Warm Jupiter Migration in the Kepler-419 System

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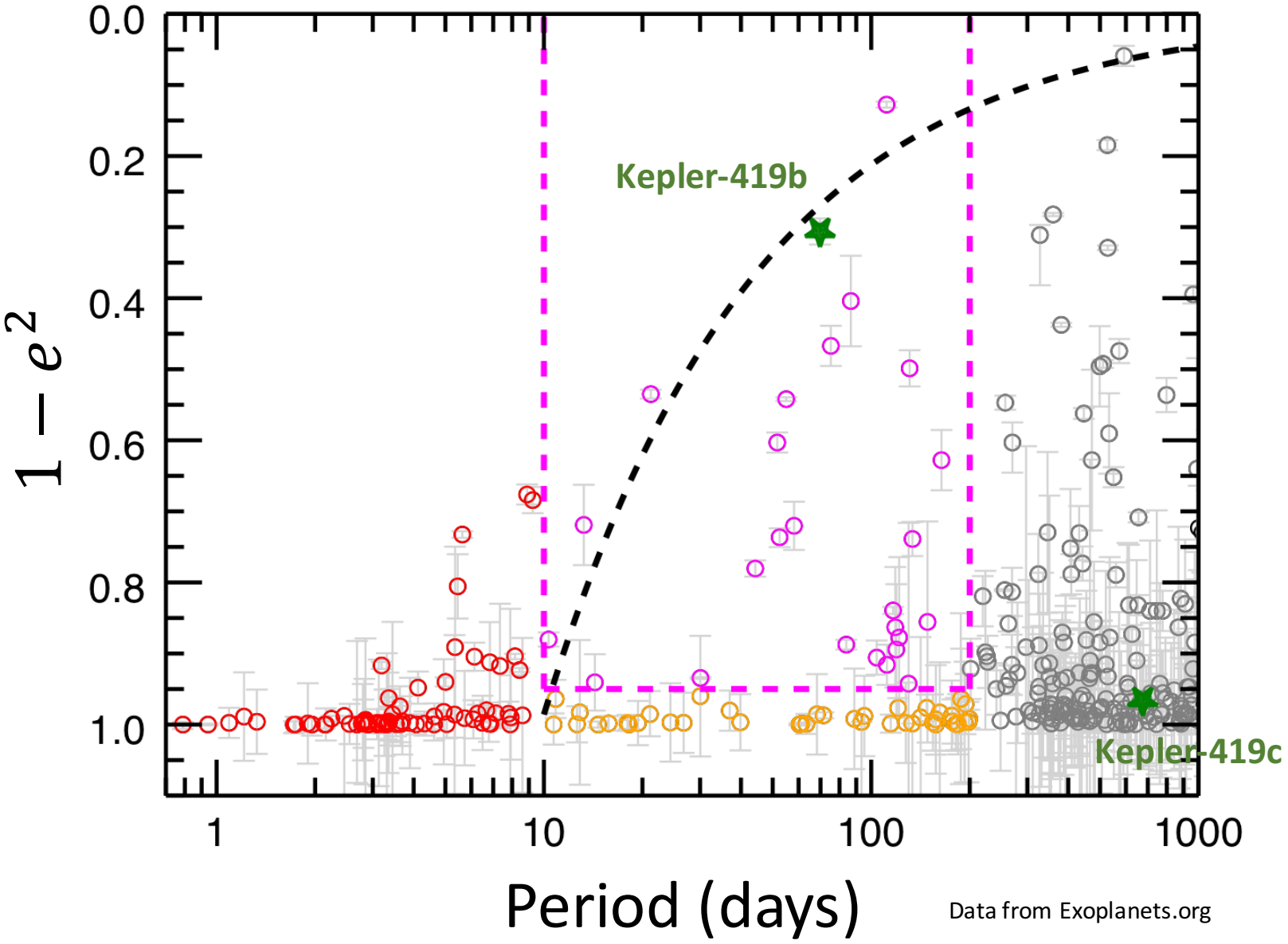
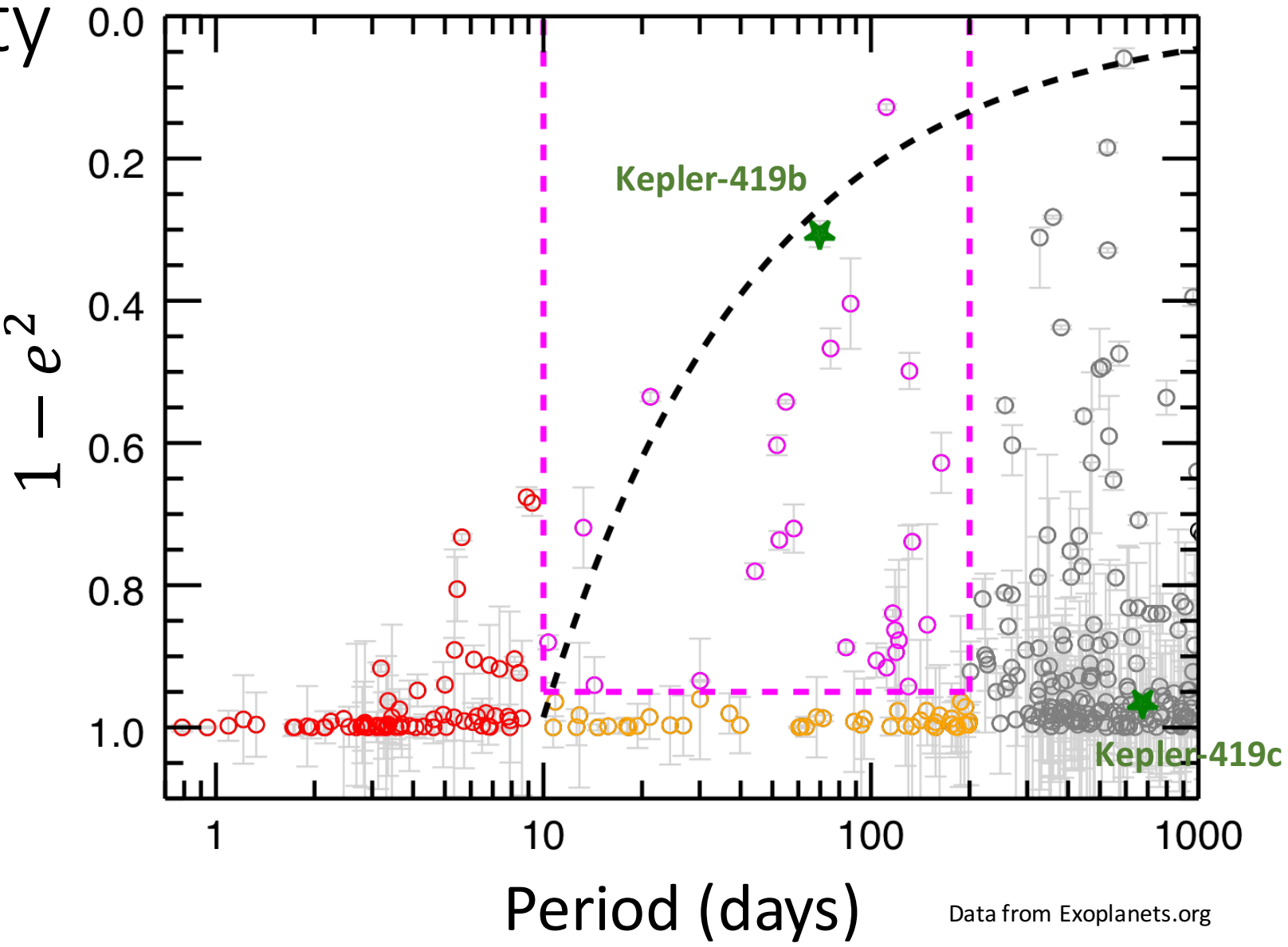
The origin story of warm Jupiters is largely a mystery



