Pre-Cursor Data Needed for JWST Transit and Eclipse Observations

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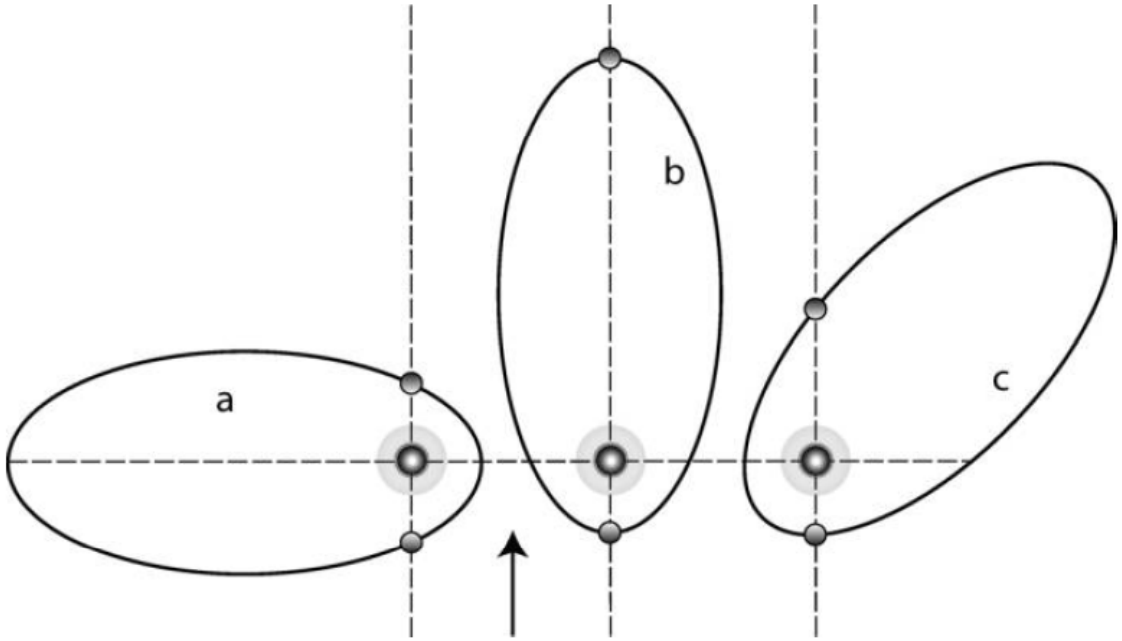
Prediction of Transit & Eclipse Times

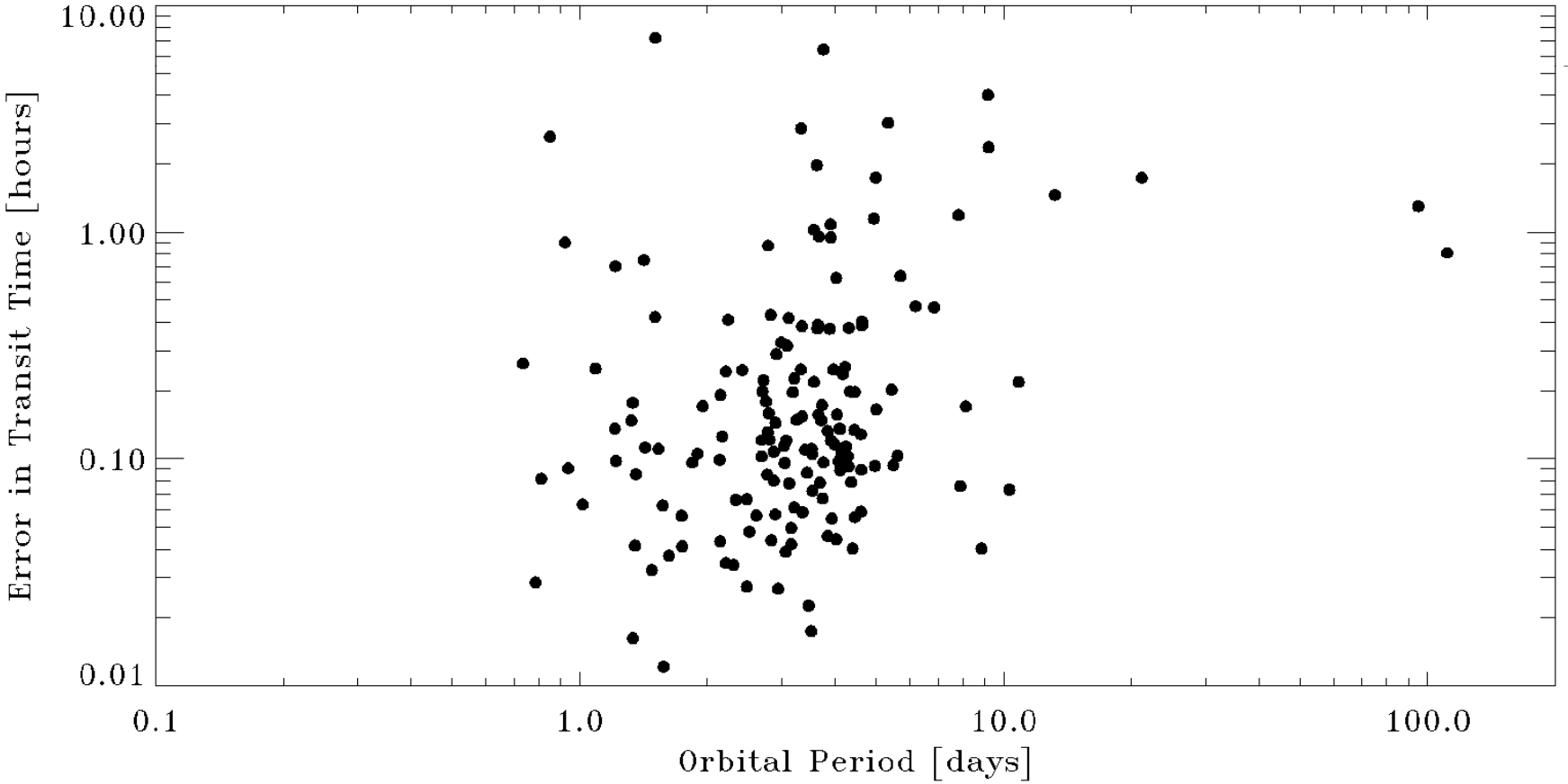
- Primary transits of KNOWN transiting systems likely not to be a big problem
- Secondary transit prediction much more problematic



