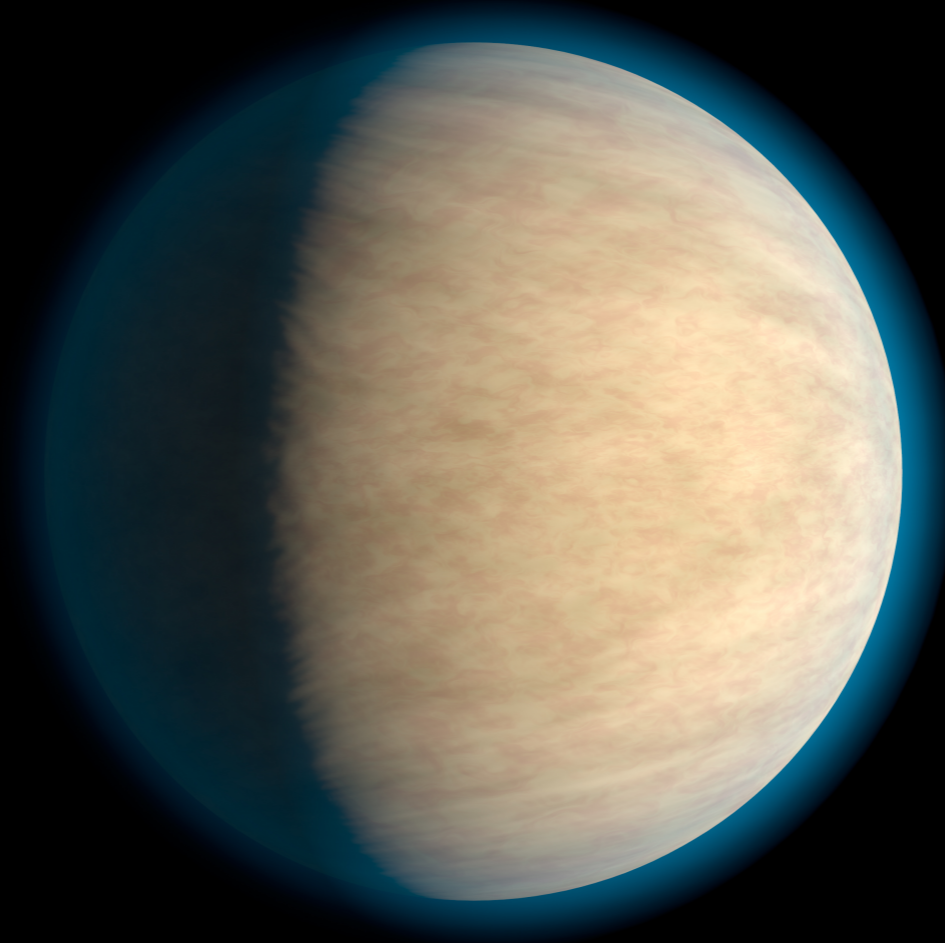


# Space-Like Infrared Photometry with Palomar/WIRC



**Shreyas Vissapragada**

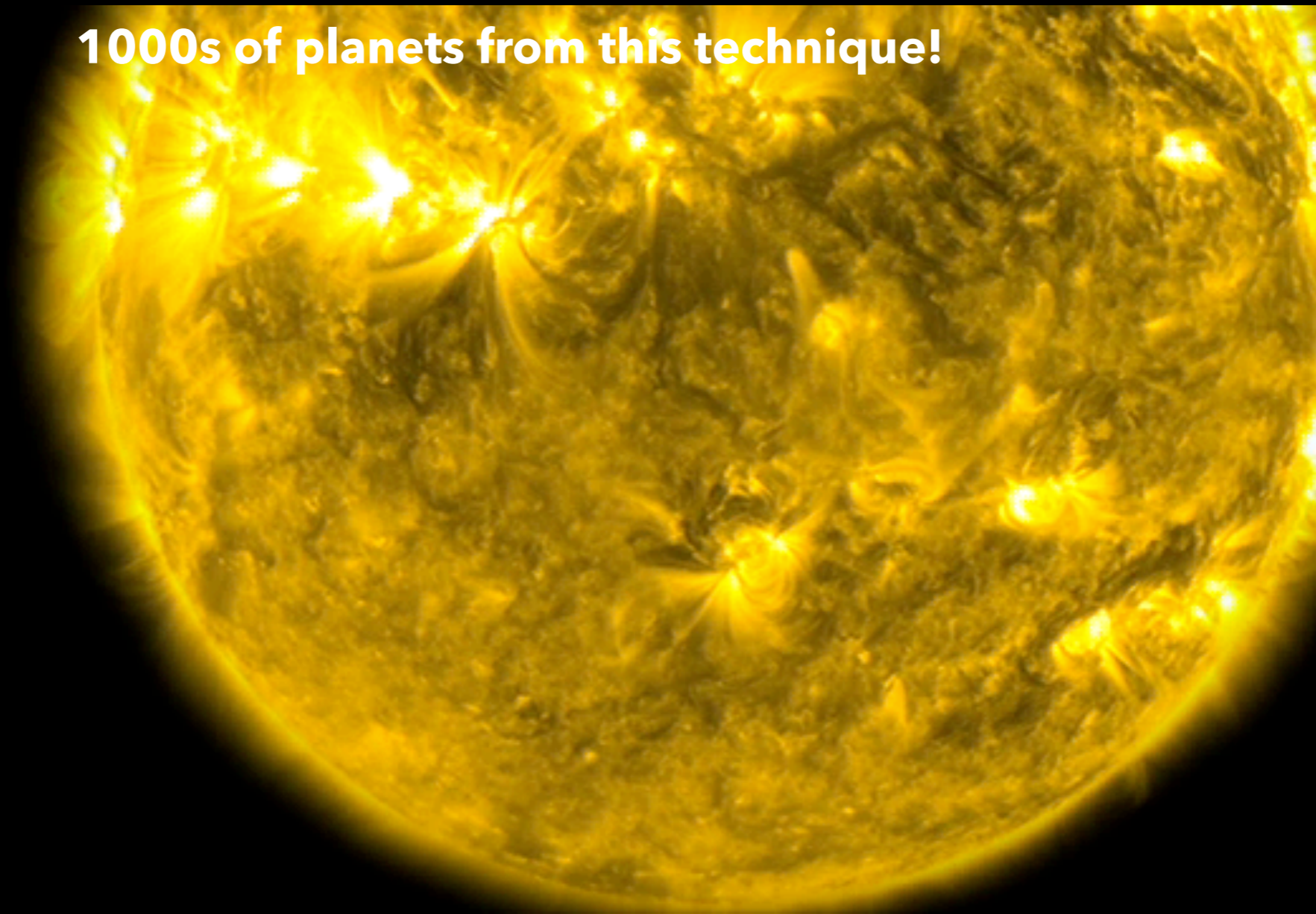
With: Heather Knutson, Daniel Jontof-Hutter, Avi Shporer, Daniel  
Thorngren, Eve Lee, Jason Wright, and the WIRC+POL team