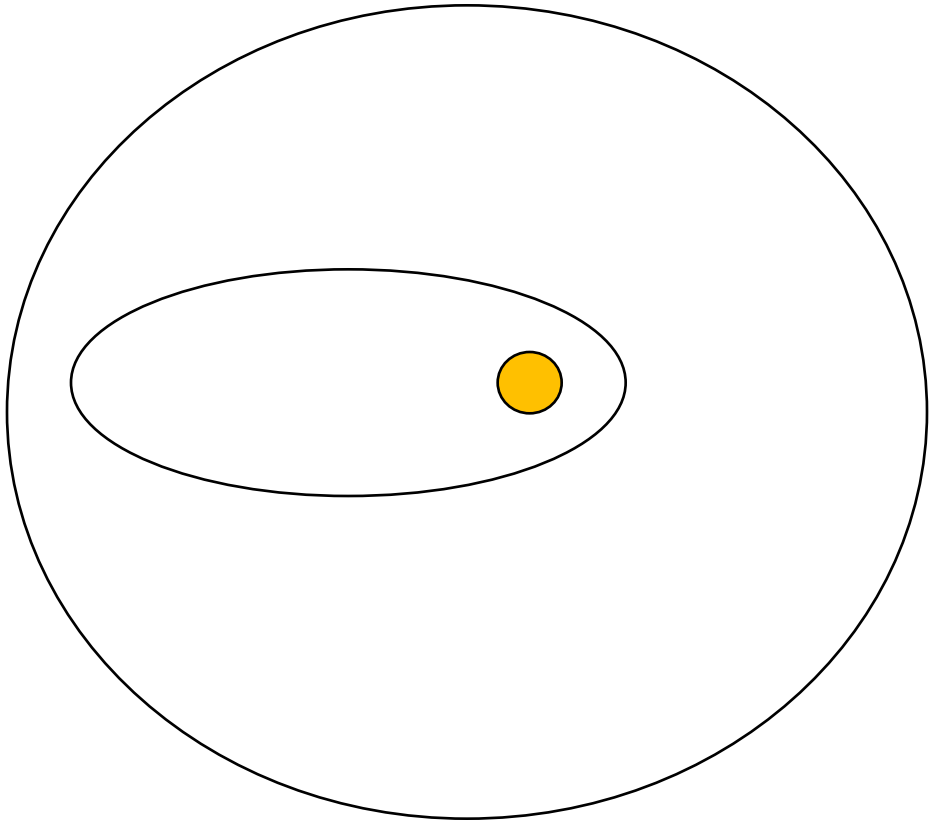
Secular eccentricity oscillations combined with high-e tidal migration could explain this population*



