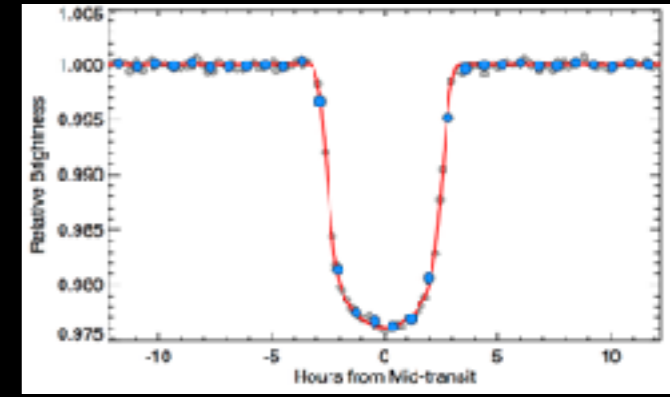
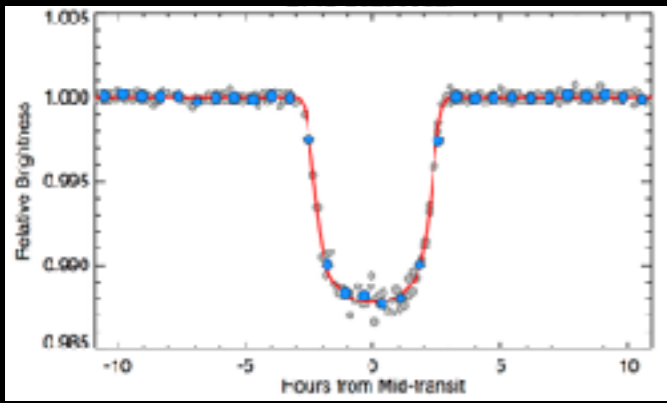


