Planet Validation in the Era of TESS: Discussion Prompts

Key Question: *What kinds of data analysis techniques and follow-up observations will be the most useful for assessing the planethood of TESS Objects of Interest?*

Background Information

1. What kinds of astrophysical systems can mimic exoplanet transits?
2. How do the properties of a host star affect the shape of a transit light curve?
3. Imagine that you've detected a planet candidate orbiting a star that was previously believed to be isolated. How would your interpretation of the transit signal change if you detect a fainter star very close to the candidate host star?
4. How could you use the following types of observations to distinguish bona fide planets from astrophysical false positives?
    a. Seeing-limited imaging
    b. High-resolution AO or speckle imaging
    c. Time series photometry (possibly at multiple wavelengths)
    d. Single epoch stellar spectroscopy
    e. Reconnaissance radial velocity observations (measure signals of roughly 50 m/s)
    f. Extremely precise radial velocity observations (measure signals of roughly 1 m/s)

The *Kepler* Mission

5. Using the tables available on the NASA Exoplanet Archive, what fraction of *Kepler* Objects of Interest (KOIs) were subsequently classified as astrophysical false positives?
    a. How does this compare to the number of planet candidates and validated planets?
    b. Is the fraction of KOIs classified as astrophysical false positives constant across planet and stellar properties?
    c. Based on your answer to part (b), which kinds of candidate transit signals should be viewed with the most skepticism?
6. What were the dominant types of astrophysical false positives detected by *Kepler*?
7. In the absence of follow-up observations, which features of the *Kepler* data might reveal that a signal is caused by an astrophysical false positive?

Differences Between *Kepler* & TESS

8. How many planets were detected by *Kepler* and how does this compare to the number of anticipated TESS detections?
9. How do the brightnesses, masses, and distances of typical TESS targets compare to those of *Kepler* targets?
10. Compare the observational cadences used by Kepler and TESS. What information is gained by observing at a higher cadence? Will that information be useful for revealing astrophysical false positives?

You may wish to consult the following resources:

The NASA Exoplanet Archive: https://exoplanetarchive.ipac.caltech.edu/
The Exoplanet Follow-up Observing Program: https://exofop.ipac.caltech.edu/
The NASA Kepler & K2 Missions: https://www.nasa.gov/mission_pages/kepler/main/index.html
The NASA TESS Mission: https://tess.gsfc.nasa.gov/