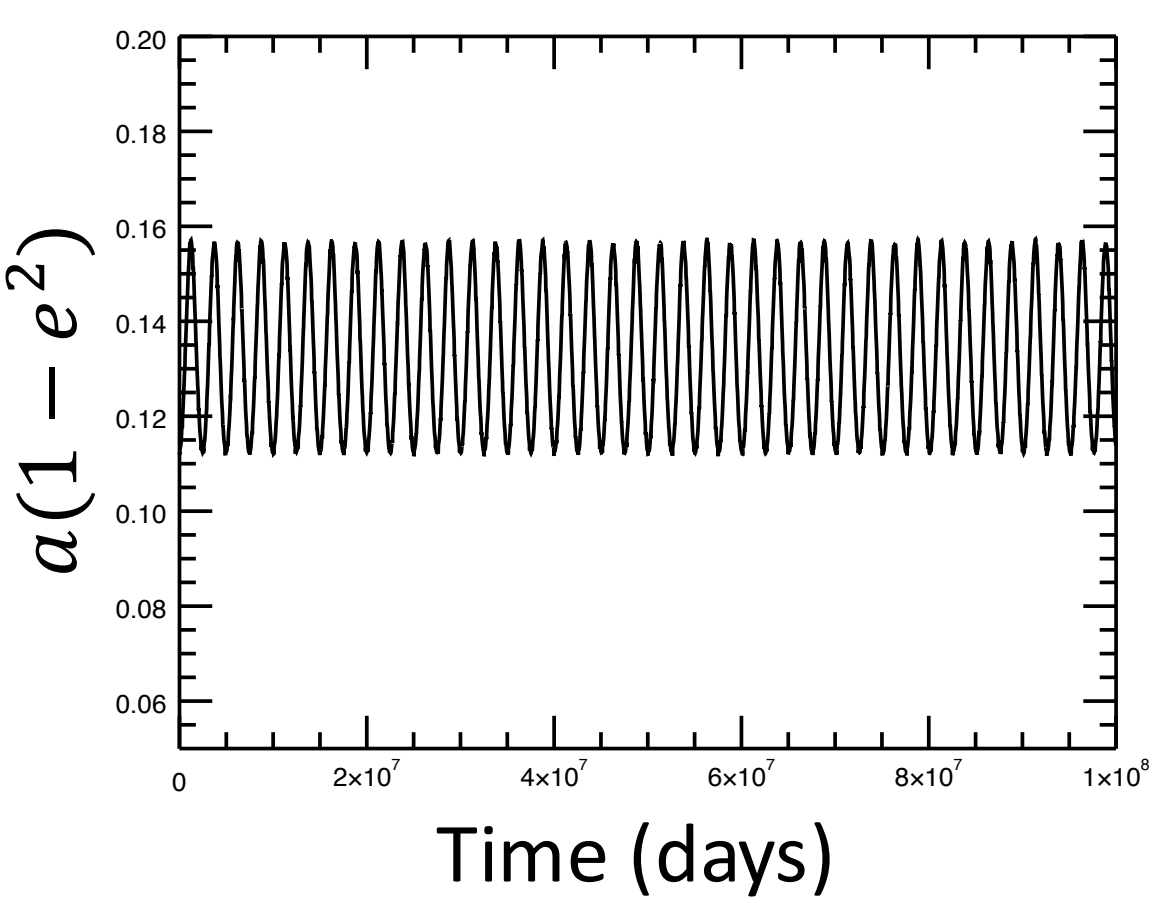
*Winn et al. 2010
Naoz et al. 2012
Petrovich and Tremaine 2016
Anderson and Lai 2017

