

# Nature of Extrasolar Planets

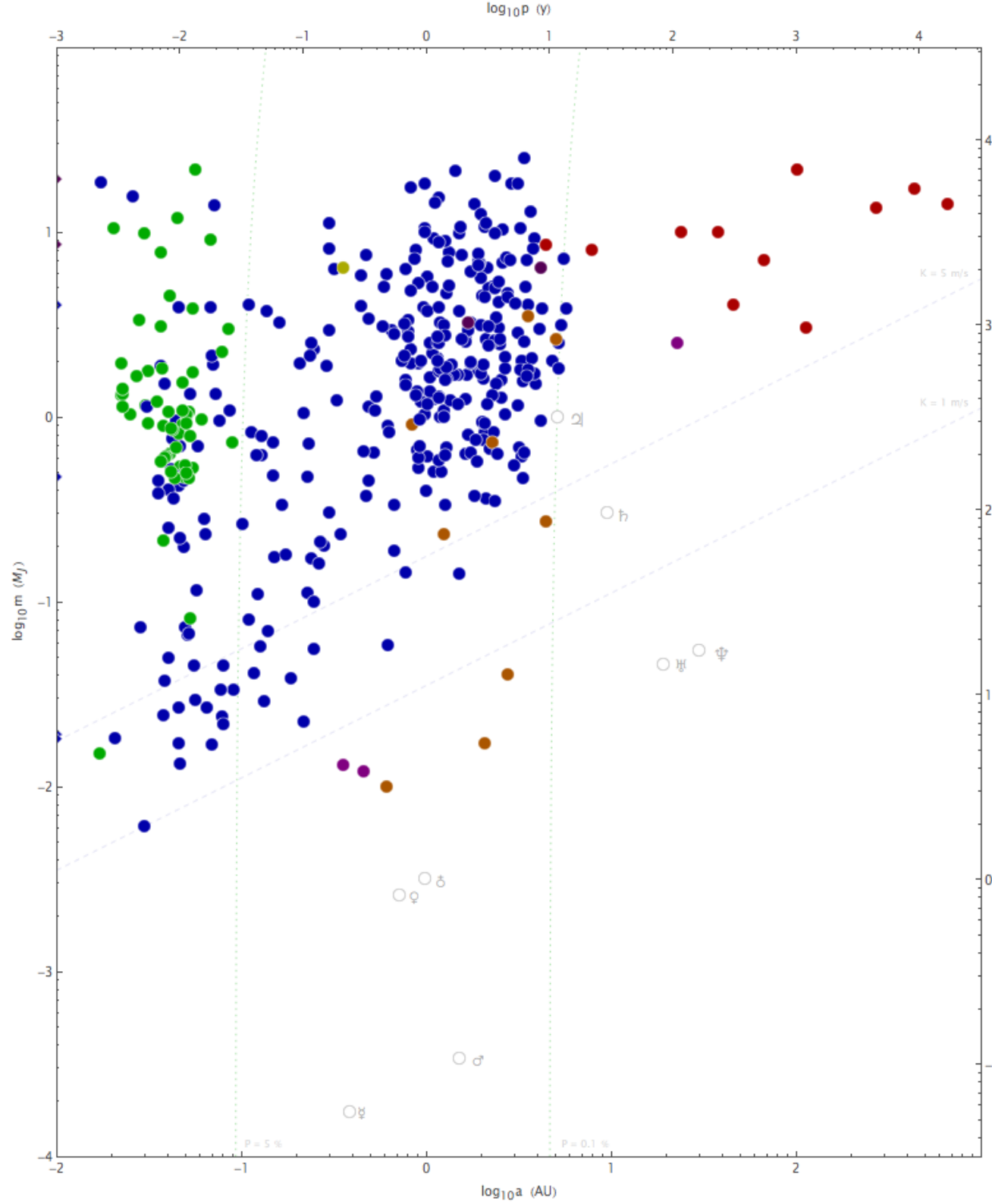
12/4/2009

# Opening Discussion

- [http://www.youtube.com/watch?v=VW0\\_kTYvARc](http://www.youtube.com/watch?v=VW0_kTYvARc)
- Have you seen anything interesting in the news?
- <http://www.msnbc.msn.com/id/34242705/?GT1=43>
- What did we talk about last class?
- Problem with plug and chug.