- Predicted primary transits or phase curves of RV-planets – probably not a realistic use of JWST time

Primary Transits

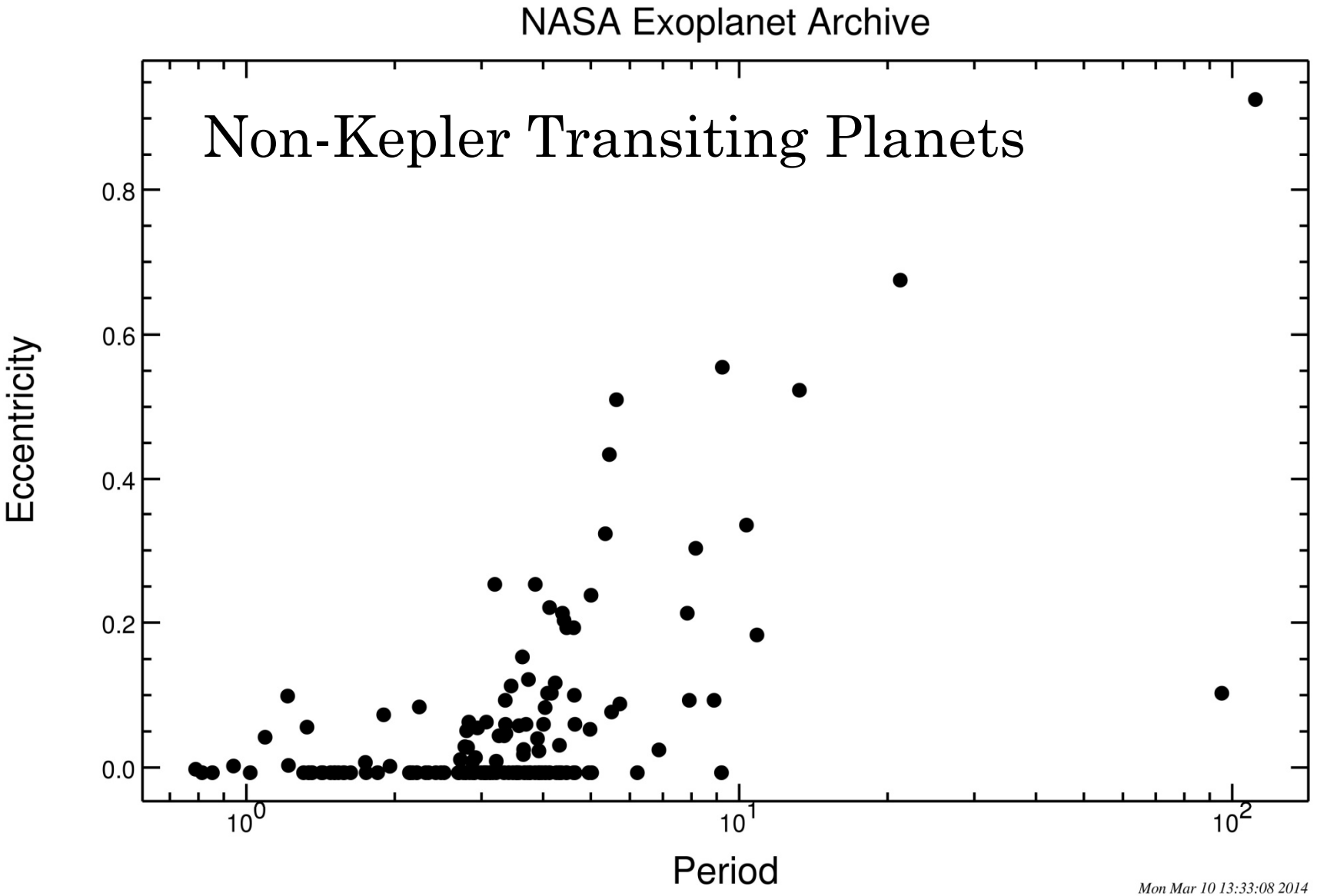
- Known (non-Kepler) transit uncertainties (period & epoch) propagated to mid-2018
- Does not include systematic errors in ephemerides