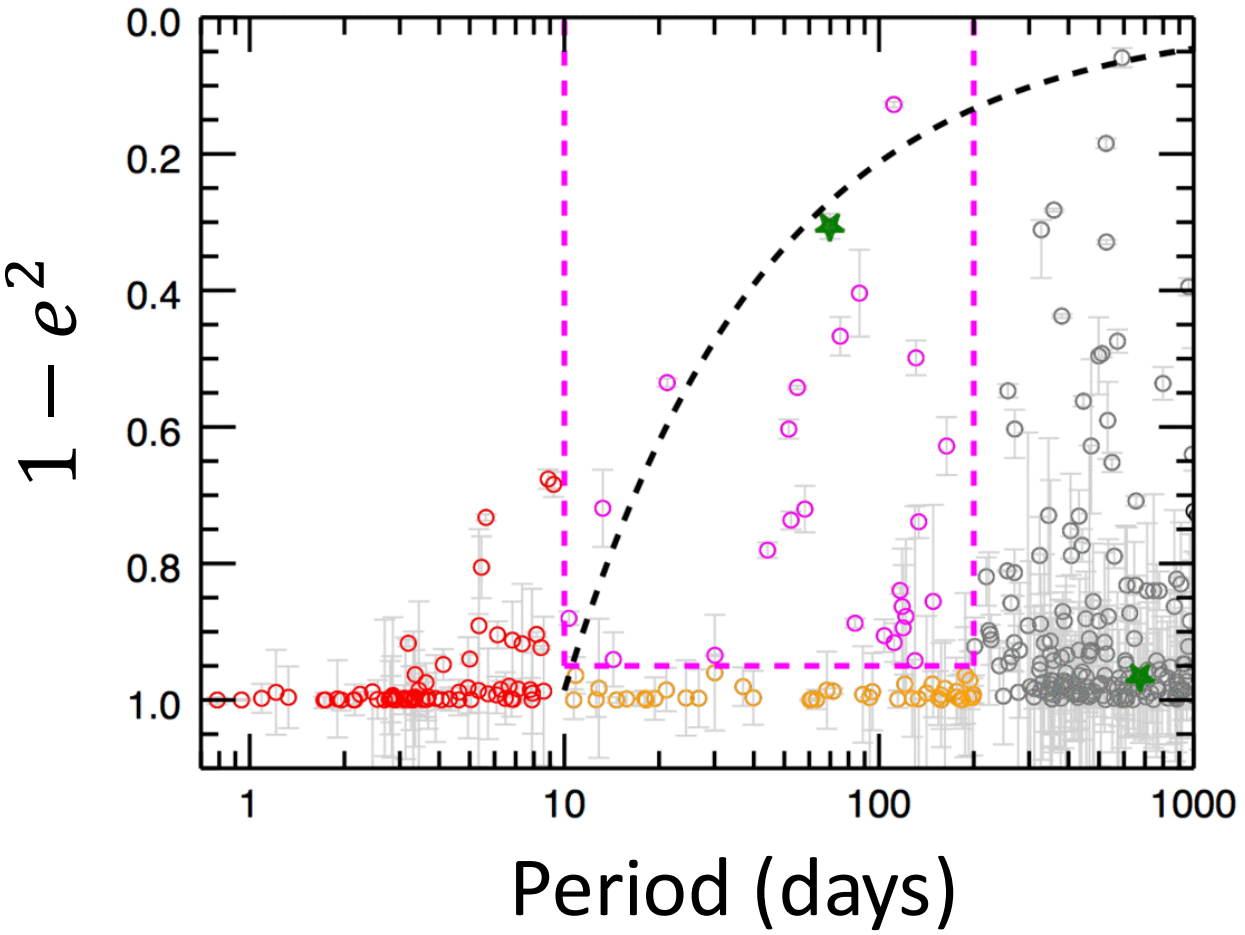
Kepler-419b is an ideal test case:

- Highly eccentric warm Jupiter ($e=0.833 \pm 0.013$)
- Known planetary companion (discovered with TTVs, Dawson et al. 2014)

