

Eli Dean

EXOPLANETS

What is an exoplanet?

- ⦿ Also called extrasolar planet
- ⦿ Is a planet outside of our solar system
- ⦿ May be orbiting:
 - Another star
 - Remnants of a star
 - A brown dwarf
- ⦿ Rouge planets also possible

Importance of exoplanets

- ⦿ Improve our understanding of the formation of our own system
- ⦿ Can we live outside of our solar system?
- ⦿ Are we alone?

History

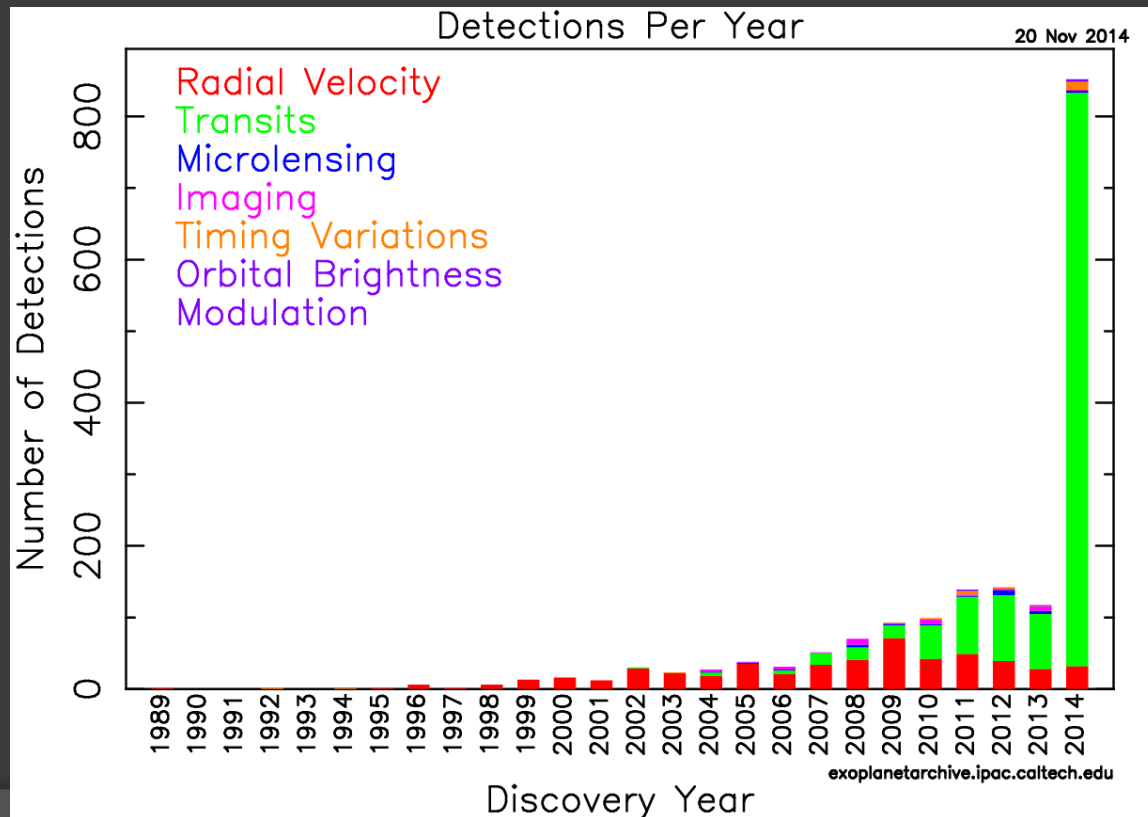
- ◎ In 1584, Giordano Bruno, a monk, first proposed the idea of exoplanets
 - Before Copernican Revolution
 - Not accepted
- ◎ Technology limited observations
- ◎ Into the 1900s, proof of exoplanets was more than elusive
 - Even great astronomers such as Edwin Hubble couldn't find proof

History

- ⦿ In the 60's and 80's, claims of exoplanets disproved
- ⦿ In 1994 Dr. Alexander Wolszczan found exoplanets around a pulsar
- ⦿ In 1995, Swiss team found exoplanet around a star like ours
 - Began the onrush of exoplanet discoveries