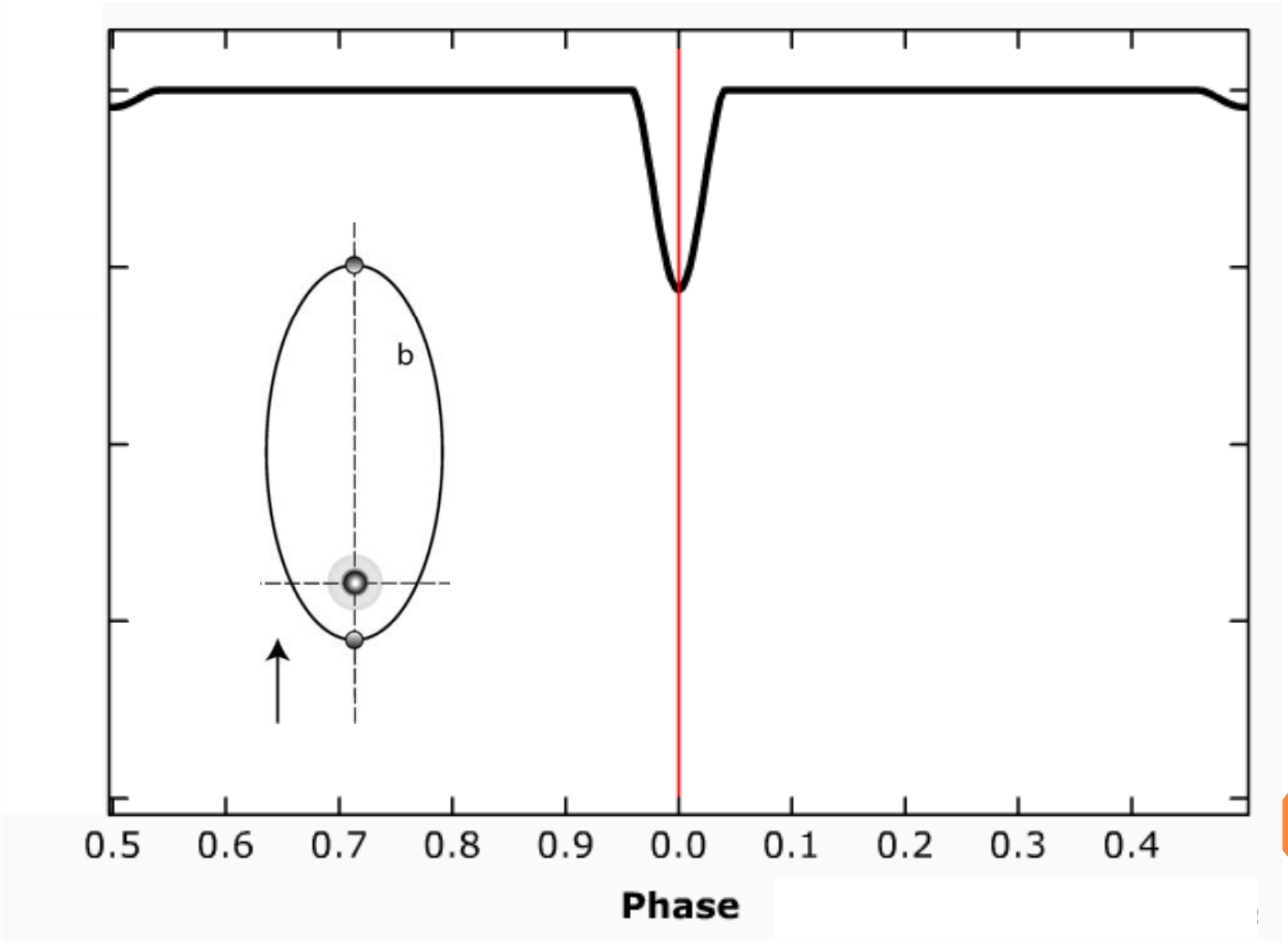
Secondary Eclipses

- This is much a more difficult problem
- Eclipses generally not previously measured
- Time of secondary eclipse depends on
  - Period
  - Eccentricity
  - Longitude of Periastron (!)
  - Epoch of Periastron (!)
  - Inclination
  - And the associated uncertainties