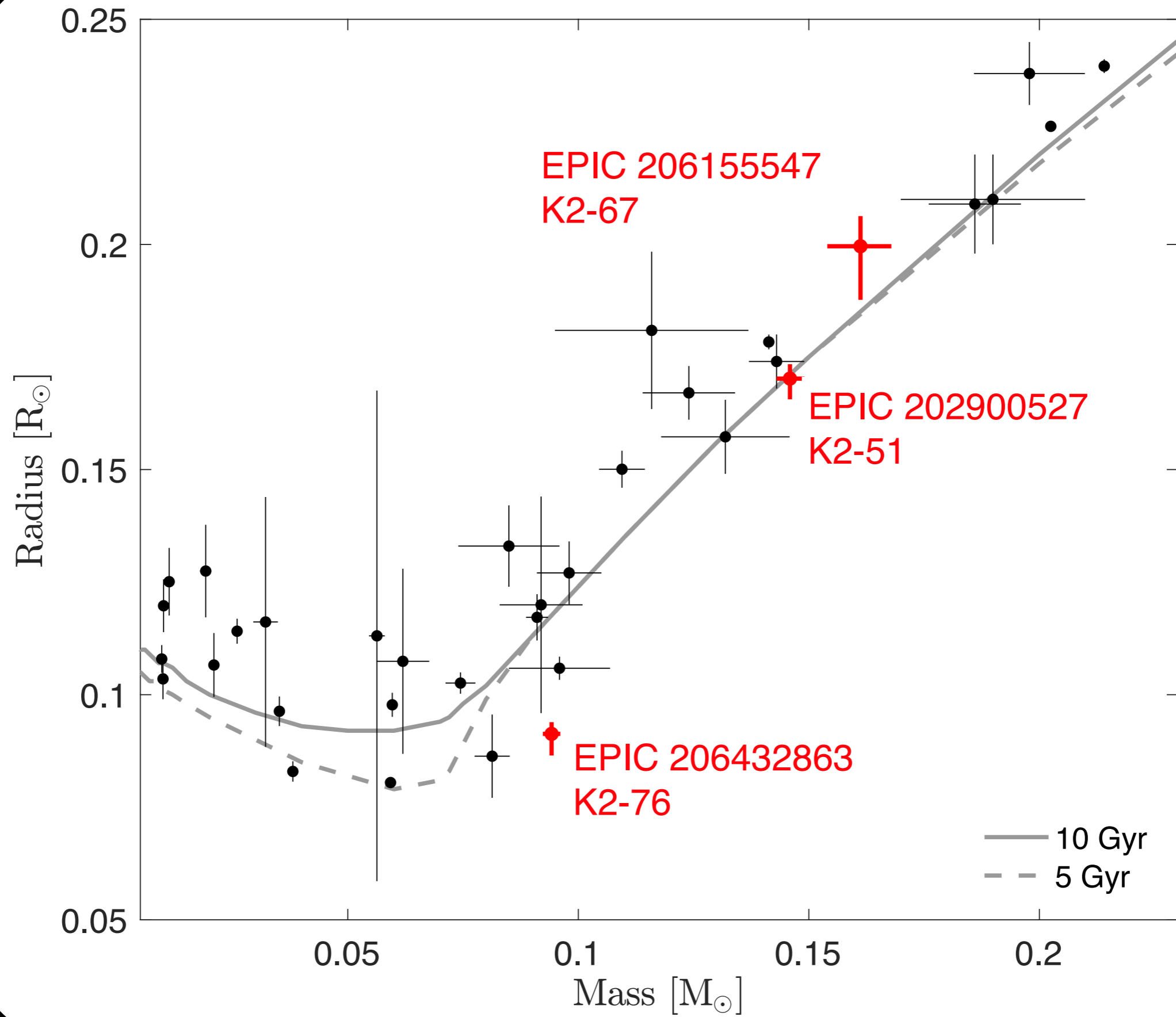
*RV error bars include jitter term



Misclassified statistically validated K2 planets