# Known Exoplanets

- radial velocity = dark blue
- transit = dark green
- astrometry = dark yellow
- direct imaging = dark red
- microlensing = dark orange



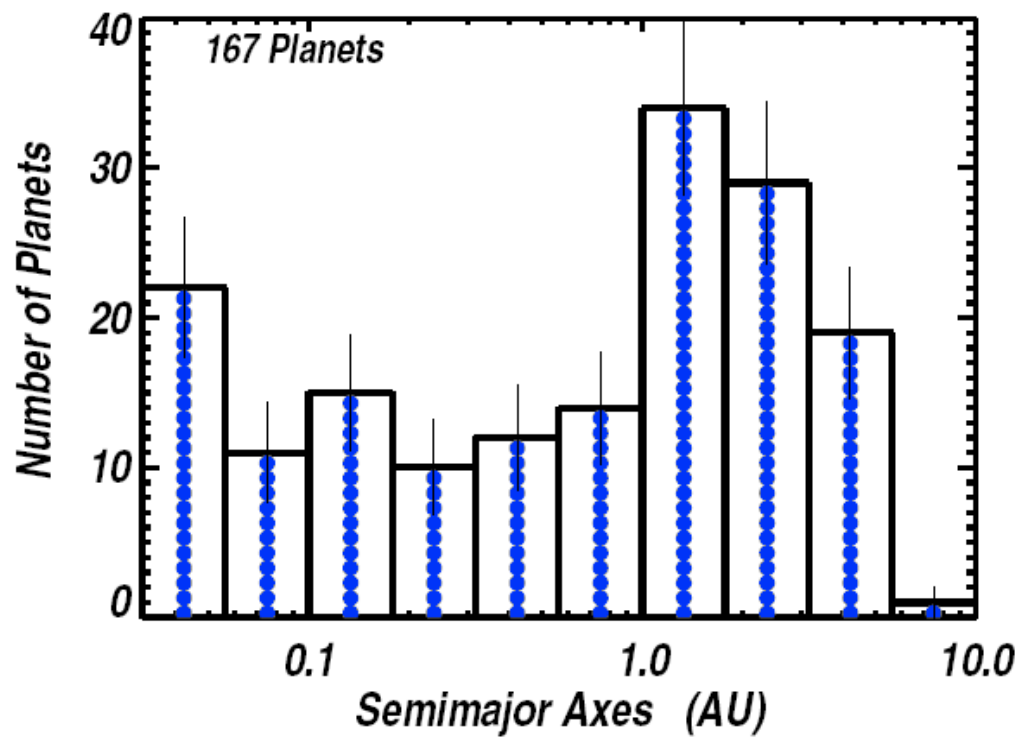
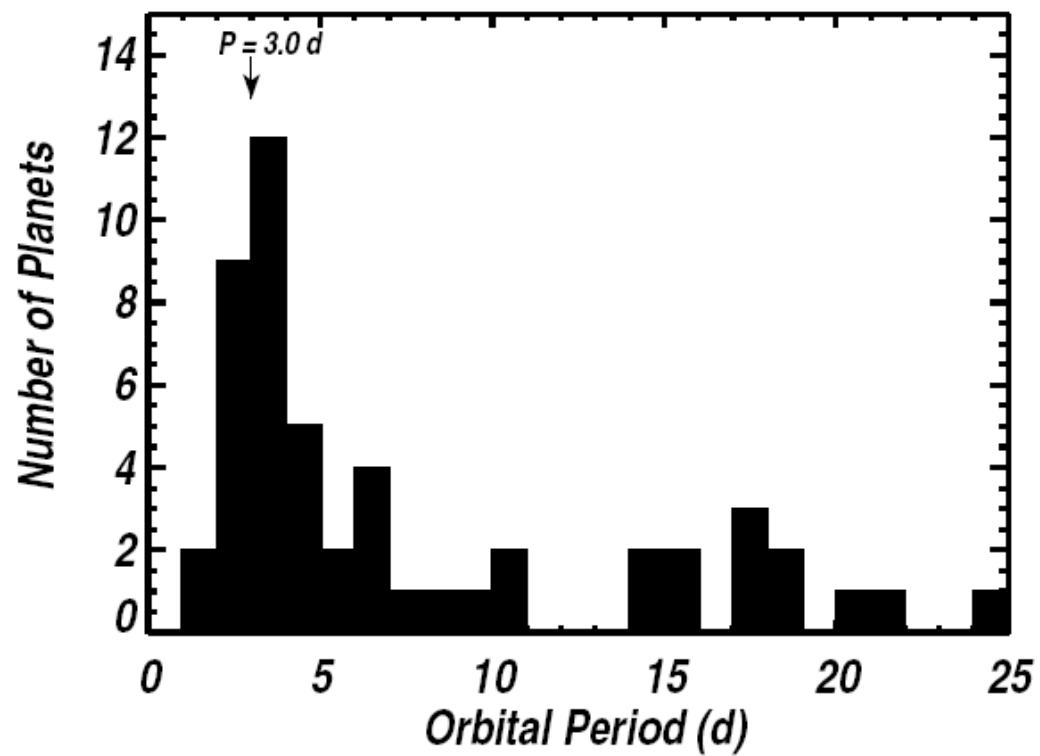
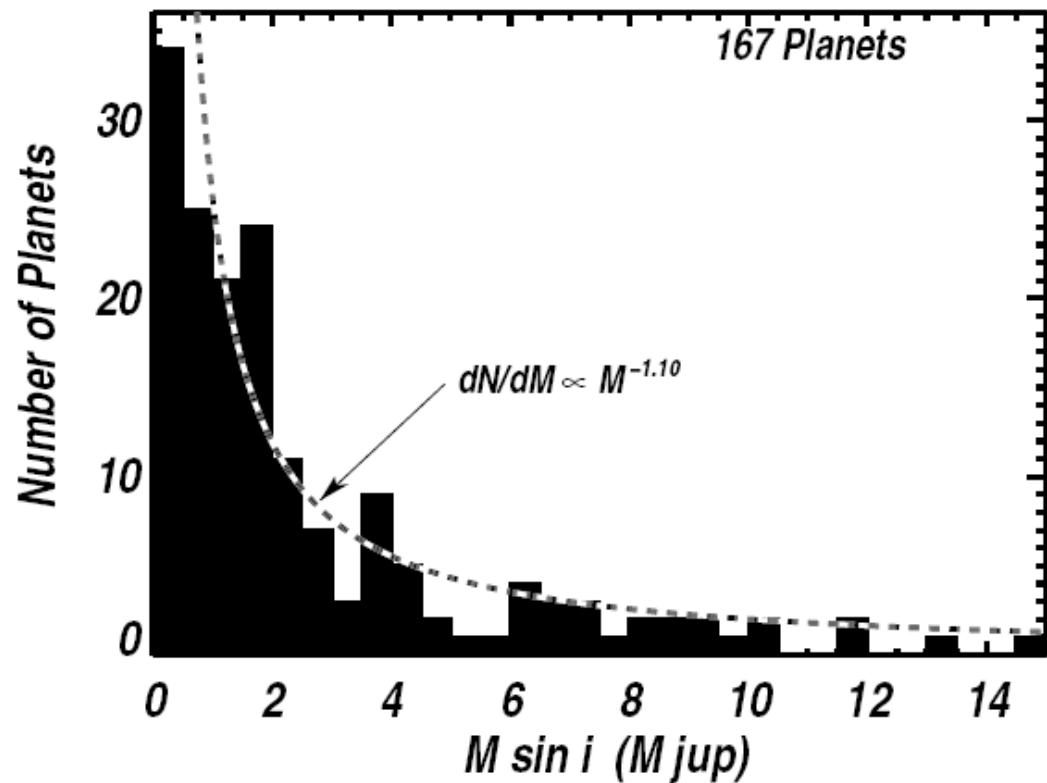
# Properties