 [@astroshrey](https://twitter.com/astroshrey)

Image Credit:  
NASA/JPL-Caltech

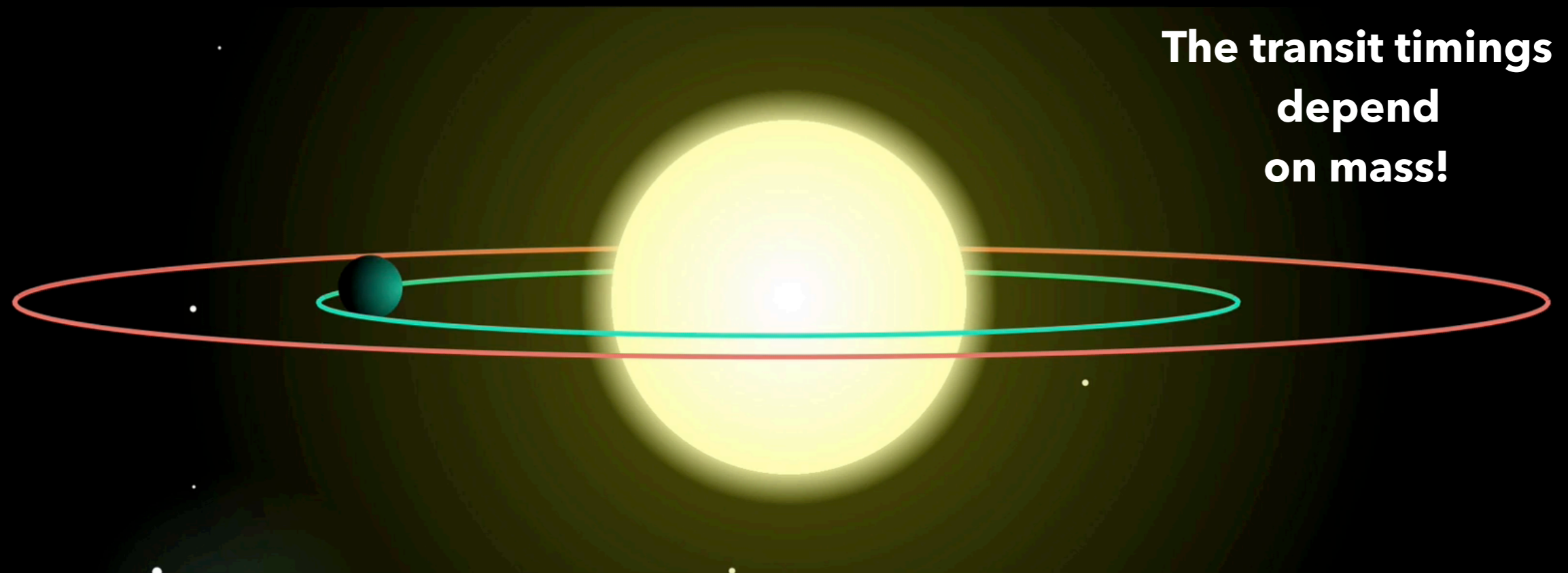
# Transits help us detect planets and measure their sizes

**1000s of planets from this technique!**



**Video Credit:  
NASA Goddard**

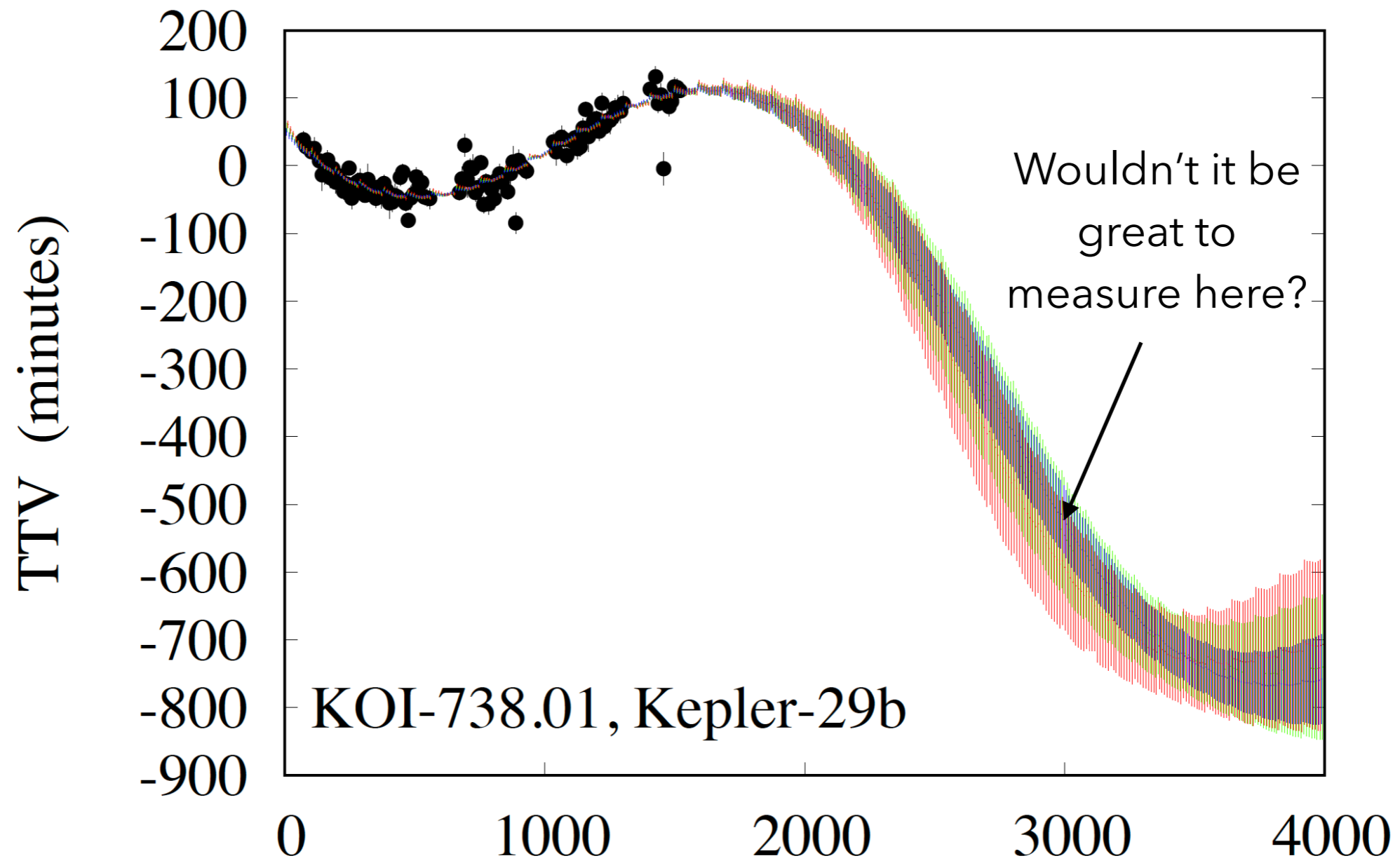
# Multi-planet systems can exhibit timing variations