Shporer et al. 2017b





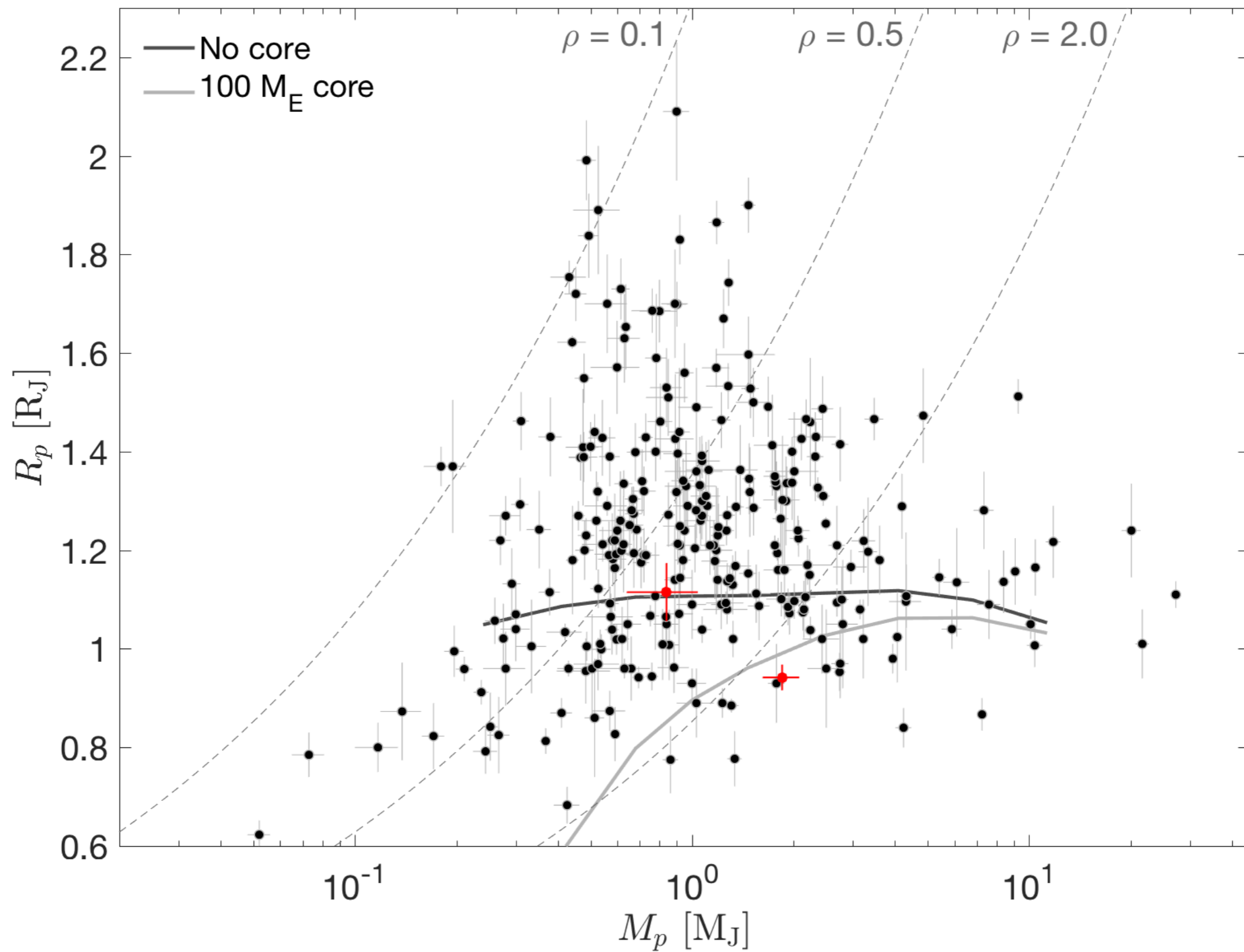
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Additional
slides