- Orbital period – all methods
- Orbital distance – from period
- Orbital shape – astrometry or radial velocity
- Mass – astrometry, lower bound from radial velocity
- Size/radius - transits
- Density – comes from mass and size
- Composition – some information from transits

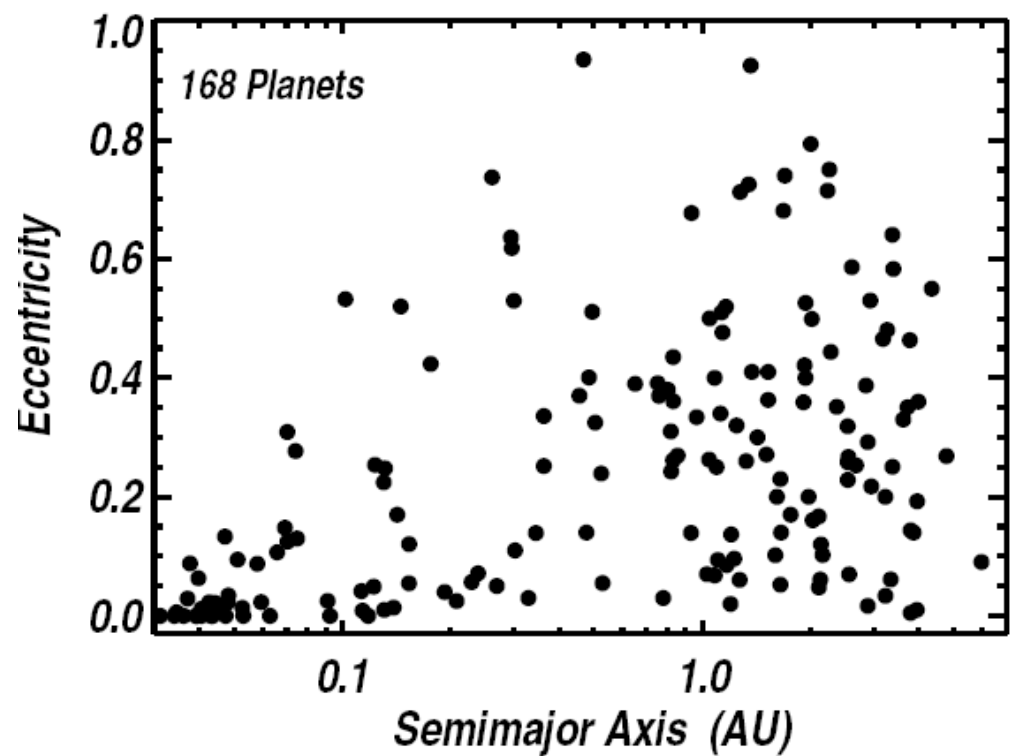
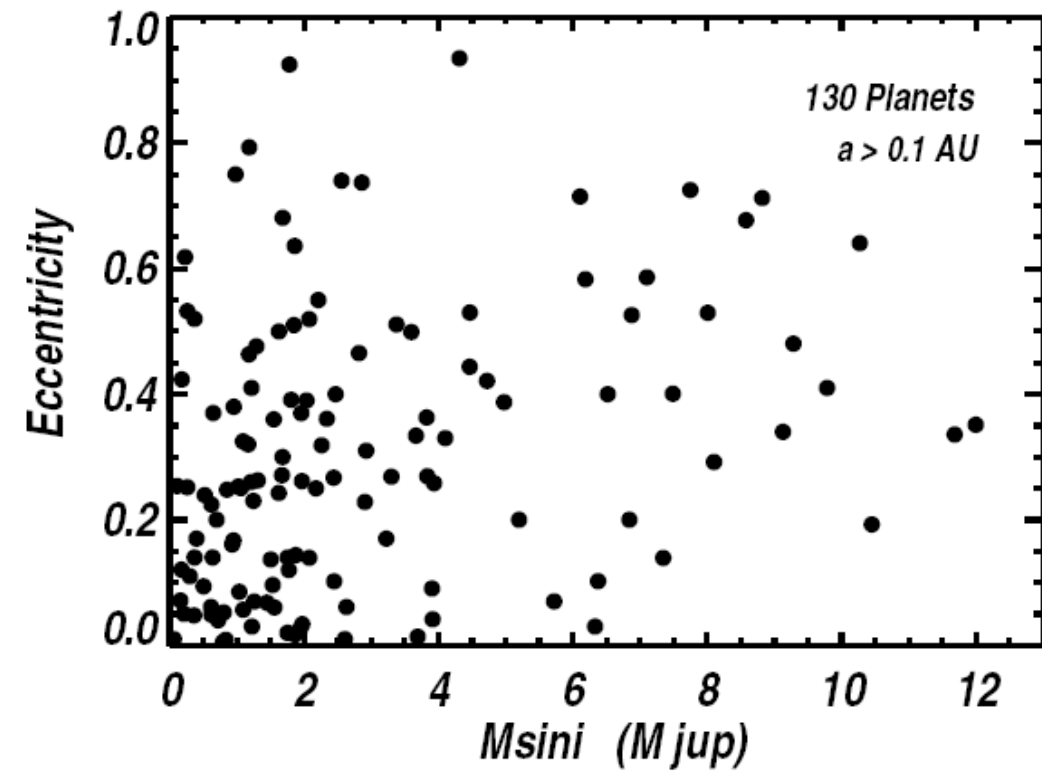
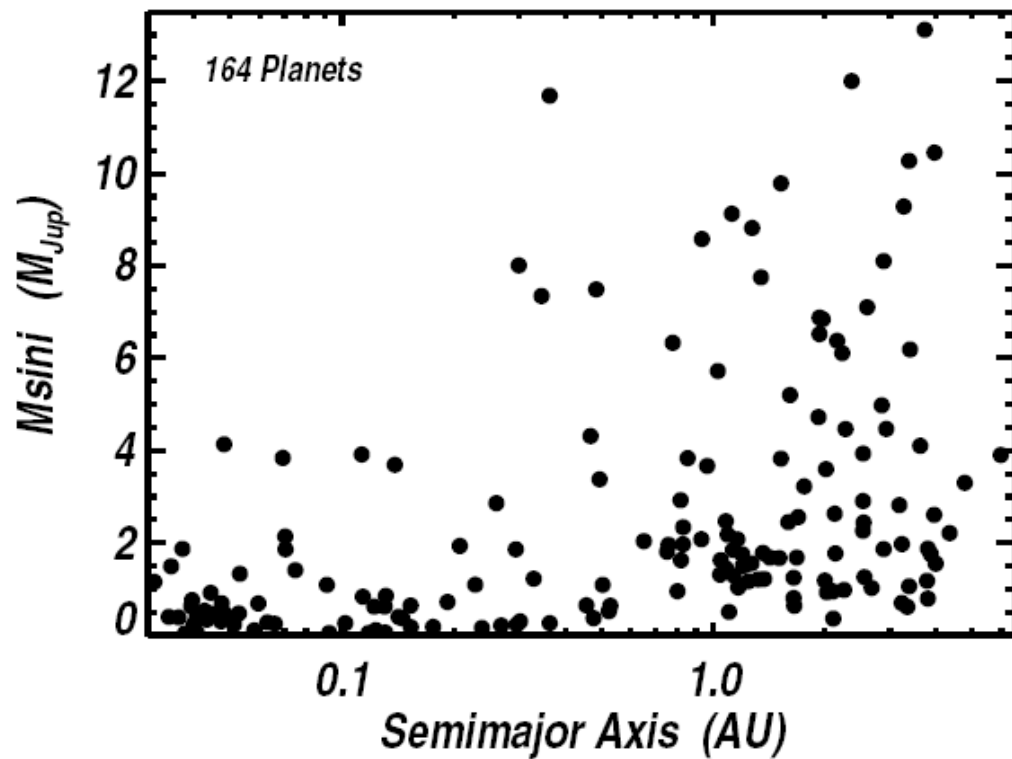
# Links of Good Sites