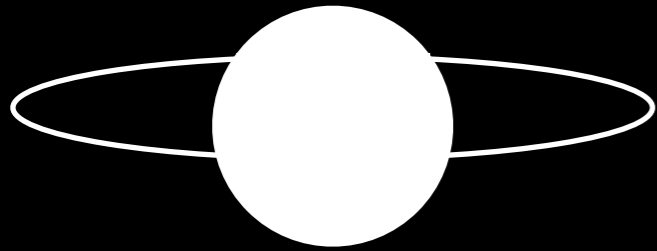
e.g. Agol et al. (2005), Holman & Murray (2005), Agol & Fabrykcy (2017)

**Simulation Credit:  
GravityKit**

# When studying dynamically-interacting systems, you *need* long baselines



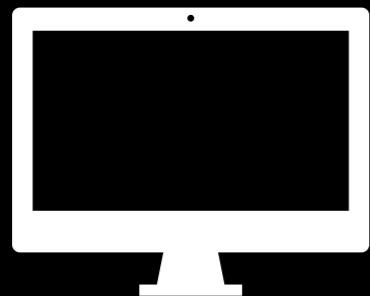
Credit: D.  
Jontof-Hutter



Introduction: transiting  
exoplanets



**Methods: diffuser-  
assisted photometry**



Results and future work

The addition of a **Beam-Shaping Diffuser\*** mitigates time-correlated noise

\*a static, rough surface that homogenizes and re-shapes an input beam of light

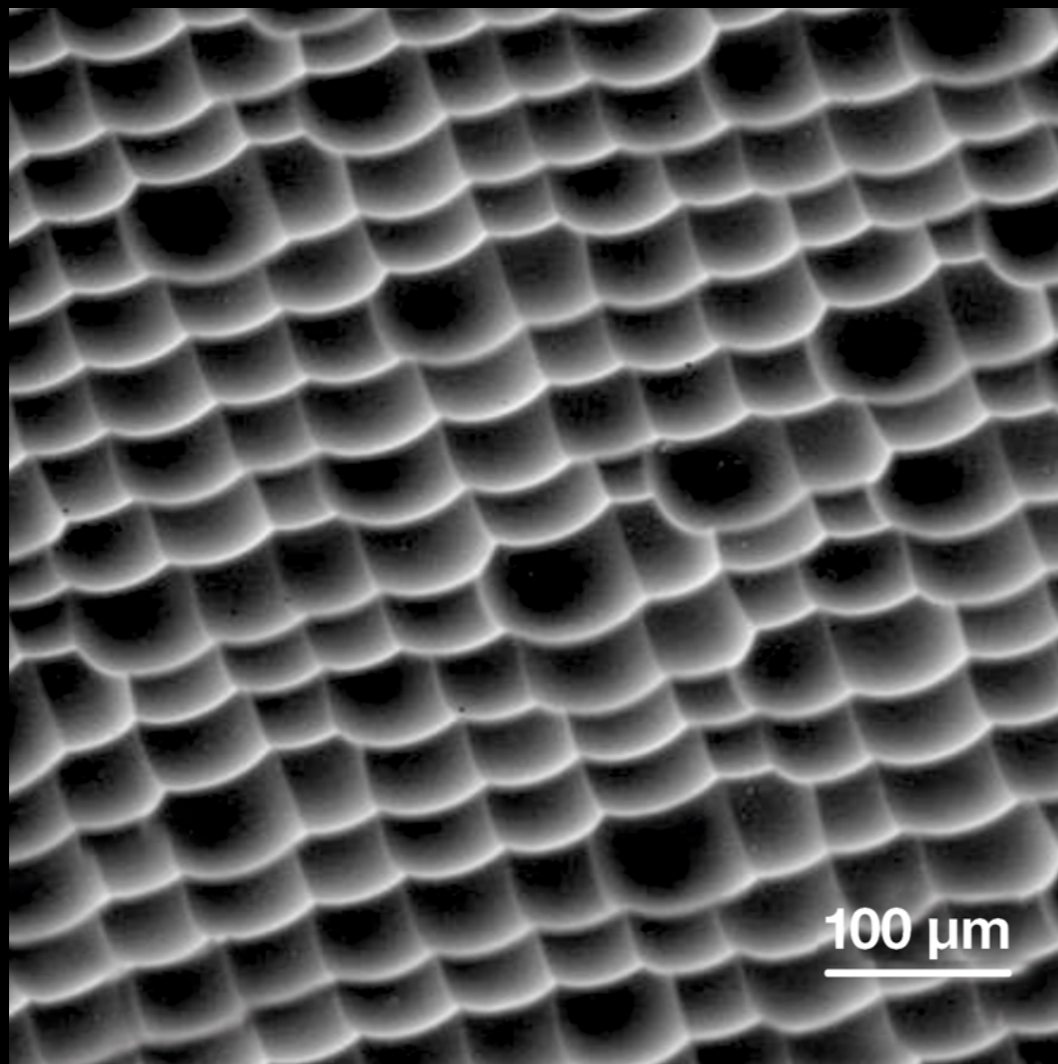
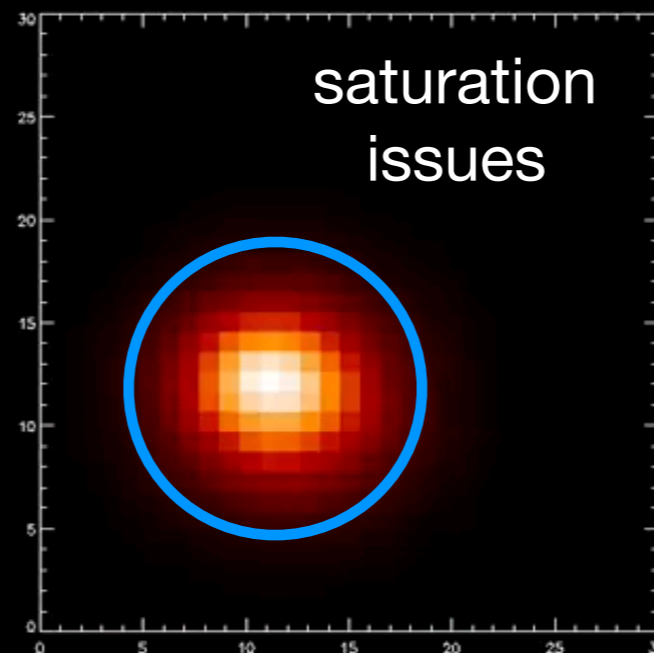