“EPIC 201702477b: A transiting brown dwarf from K2 in a 41 day orbit”

Bayliss et al. 2017

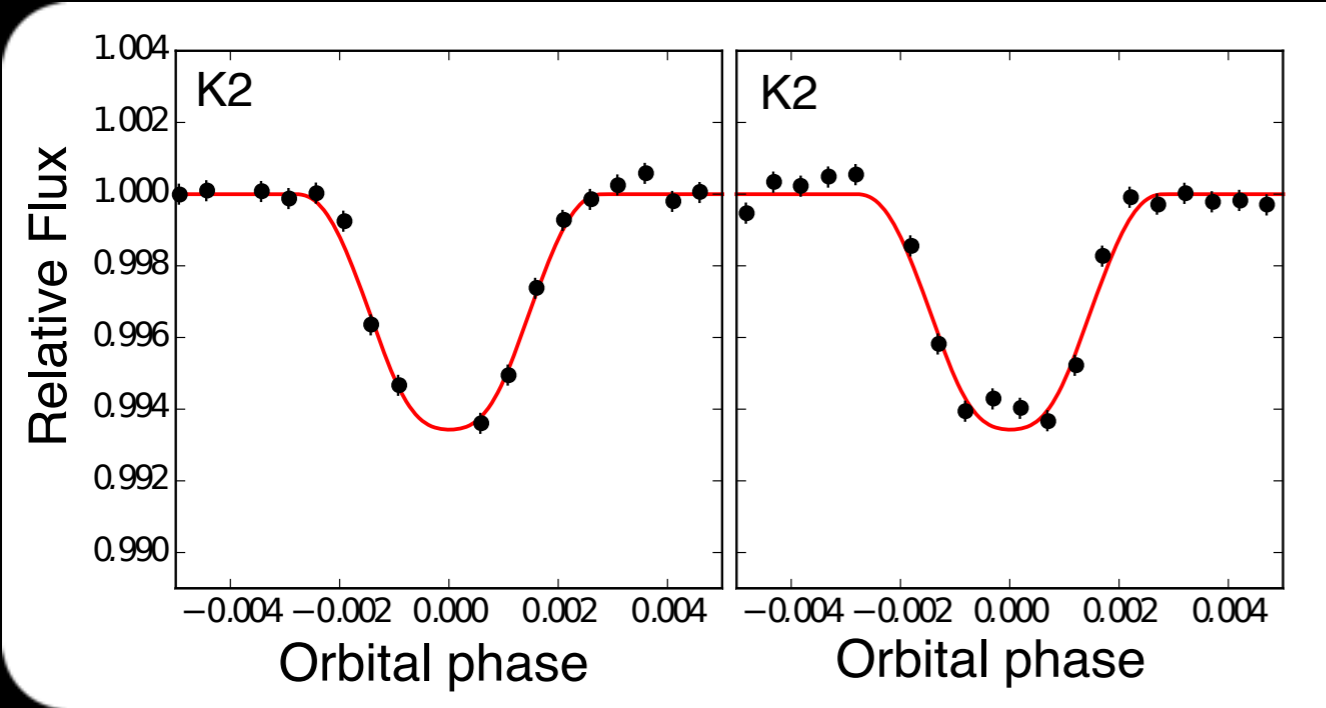
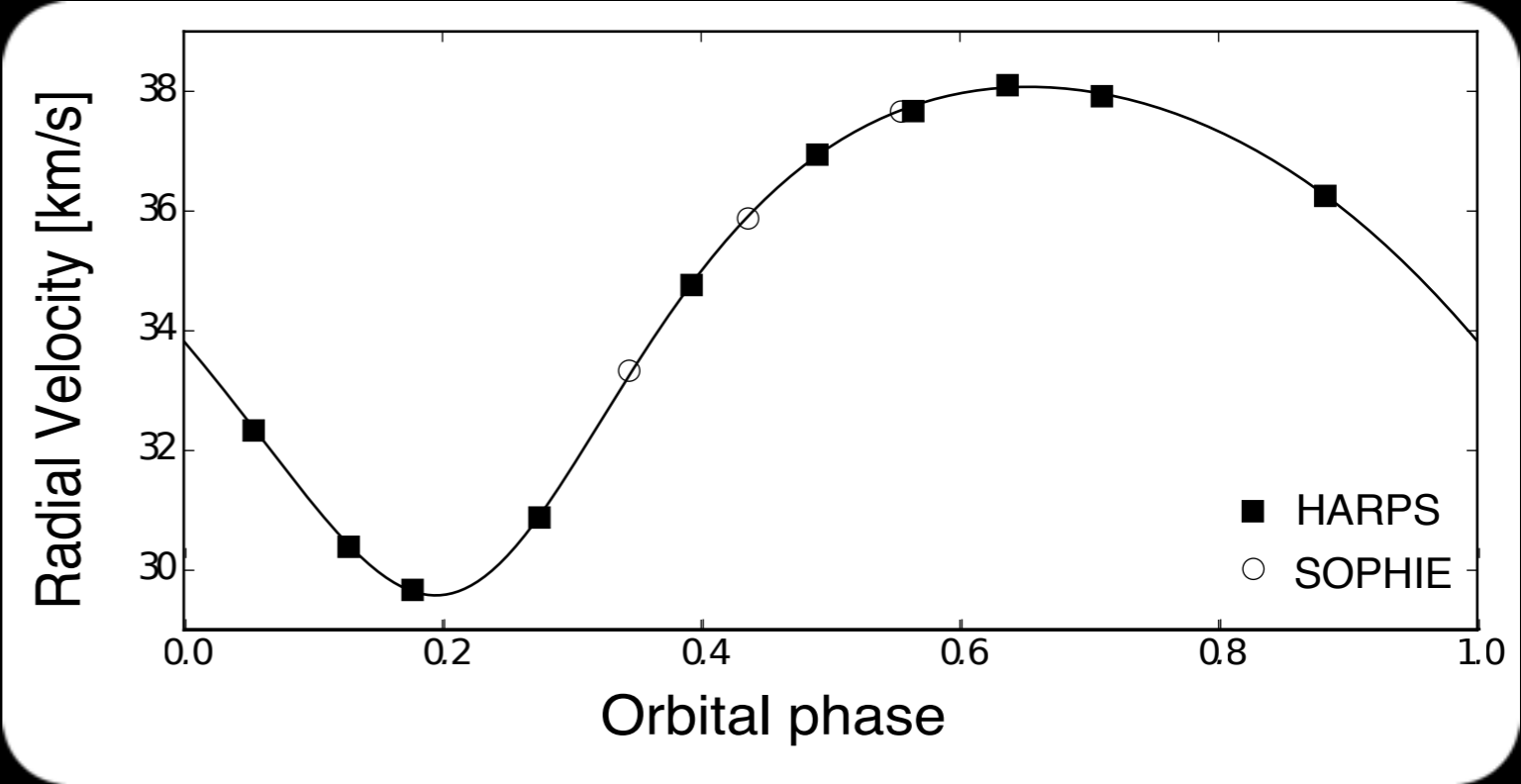
One of only 13 known transiting brown dwarfs

$$P = 40.7 \text{ d}$$

$$e = 0.23$$

$$R_2 = 0.757 \pm 0.065 R_J$$

$$M_2 = 66.9 \pm 1.7 M_J$$



“EPIC 201702477b: A transiting brown dwarf from K2 in a 41 day orbit”