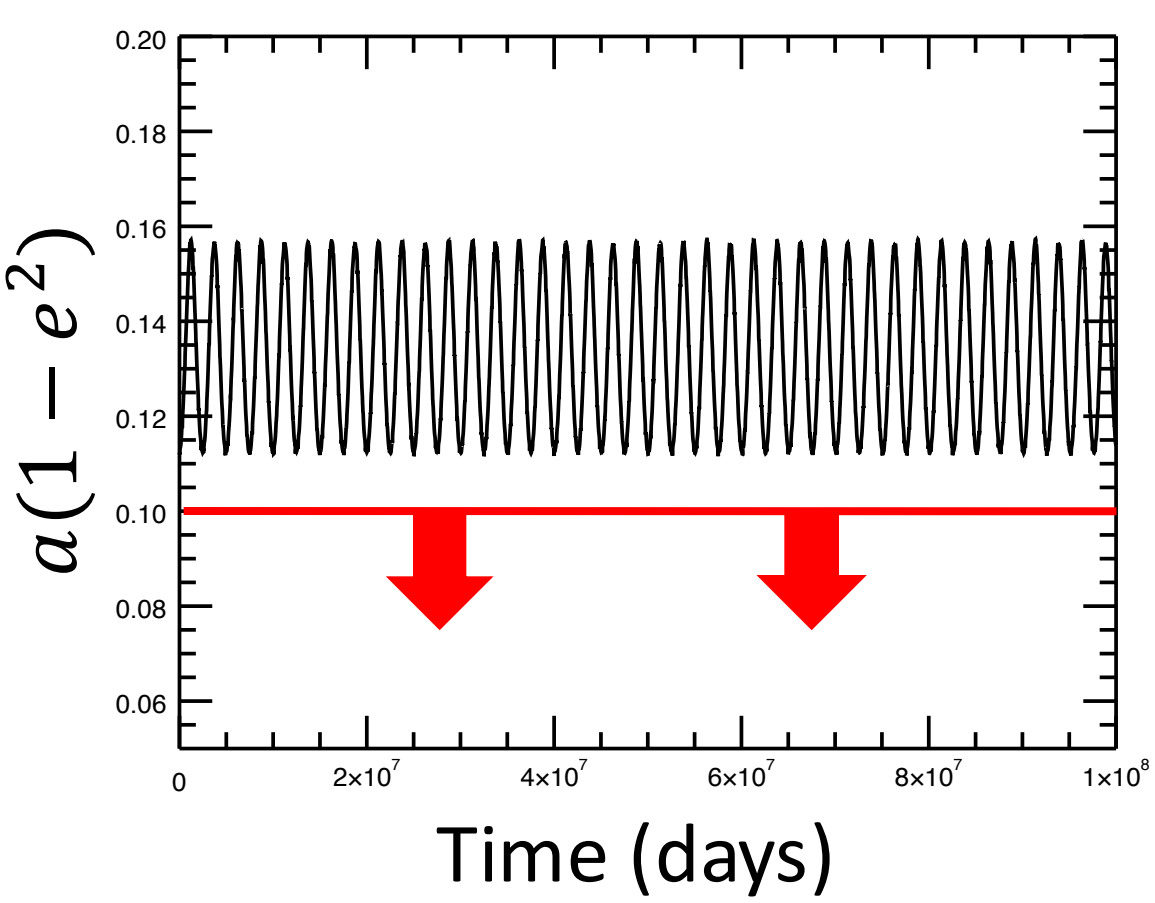


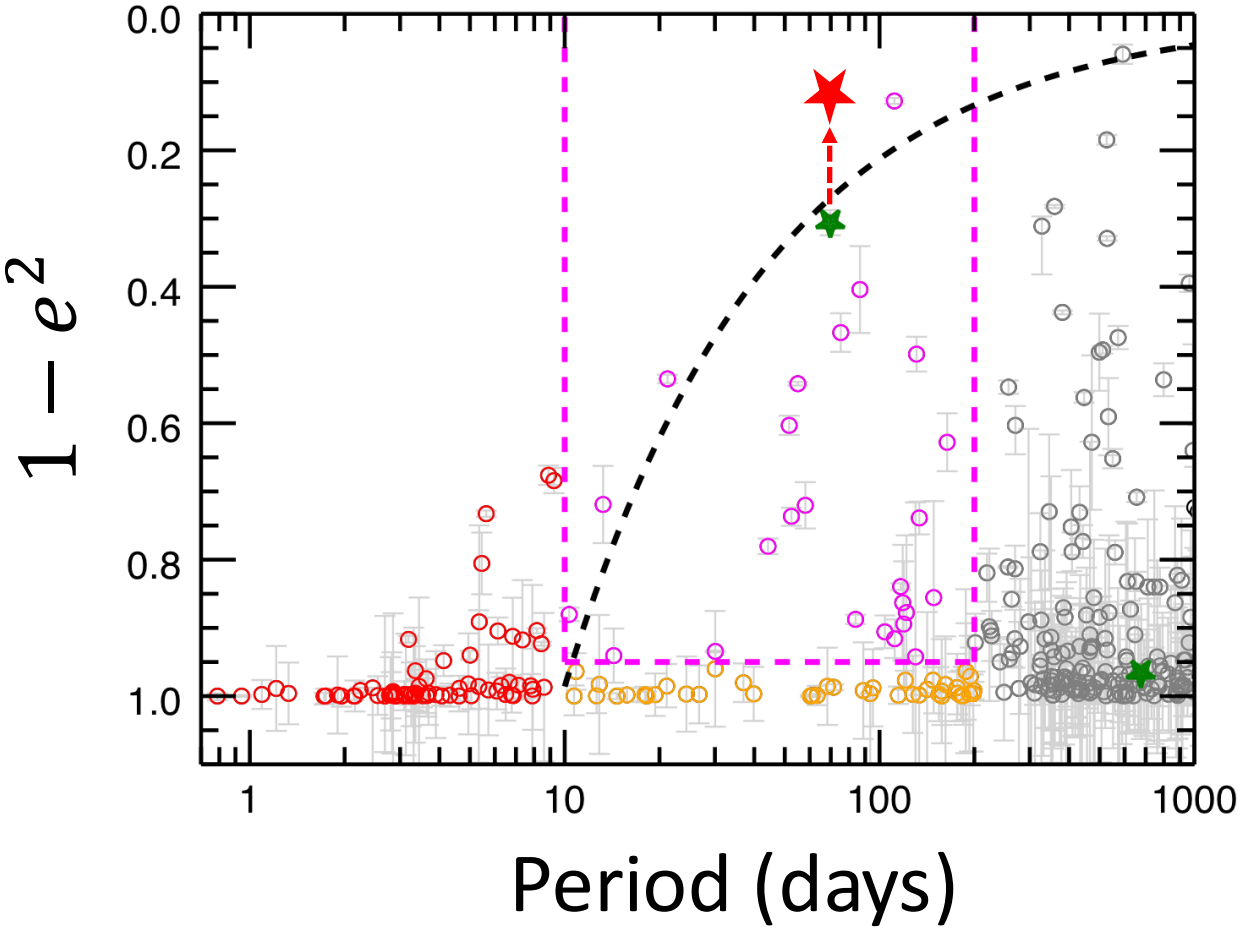
Eccentricity Oscillations in Kepler-419b