Image Credit: RPC  
Photonics

# What do diffused stars look like on our detector?

WIRC PSF comparison

Focused



See: Stefansson et al. (2017), Stefansson & Li et al. (2018),  
von Essen et al. (2019)

Video Credit: G.  
Stefansson; M. Zhao

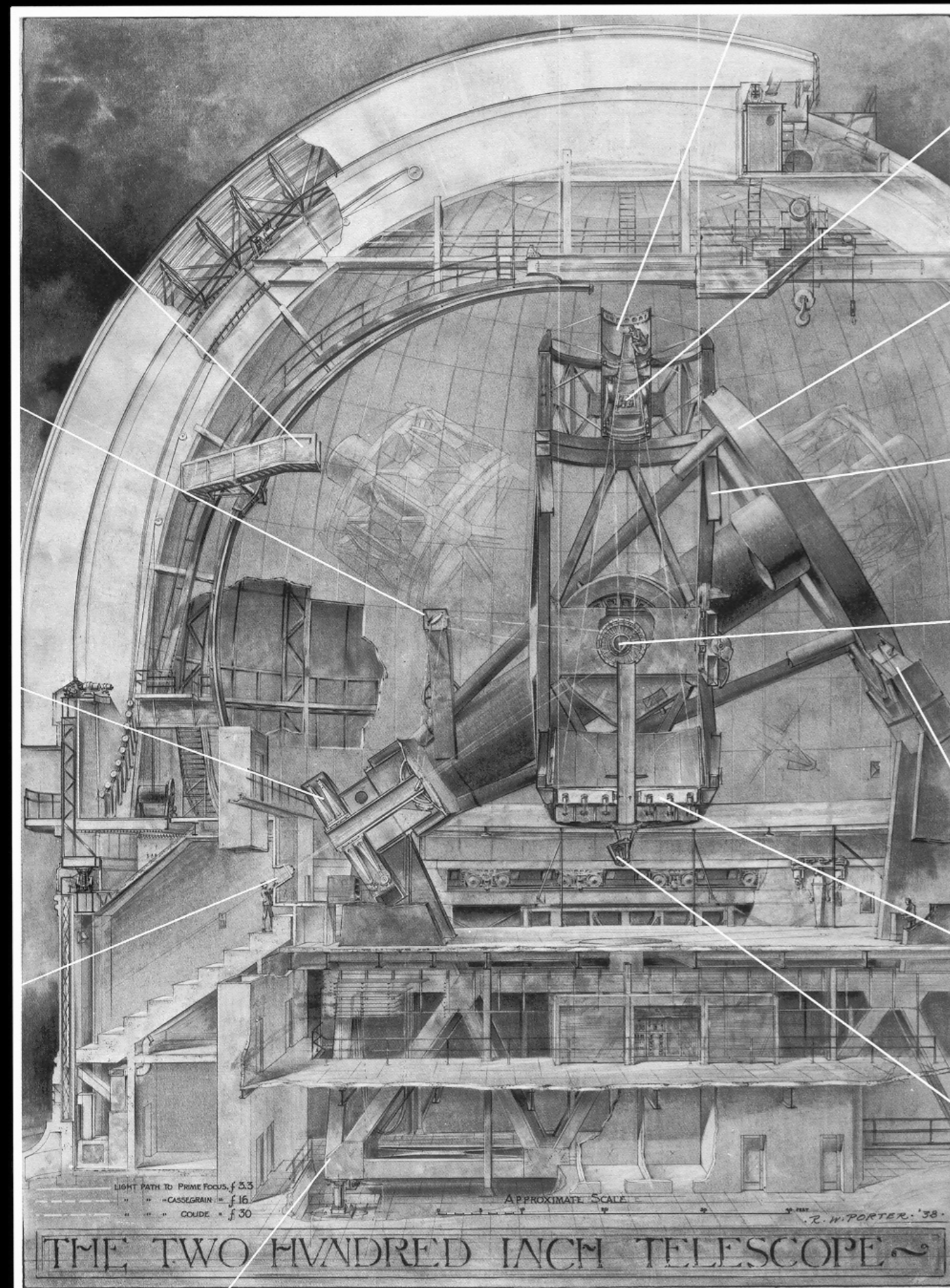
We added a diffuser to the  
Wide-field InfraRed Camera  
(WIRC)

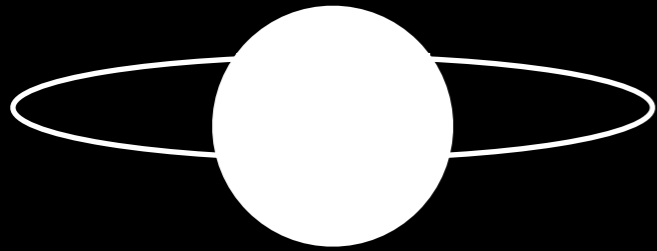
8.7' x 8.7' FOV, 2048x2048  
Hawaii-II, pixel scale ~0.25"

Sensitive between 1 and  
2.5 micron (JHK)

