Investigating Habitable Worlds: Validating and Characterizing Kepler-Identified Planet Candidates around M Dwarf Stars

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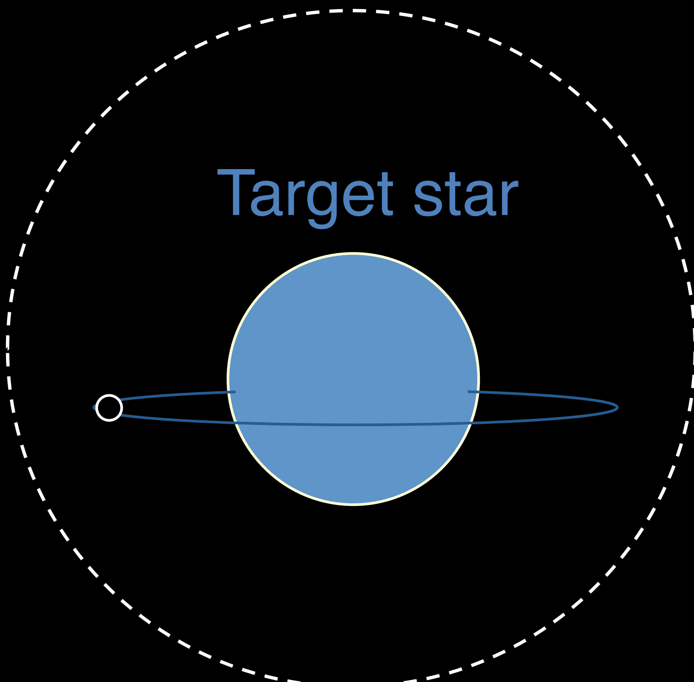
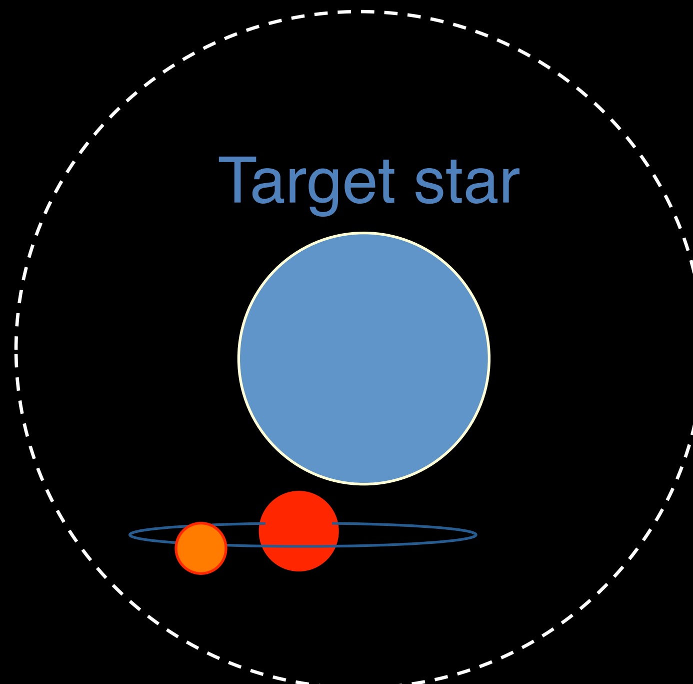
Validating *Kepler* Planet Candidates with Transit Color Dependence

Two scenarios, same Kepler light curve:

1. Transiting planet



2. Eclipsing binary (Star + Star or Planet)



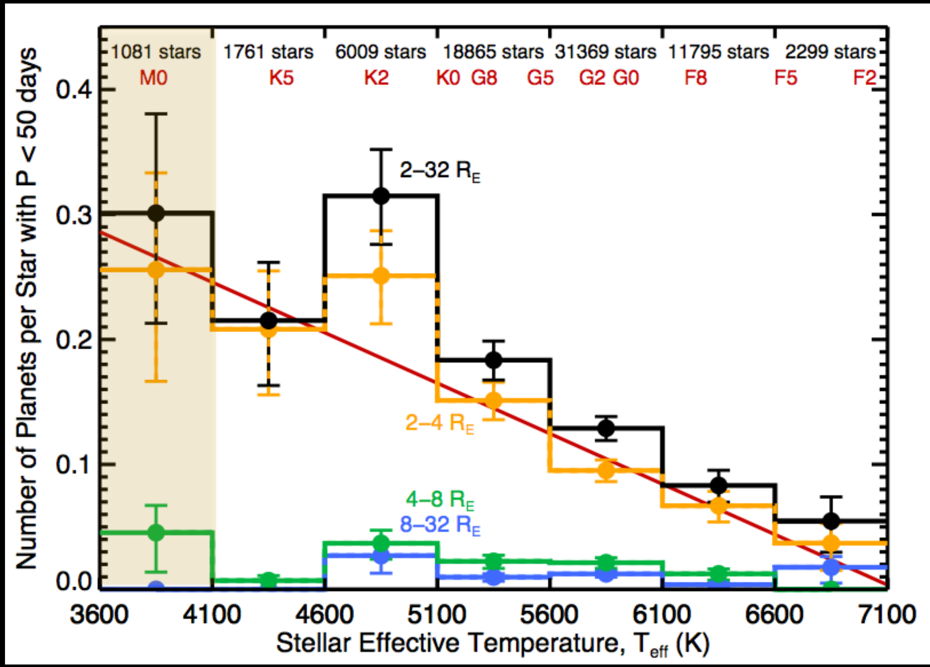
When observed at longer wavelengths with Spitzer:

1. Transit depth is the same as measured by Kepler

2. Transit depth is different

Why M dwarfs in particular?

Nature makes more small planets around M dwarfs!



Howard et al. (2011)

Star is less luminous, so habitable zone is closer to the star

→ transits of habitable-zone planets occur more often (easier to detect, easier *Spitzer* follow-up)

Star is smaller, so transits are deeper

→ transits of rocky planets easier to detect, RV follow-up possible, atmospheric follow-up easier

Characterizing M Dwarfs

We cannot know the planetary equilibrium temperature or radius without first knowing the temperature and radius of the host star. M dwarfs are notoriously difficult to characterize!

Inroads from near-infrared spectroscopy (Rojas-Ayala et al. 2011) + stellar evolutionary models = more accurate M dwarf physical parameters

For example, post near-IR spectra, the following Kepler planetary candidates around M dwarfs became smaller and cooler overnight! (Muirhead et al. 2011)

$1\ R_{Earth}$ = **$1\ R_{\odot}$ =**

KOI	Radius of Planet	Radius of star	Equilibrium temp
663.02	→	→	436 → 341
817.01	→	→	370 → 327
854.01	→	→	248 → 229
899.03	→	→	397 → 336
947.01	→	→	353 → 294
952.03	→	→	365 → 328
1361.01	→	→	279 → 257