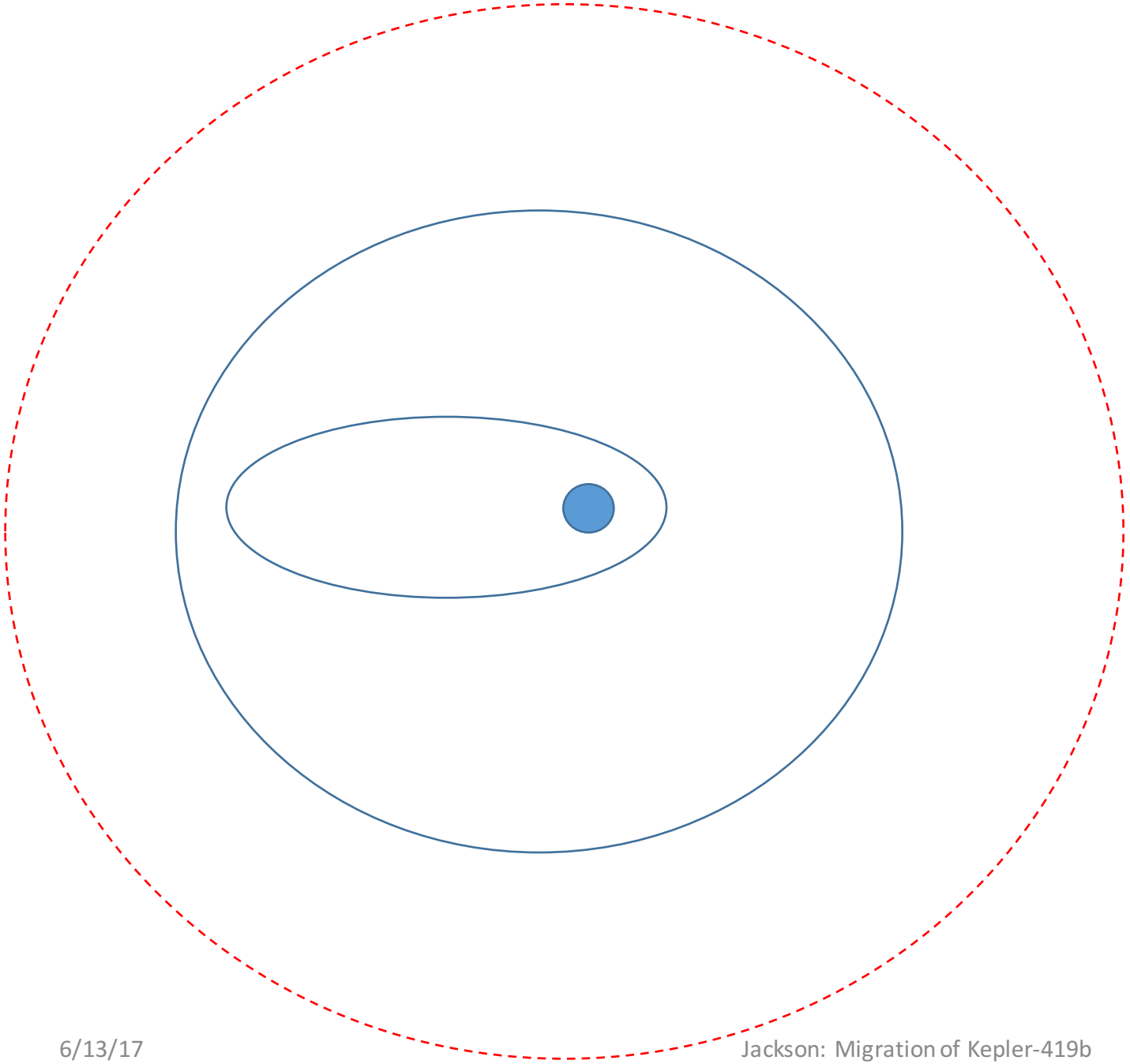




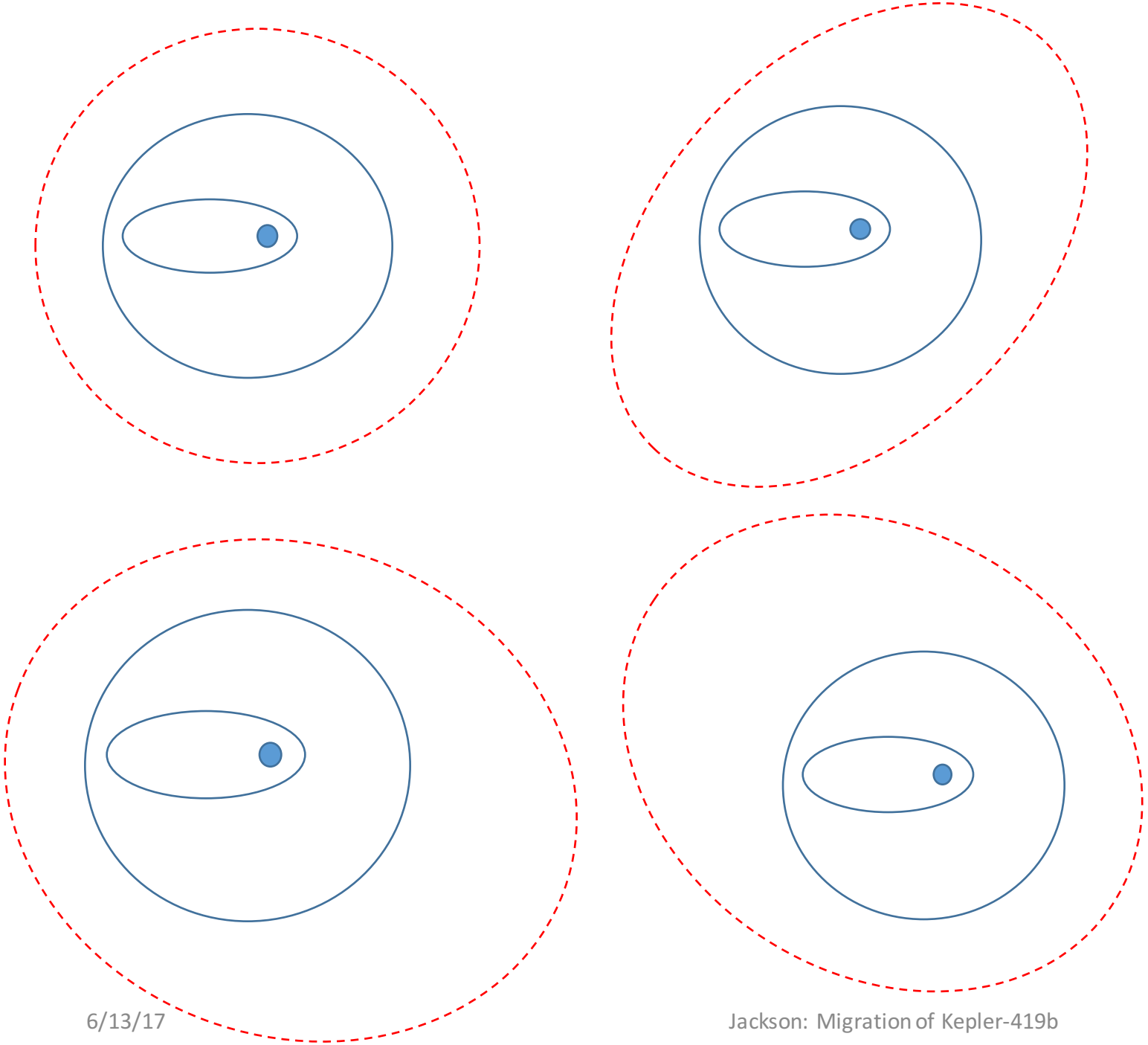
Eccentricity Oscillations in Kepler-419b