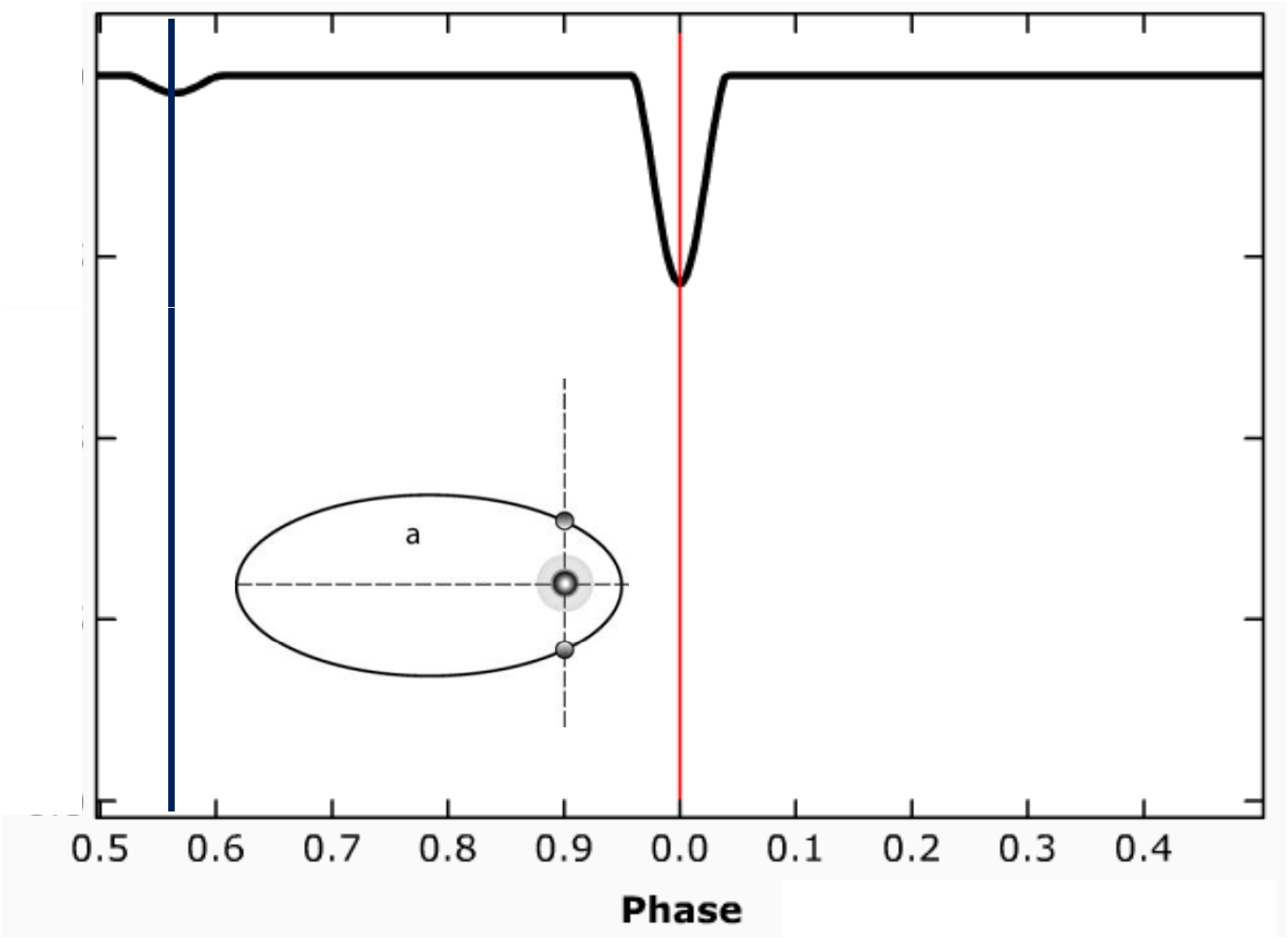
Eccentricity Distribution



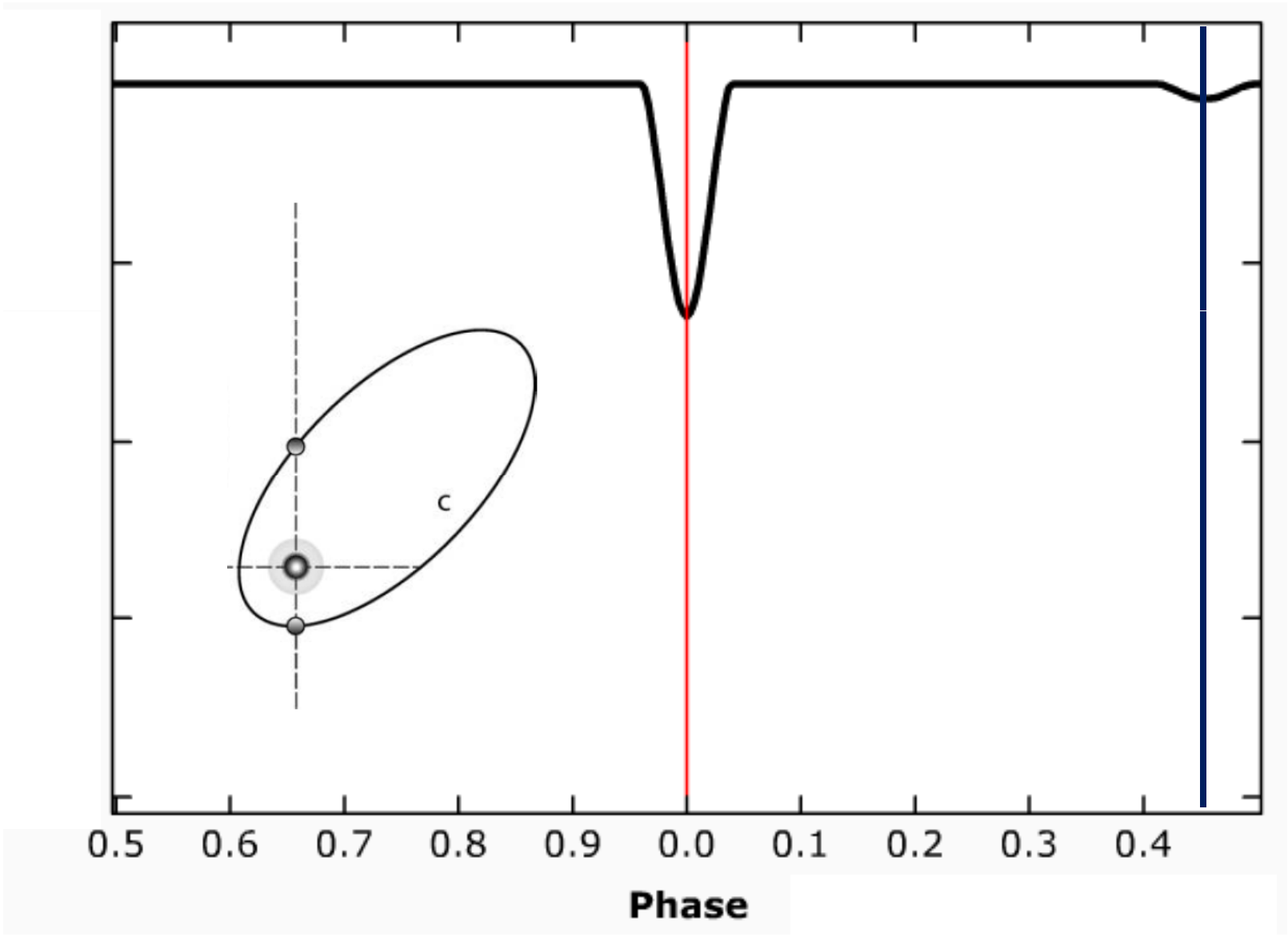
Eccentricity = N, longitude = 90



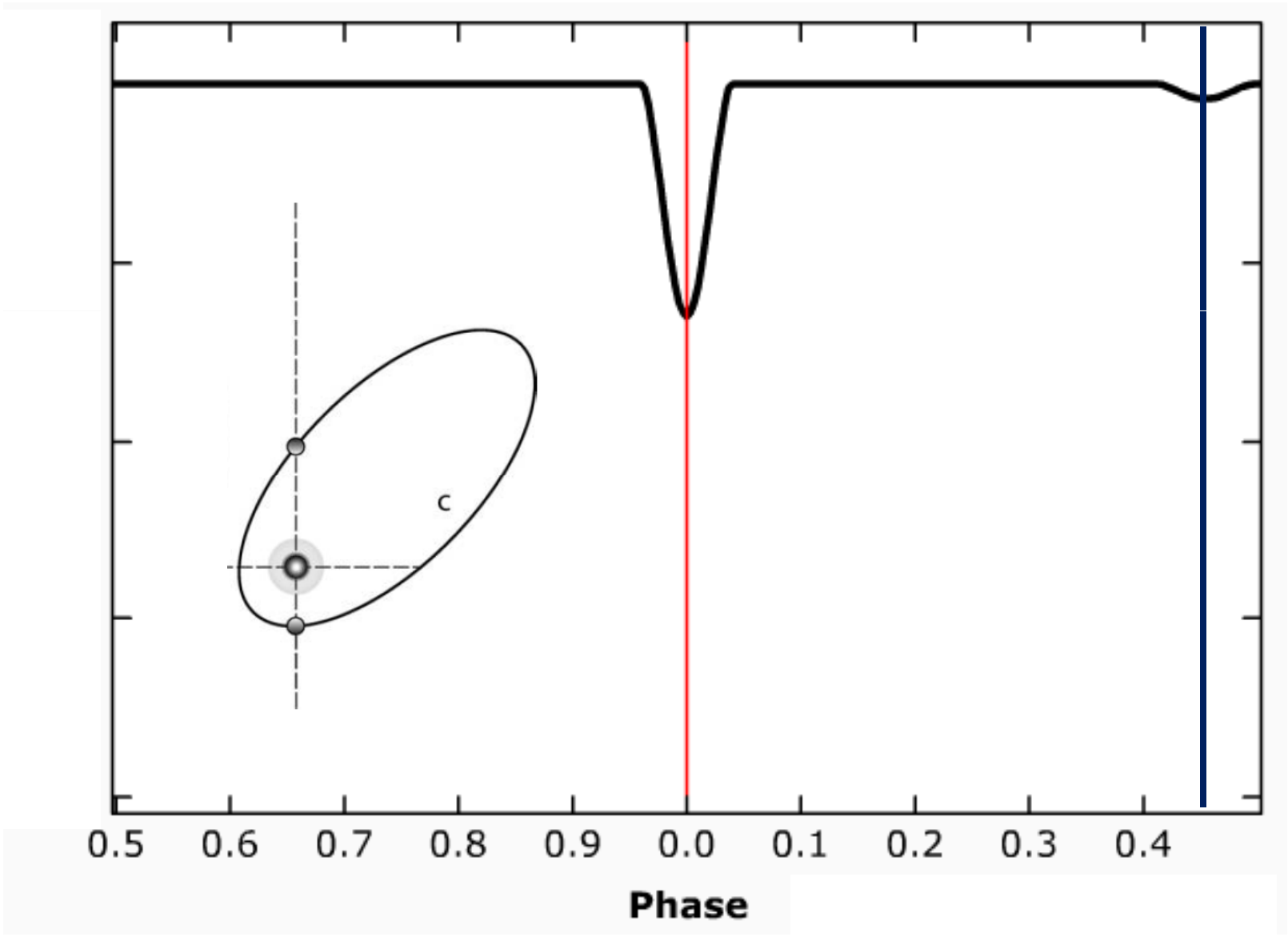
Eccentricity = 0.1, longitude = 0



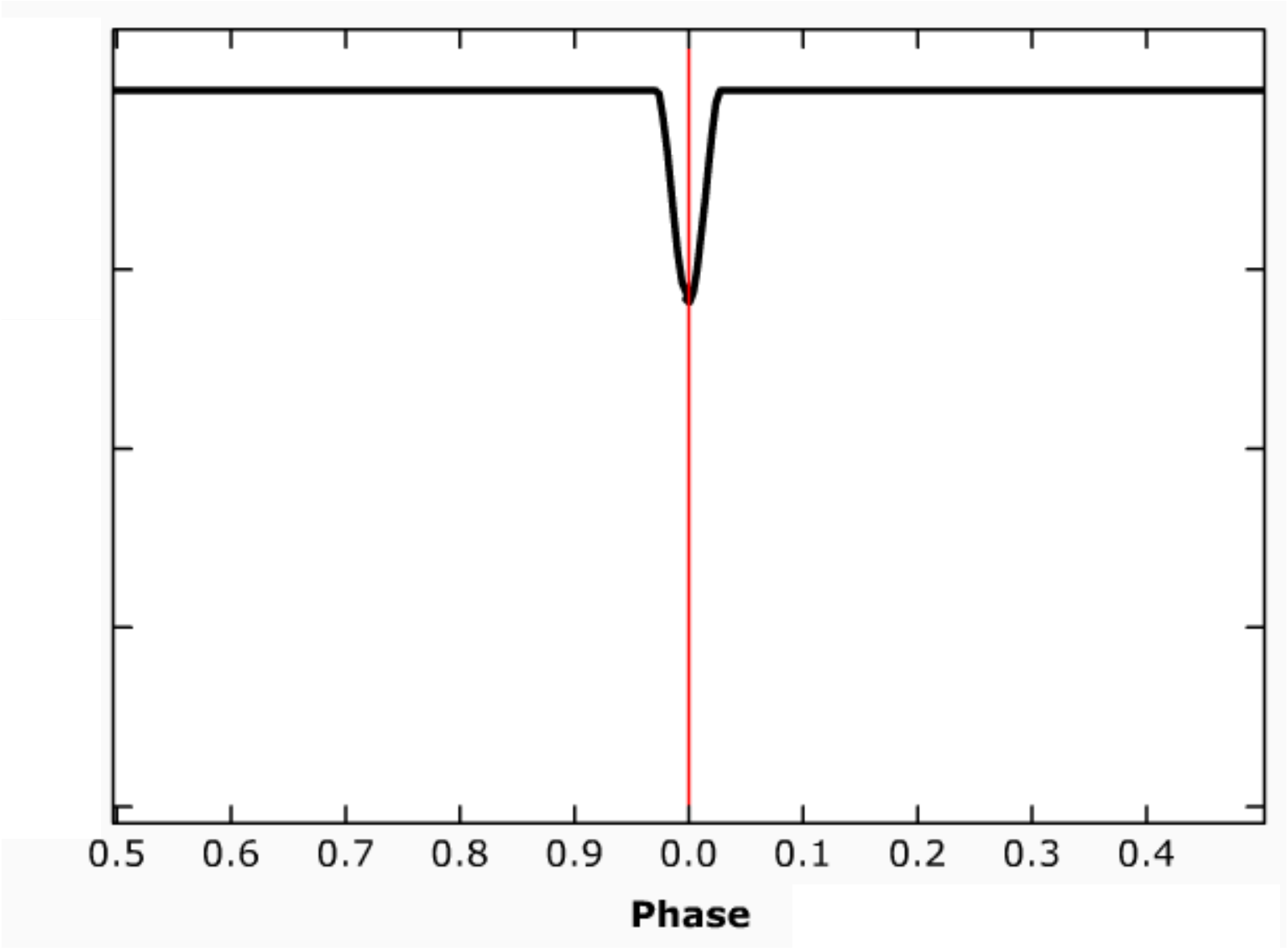