- <http://www.planetary.org/exoplanets/list.php>
- <http://www.exoplanet.eu/>
- <http://exoplanets.org/>

# Plots



# More Plots



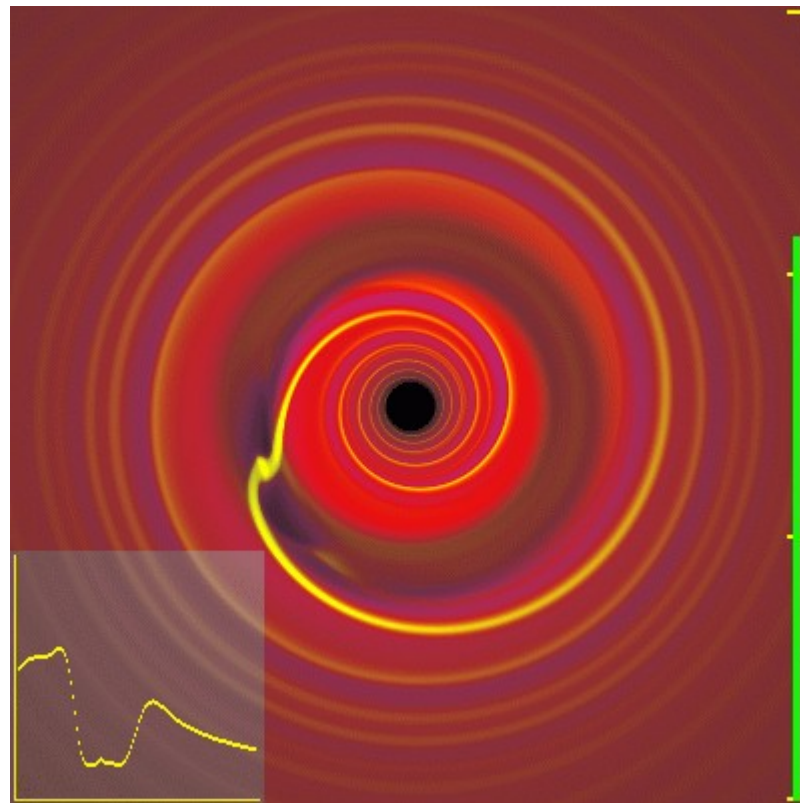
# Comparison to our Solar System

- The Jovian/Terrestrial distinction seems to hold.
- Many massive Jovian type planets are really close to their stars.
- Many of the planets have elliptical orbits.



# Planetary Migration

- Launching waves in the gas disk can cause planets to migrate.
- [http://jilawww.colorado.edu/~pja/planet\\_migration.h](http://jilawww.colorado.edu/~pja/planet_migration.h)



# Resonances and Encounters

- In systems with multiple planets we have found several where the planets are in resonance. Remember, it is resonances that give the Jovian satellites their eccentricity. They could do the same for these planets.
- Another way to move planets and give them high eccentricities is for them to have encounters. When planets scatter off of one another it alters their orbits significantly, perhaps removing them from the system.

# Implications for Nebular Theory

- Our original description of the nebular theory was oversimplified.
- We need to add migration, resonances, and encounters. (This facilitated development of the Nice model.)
- How unique is our system?
- Current methods are limited. We are finding the types of things they can find around 1 in 10 stars.

# Finding More Planets

- There are current or planned missions to find more planets, including Earth sized planets.
  - Kepler and CoRoT are in space and using the transit method. CoRoT has already shown one planet to be terrestrial.
  - GAIA (2011) and SIM are astrometric missions. They do interferometry in space.
  - TPF and Darwin are direct detection missions.

# Minute Essay

- Do you think that Earth like planets will prove to be common? Why or why not?
- Next Monday we will do course evals and talk about life. Remember to bring a laptop for evals if you can.