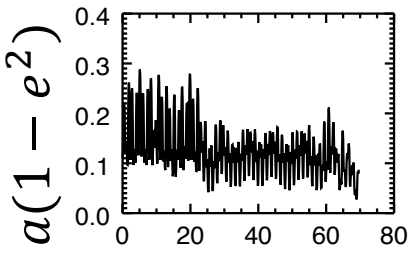
We cannot rule out tidal migration without testing for a third, dynamically relevant planet in the system

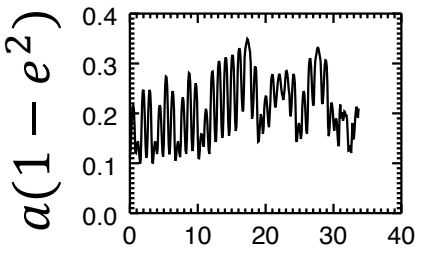


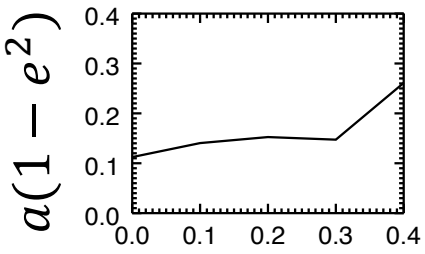
We run ~3000 N-body simulations with a wide variety of initial “planet d” parameters