Bayliss et al. 2017

Star:

EPIC 201702477

$$R_s = 0.901 \pm 0.057 R_{\text{sun}}$$

$$M_s = 0.870 \pm 0.031 M_{\text{sun}}$$

$$T_{\text{eff}} = 5517 \pm 70 \text{ K}$$

$$\log g = 4.466 \pm 0.058$$

$$[\text{Fe}/\text{H}] = -0.164 \pm 0.053$$

$$v \sin i < 2 \text{ km/s}$$

$$\text{Age} = 8.8 \pm 4.1 \text{ Gyr}$$

$$V = 14.57 \text{ mag}$$

Brown dwarf:

EPIC 201702477b

$$P = 40.73691 \pm 0.00037 \text{ d}$$

$$e = 0.2281 \pm 0.0026$$

$$a = 0.2265 \pm 0.0026 \text{ au}$$

$$R_p = 0.757 \pm 0.065 R_J$$

$$M_p = 66.9 \pm 1.7 M_J$$

“EPIC 201702477b: A transiting brown dwarf from K2 in a 41 day orbit”

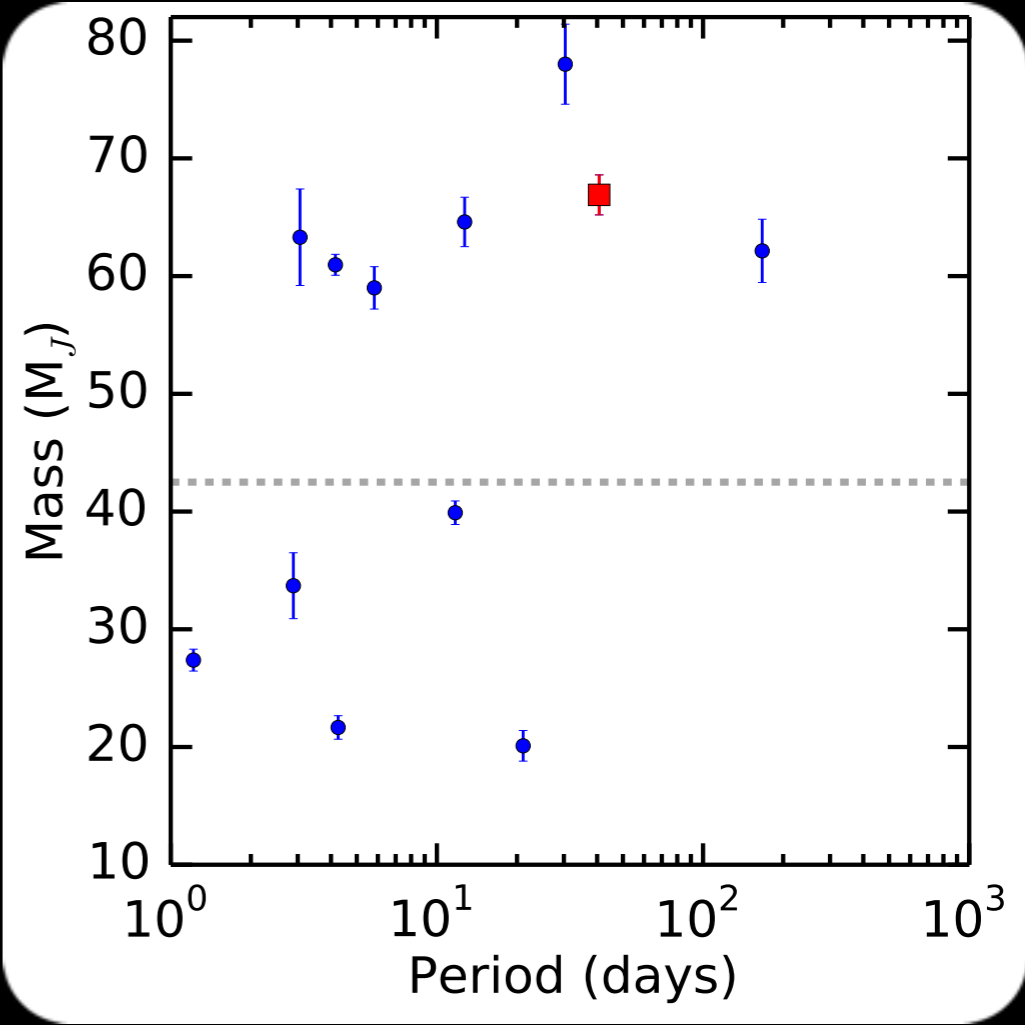
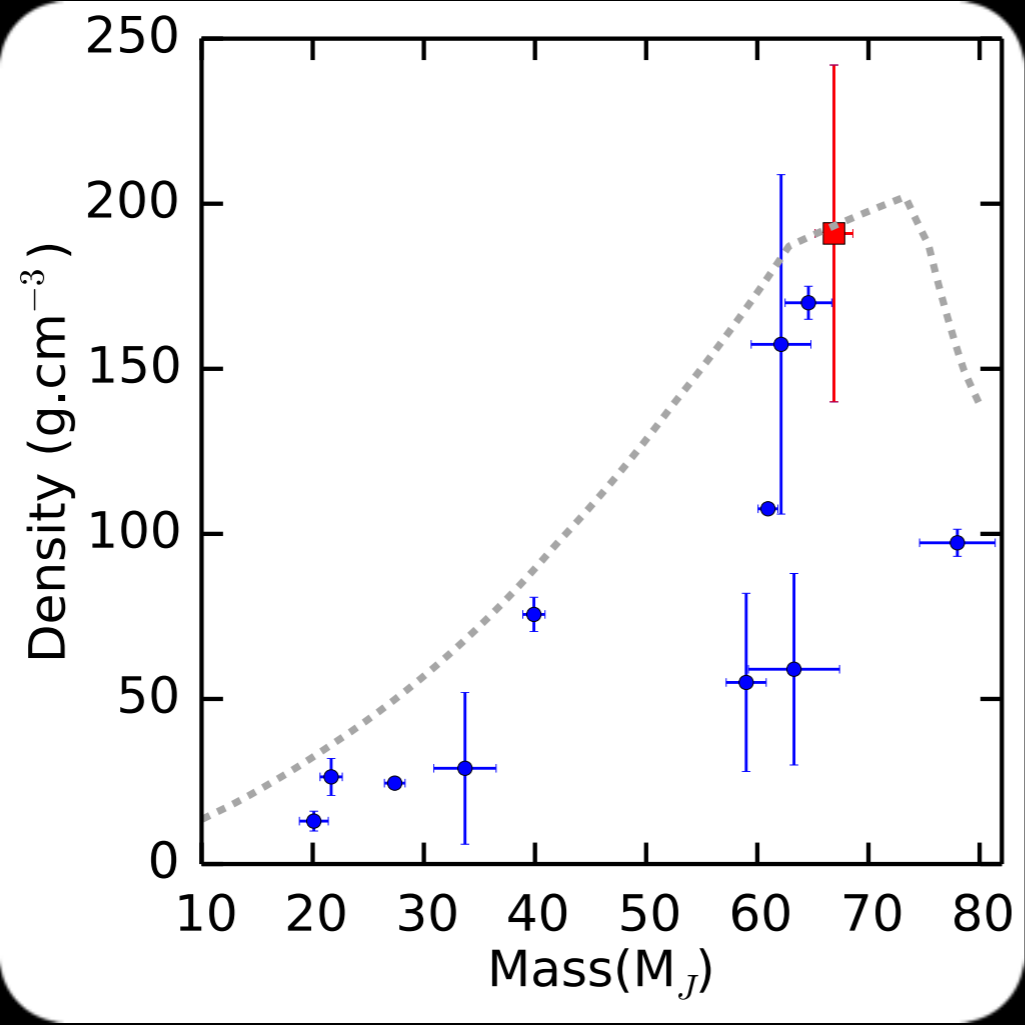
Bayliss et al. 2017

$P = 40.7 \text{ d}$

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EPIC 206155547 (K2-67) secondary eclipse