Eccentricity = 0.1, Longitude = 135



Eccentricity = 0.3, Longitude = 102.5



Eccentricity = 0.3, Longitude = 102.5, Inclination = 80



Kepler Sample

- 2903 Planetary Candidates
- 942 Confirmed or Validated Planets
- 20 – 30 planets have radial velocity orbits

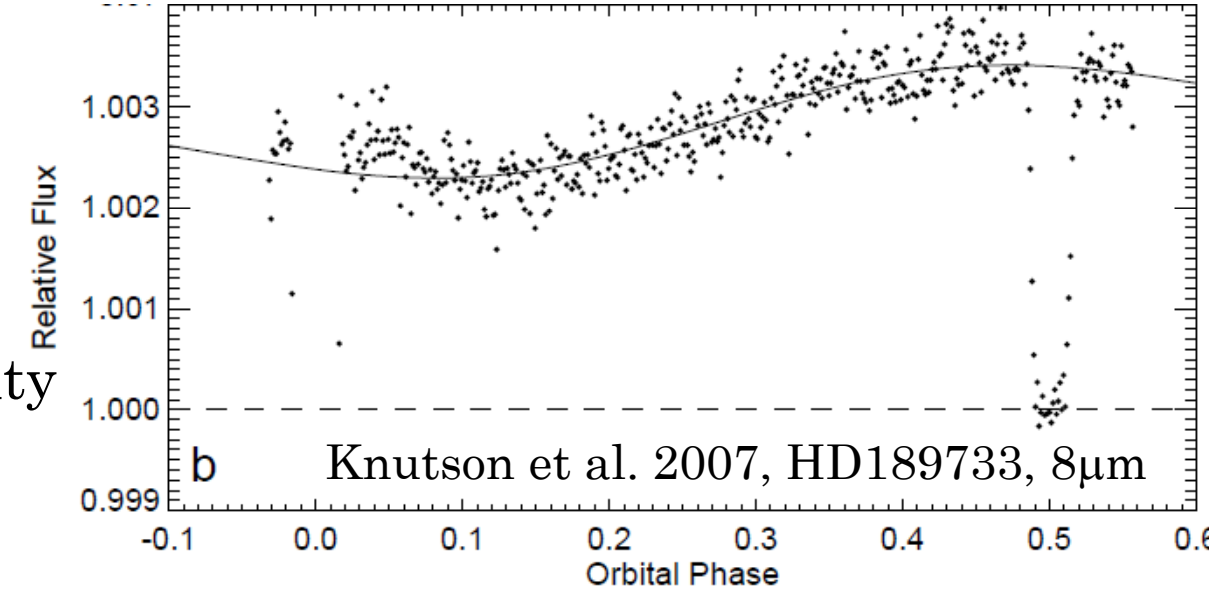
- Problem is likely even more expansive for TESS – but unlike Kepler (!)
  - Stars will be brighter
  - Orbital periods shorter
  - Planets more massive
  - Radial velocity easier