Current Knowledge

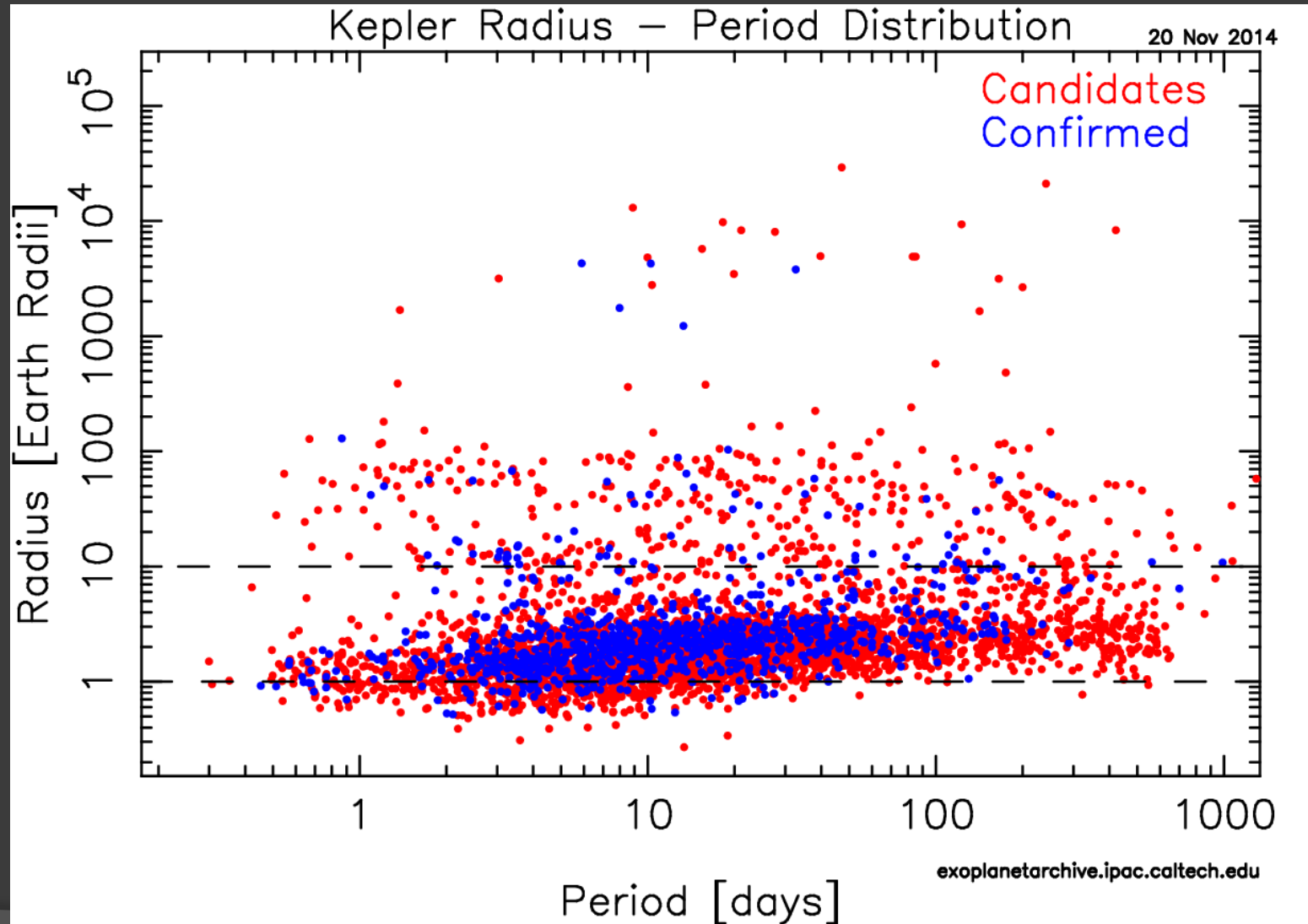
- 1,773 confirmed
 - Largely due to the NASA craft Kepler