Located at prime focus  
of the Hale 200"

**Image Credit: R. Porter,  
NASA/JPL-Caltech**

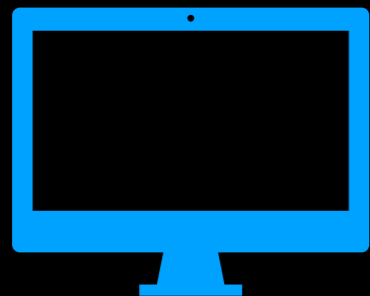




Introduction: transiting  
exoplanets

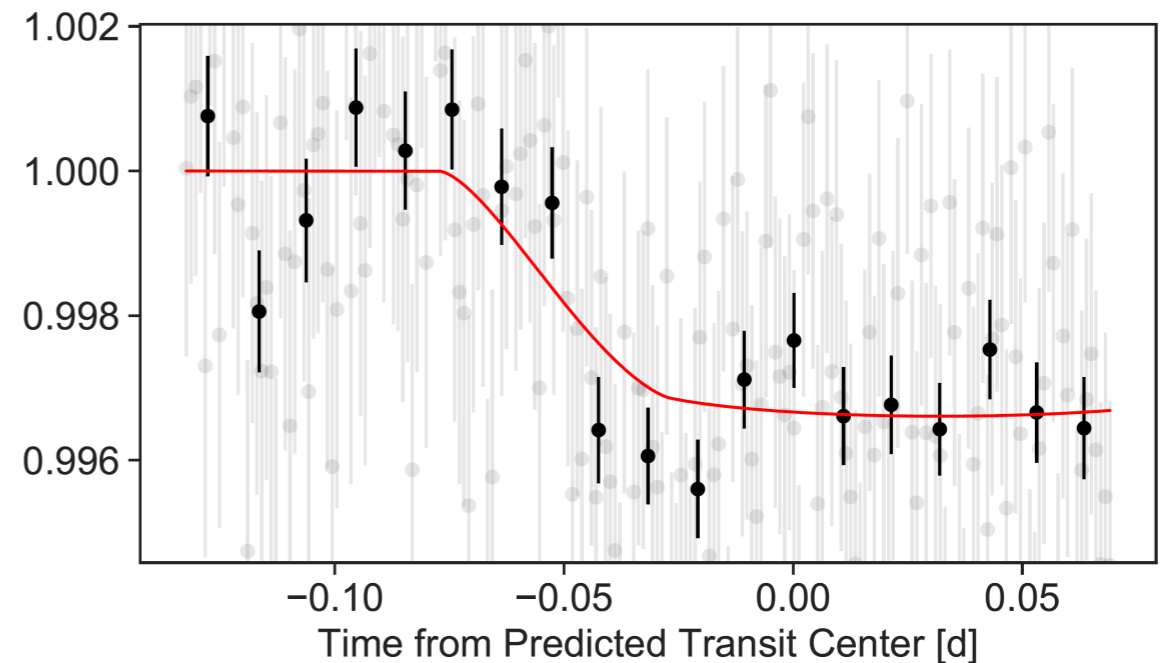
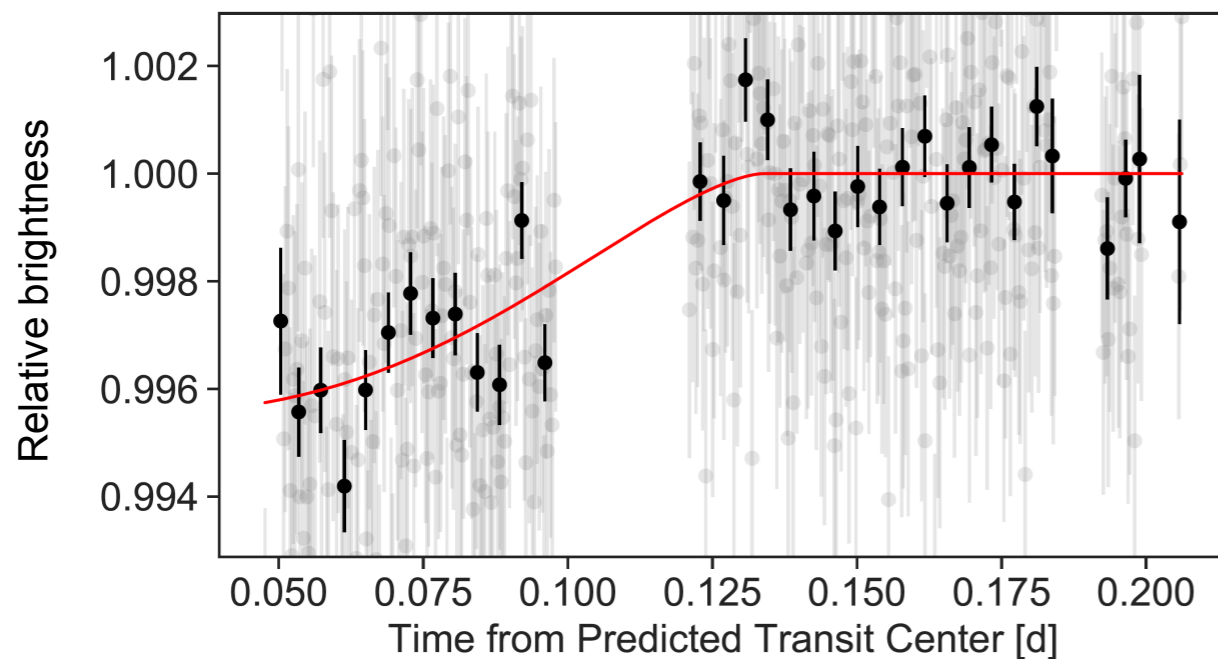
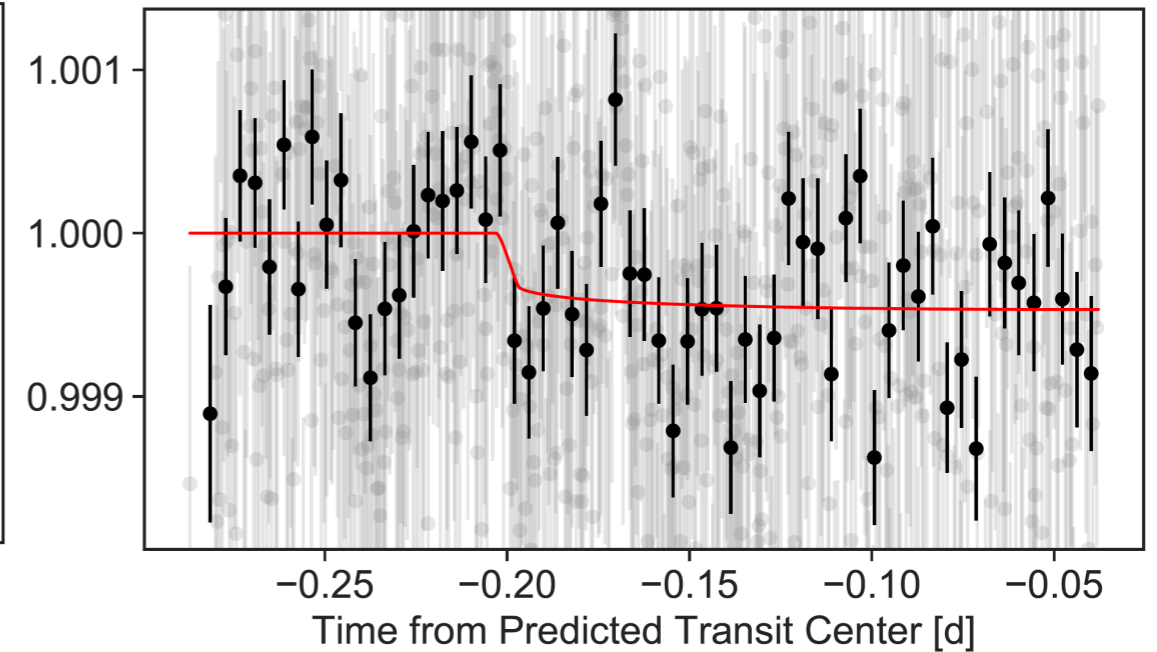
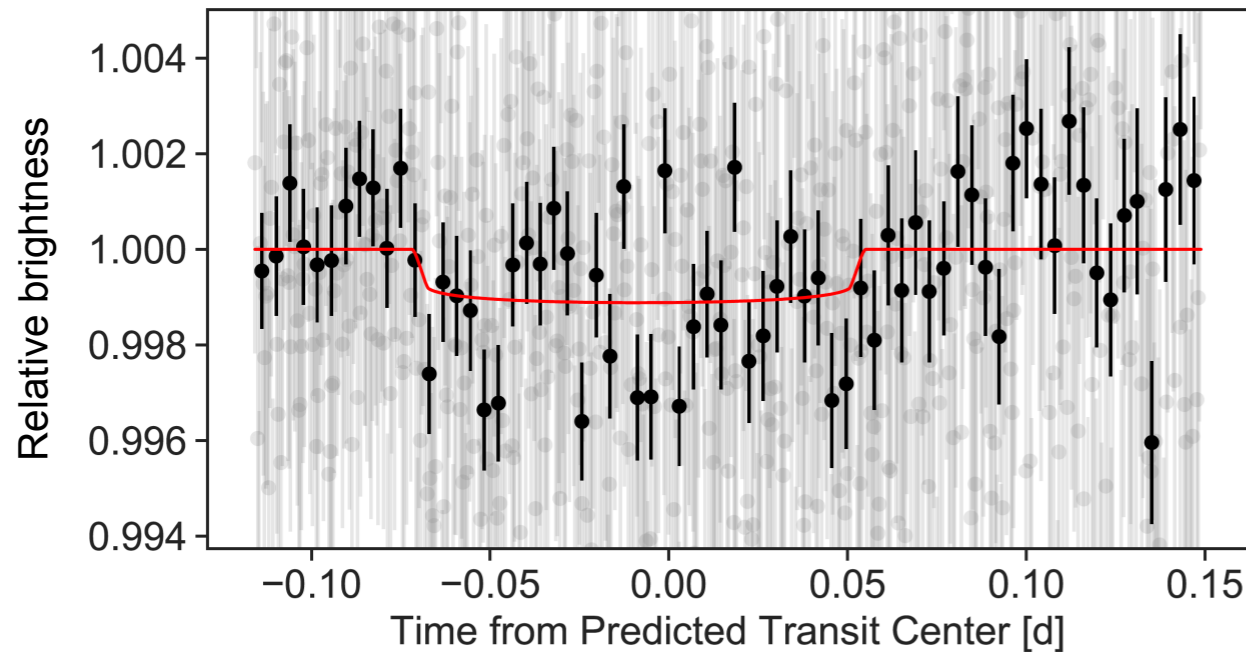