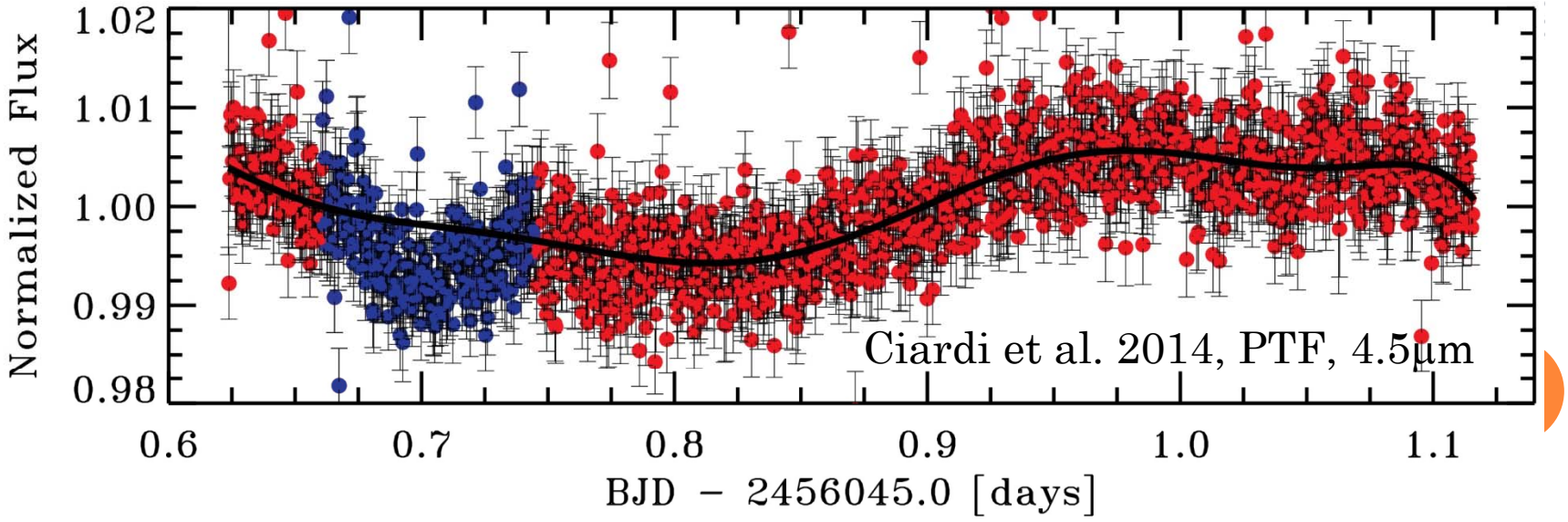
Target Selection

- Systems with transiting planet already known
  - Brightness of target already known
  - Stellar characterization already known
  - High resolution image to make sure no nearby contaminating stars – Likely already obtained particularly for Kepler, K2, and TESS targets
- Variability
  - Stellar variability does affect the ability to measure the transit and eclipse depths accurately
  - Phase curves vs. stellar rotation are particularly hard
  - Stellar spots and variability minimized in the infrared