Our simulations produce a variety of potential results

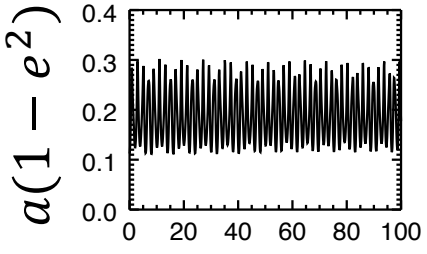
Unstable

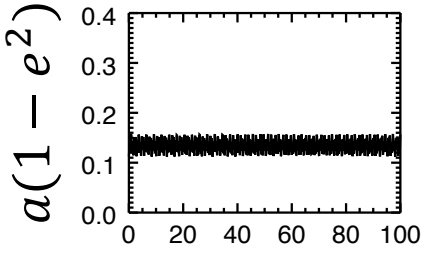


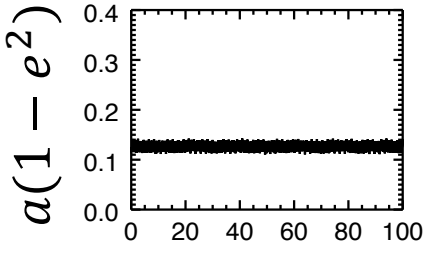




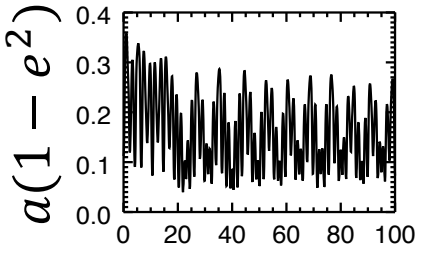
Stable but not eccentric enough

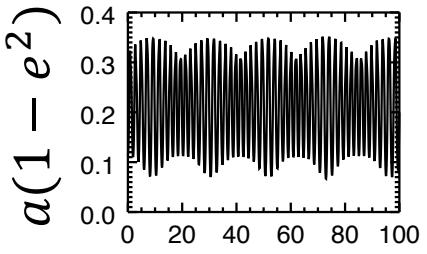


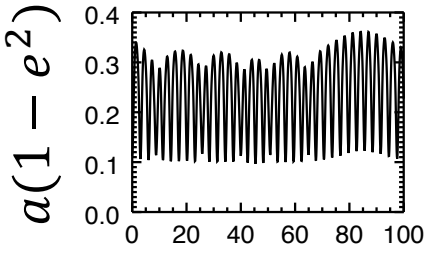




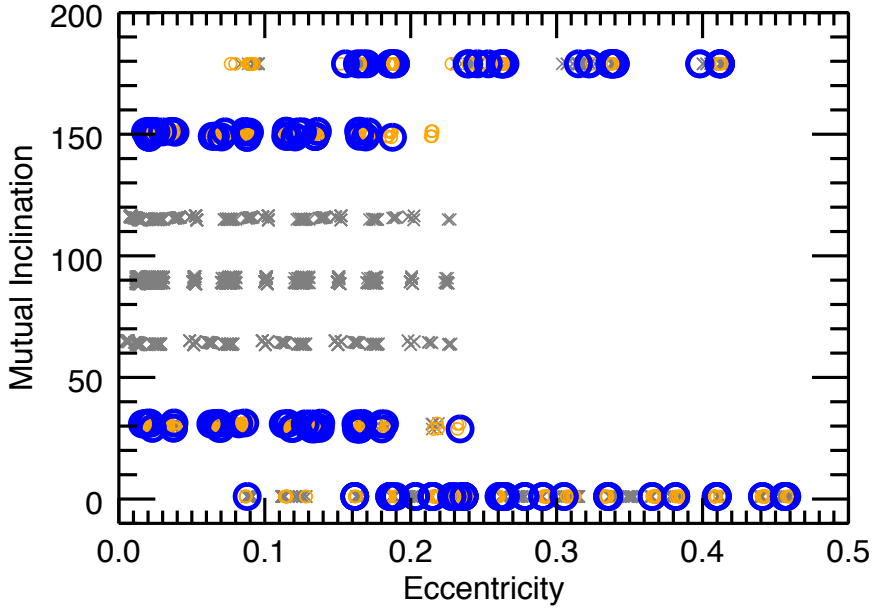
Stable and meets the eccentricity cutoff

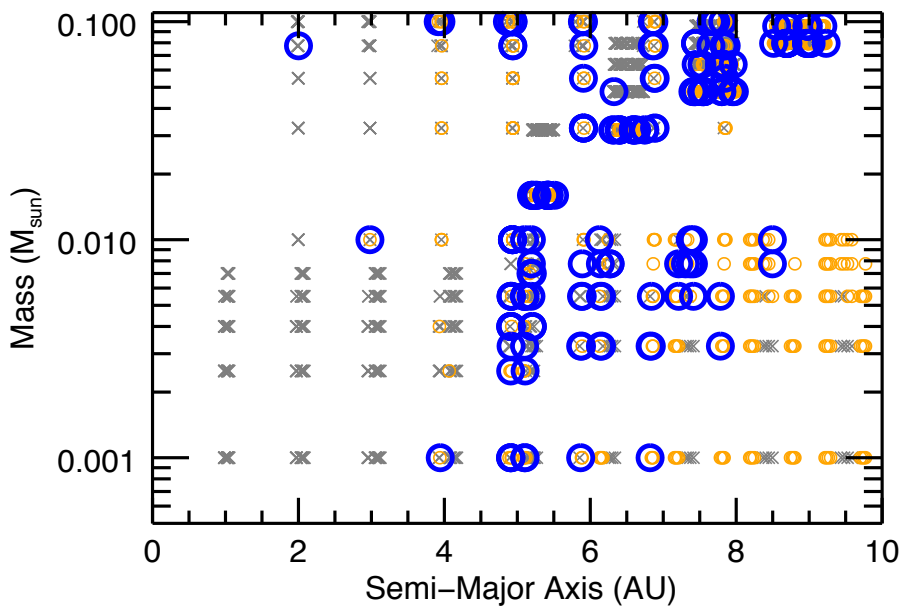


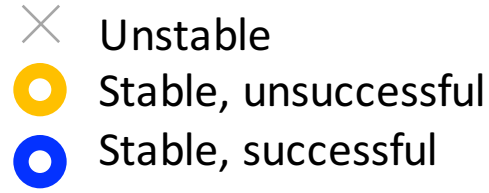




We can use these results to constrain the parameter space of the potential third planet





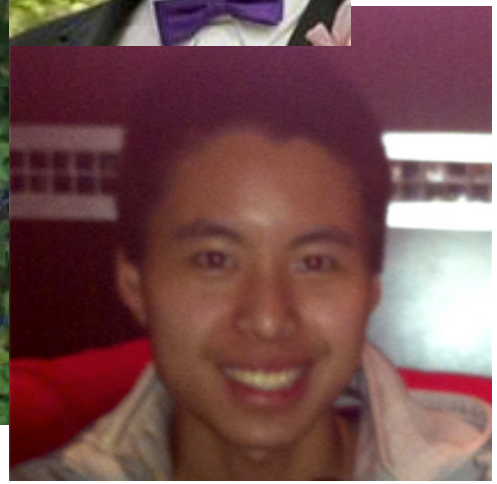


Next Steps

- Continue successful simulations to determine long-term stability (underway)
- If some portion of parameter space remains, calculate radial velocity signal which will either
  - a) rule out the third planet from existing RV data
  - b) inform future observations of the system

Acknowledgements

Advisor:
Rebekah
Dawson



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