Methods: diffuser-  
assisted photometry



**Results and future work**

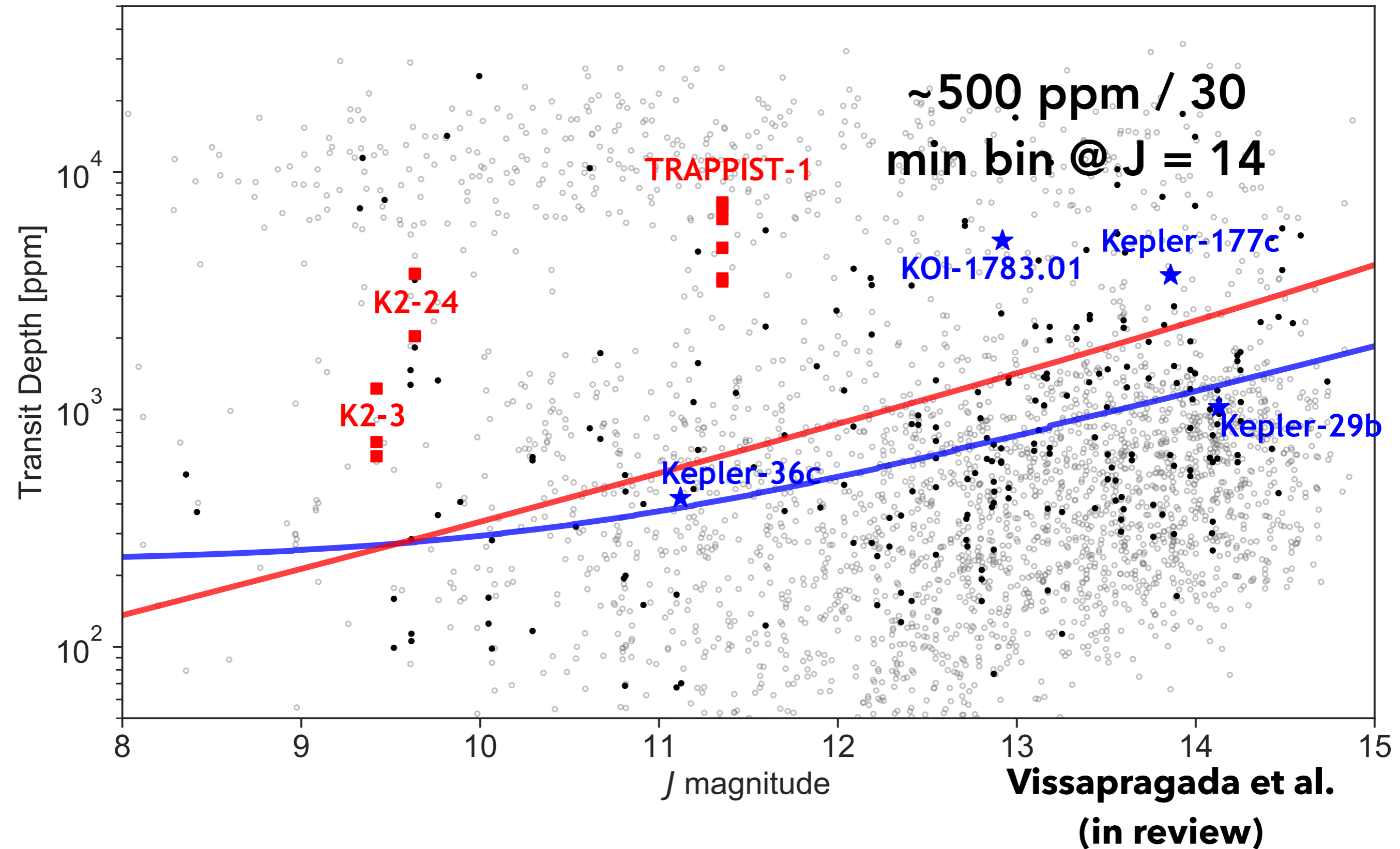
# Four dynamically interacting Kepler systems



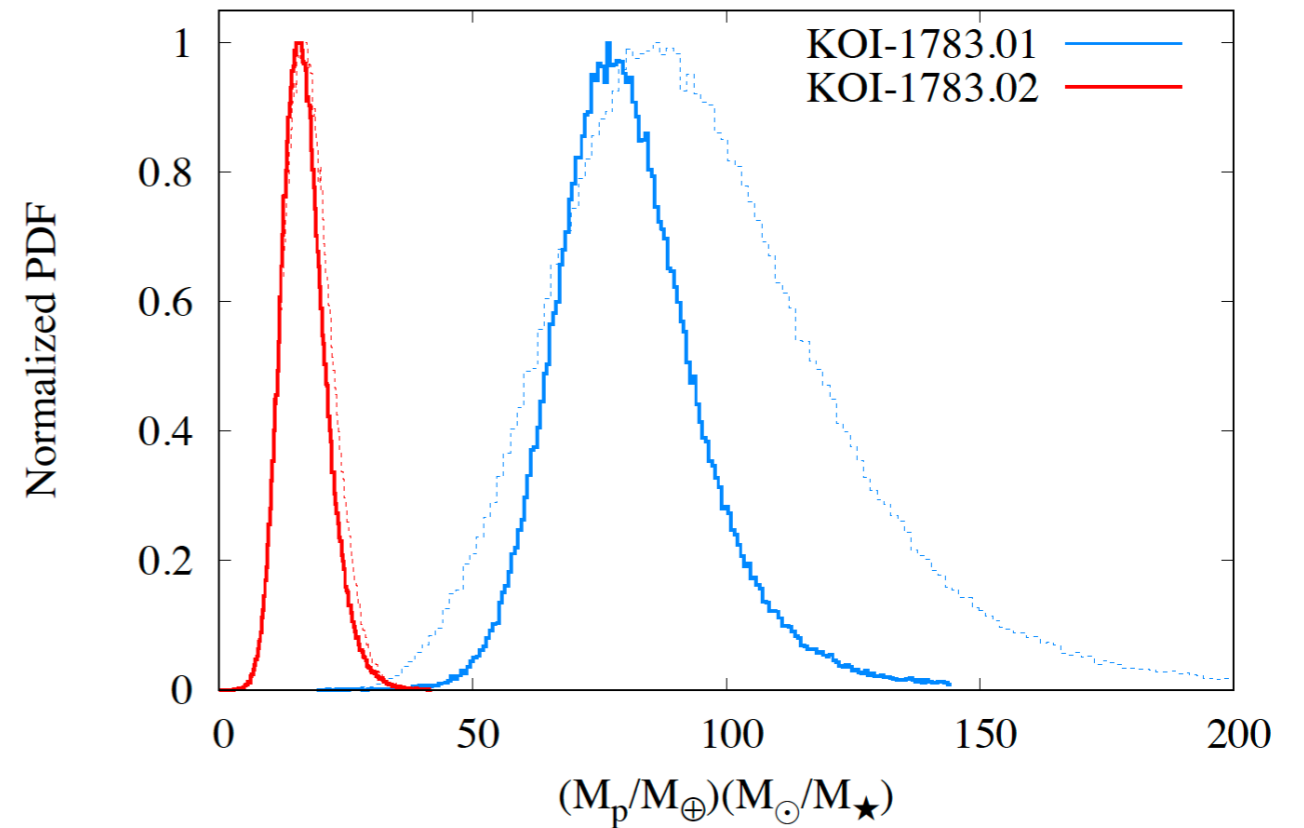
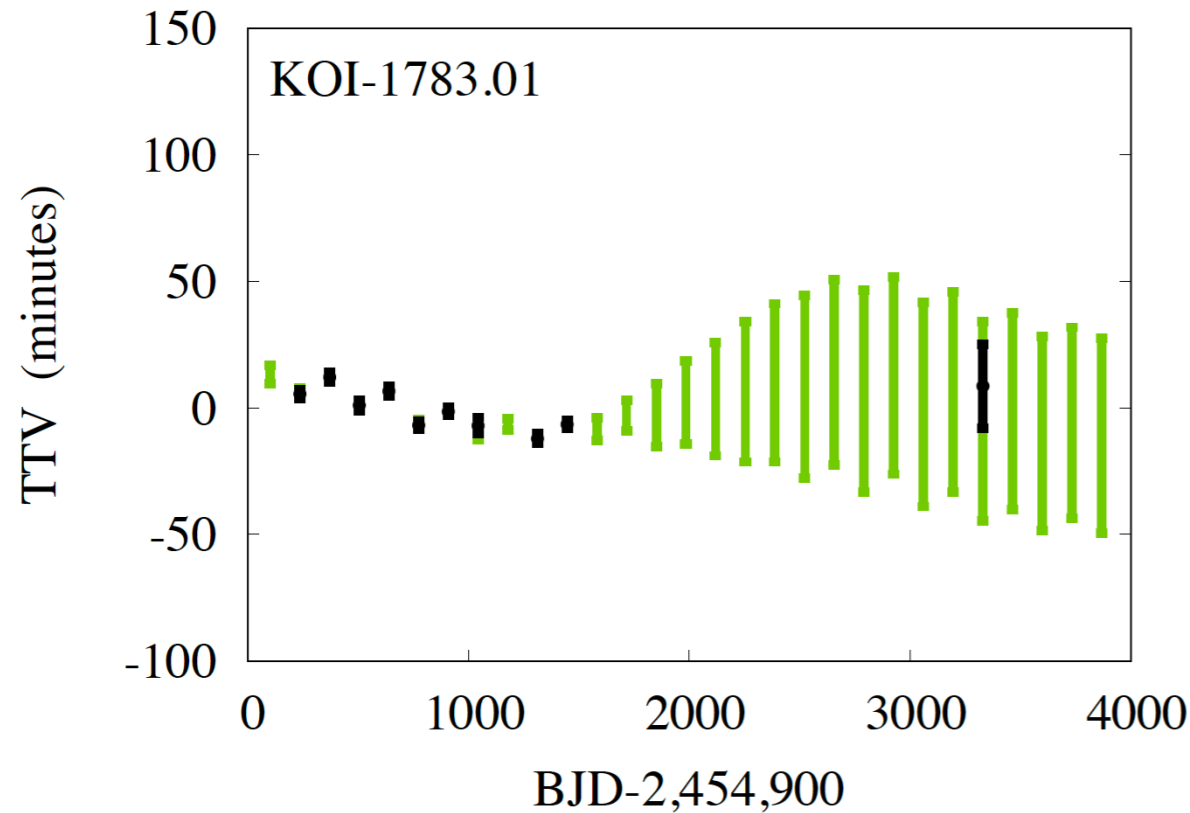
1.2-1.5x photon noise; timing  
precisions ~10 min