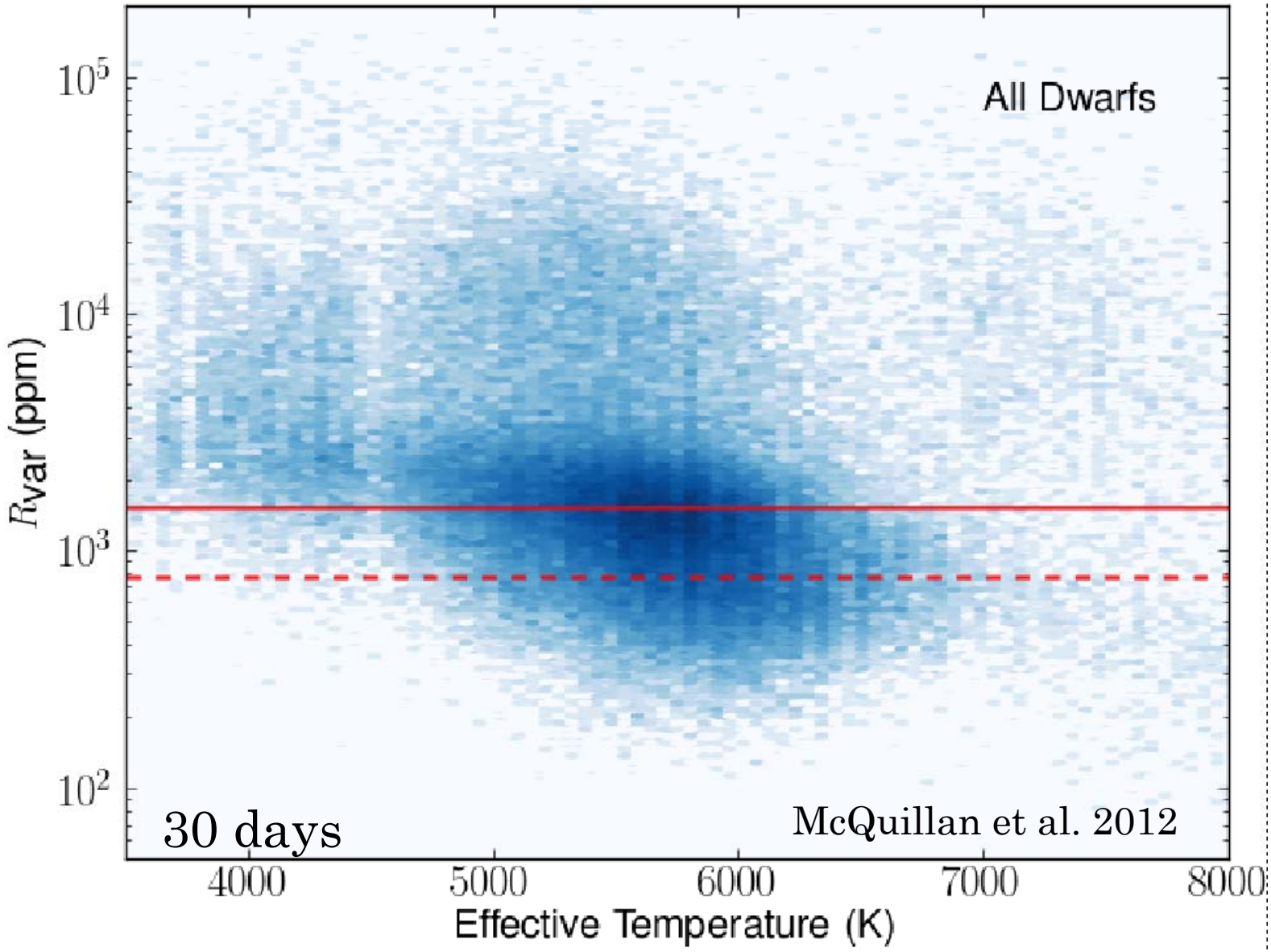
Phase Curves or Stellar Variability

- If phase curves are the goal rather than transits or eclipses, then stellar variability is much more crucial to understand

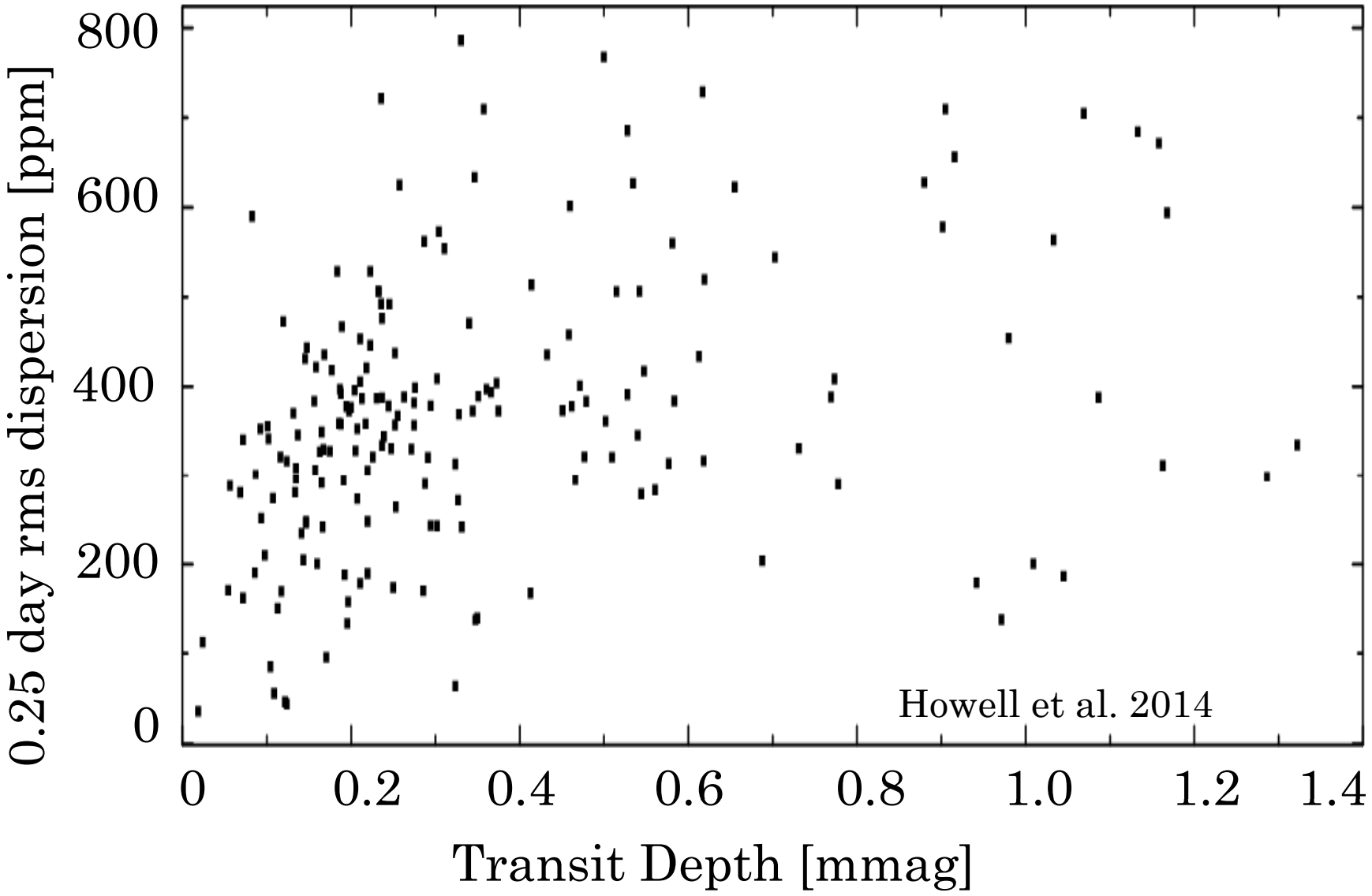




Stellar Variability



Smallest Planets around Quietest Stars



What's Needed Prior to Observing

- Orbital Parameters
  - Most important in terms of pre-cursor observations for planning purposes – particularly for secondary eclipse observations
  - Radial velocity monitoring or photometric monitoring to find secondary eclipse
- Stellar Variability Selection
  - Spots and variability could affect radii determinations
  - Strong Variability may be an issue particularly for phase curves