**Vissapragada et al.**  
**(in review)**

# Offers a replacement to *Spitzer*!



# KOI-1783: a newly confirmed system near 2:1 mean-motion resonance



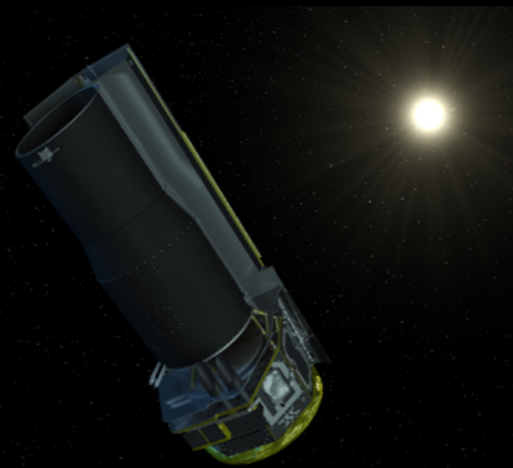
**Mass of the giant KOI-1783.01  
improved by 2x!**

**Vissapragada et al.  
(in review)**

# Summary

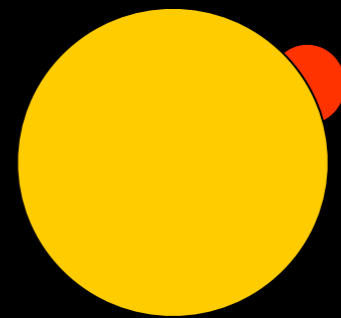


= 2 x

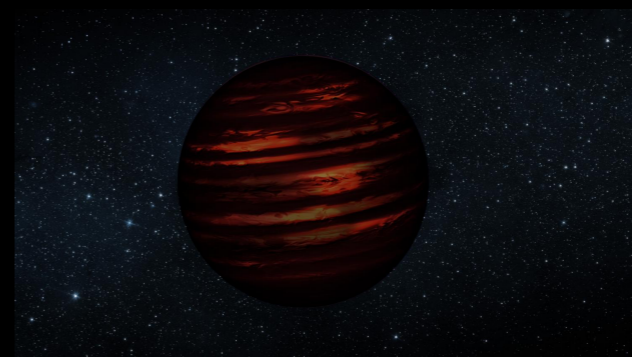


(at  $J = 14$ )

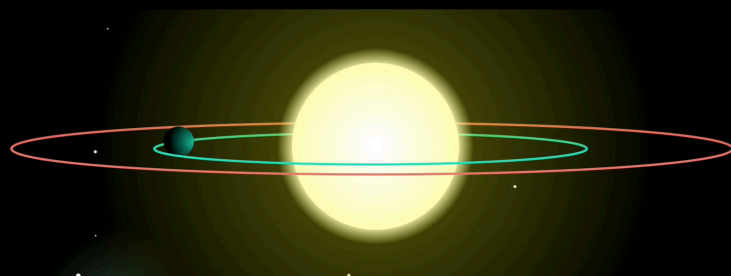
NIR  
secondary  
eclipses



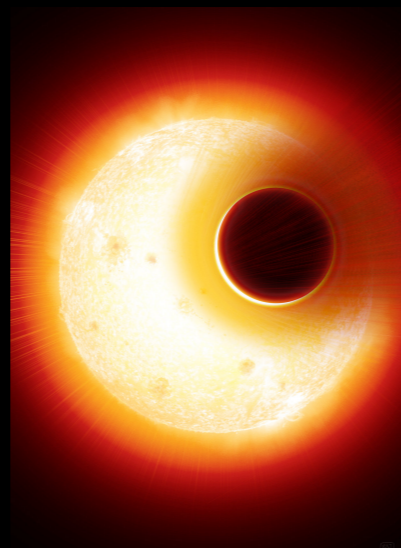
brown  
dwarf  
variability



tidal decay  
physics



dynamically  
-interacting  
systems



atmospheric  
escape