Candidate vs confirmed

- ⦿ 3217 candidate exoplanets
- ⦿ Candidates must be peer-reviewed to be considered “confirmed”
- ⦿ Multiple observations and/or techniques must agree
- ⦿ Confirmed to a confidence level of 99.9999%
 - Based on all known sources of error
 - 1 in 1,000,000 chance of being wrong

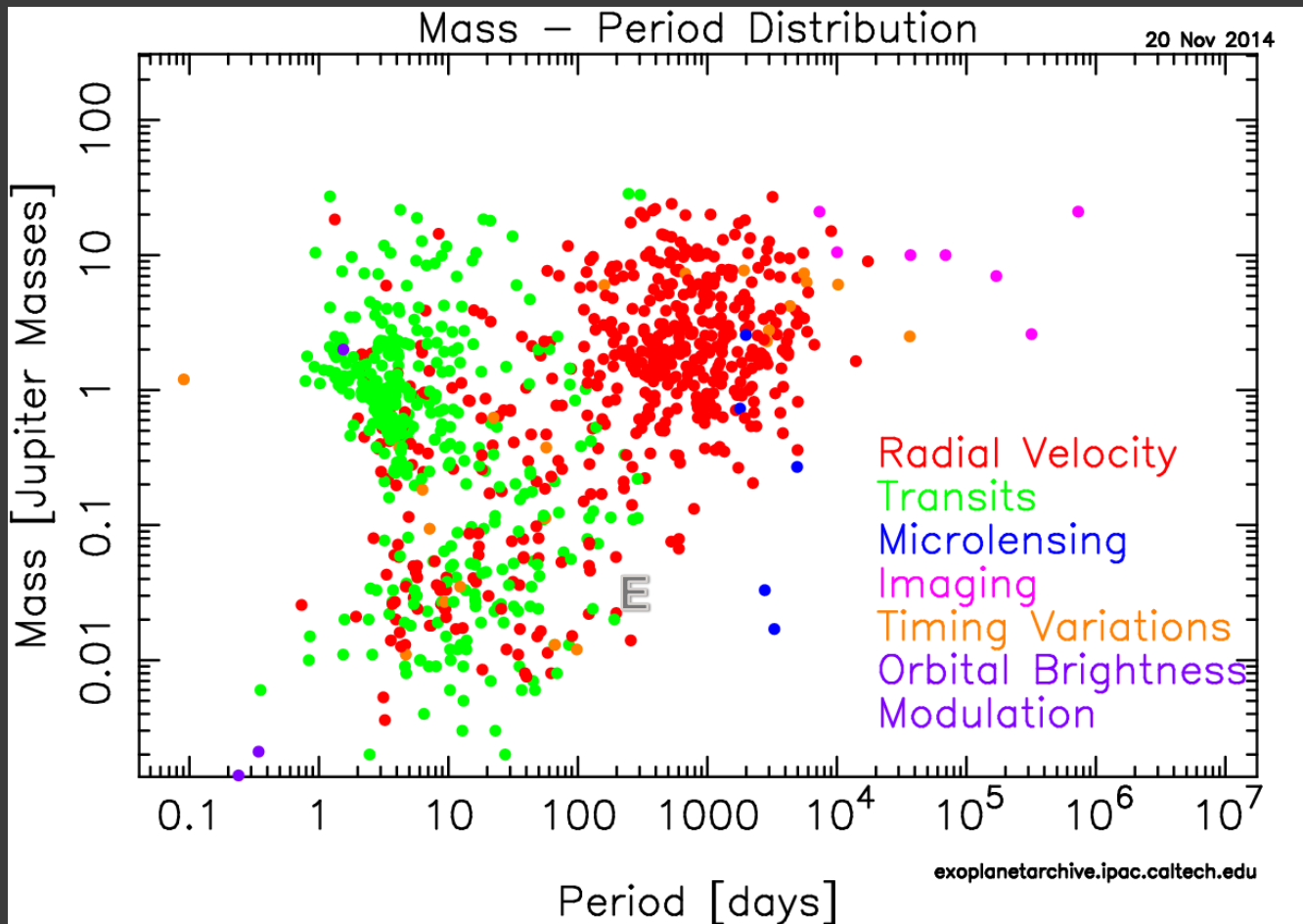
Kepler Candidates



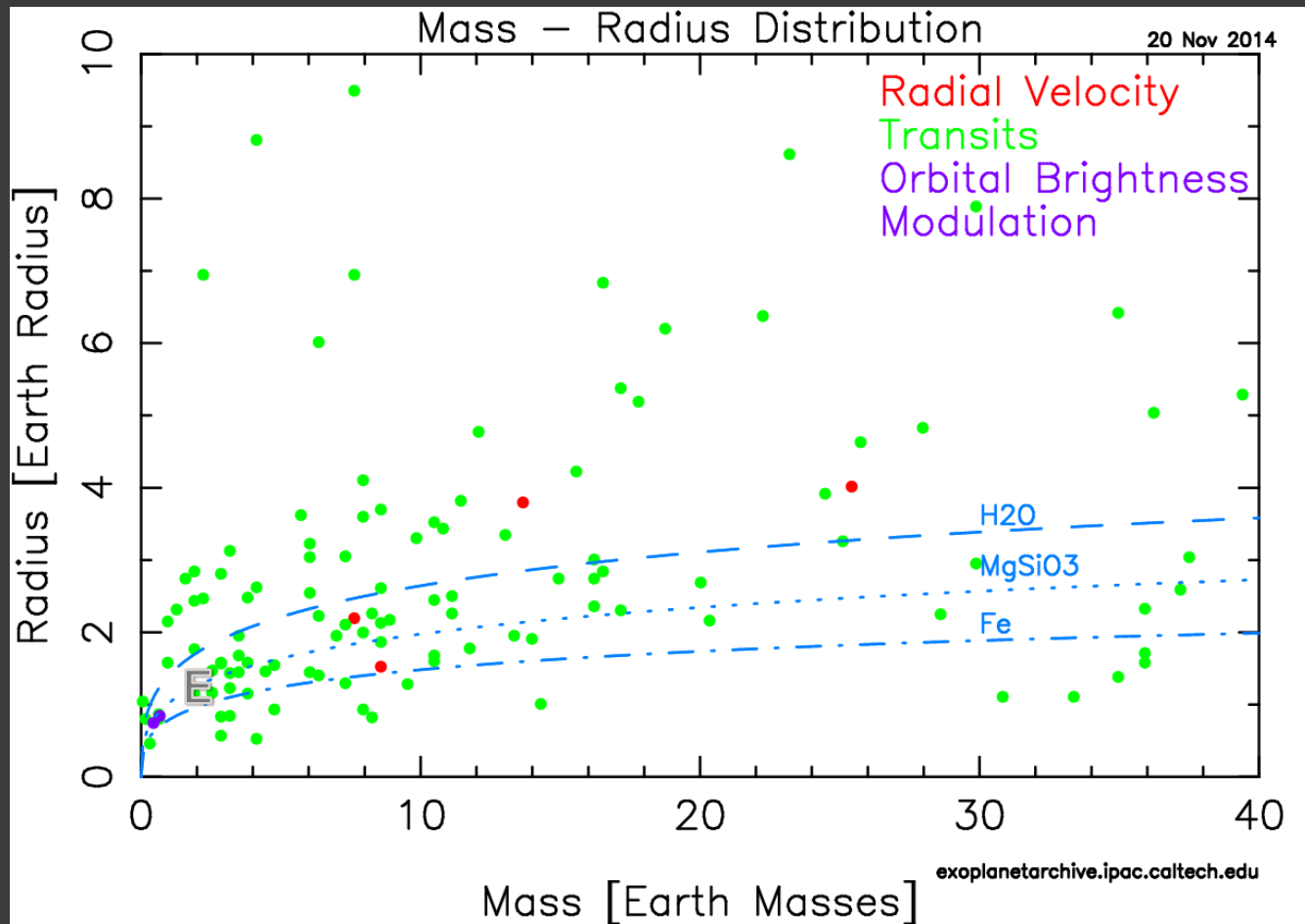
Demographics of exoplanets

- ⦿ What do the discovered planets “look like”?
- ⦿ How does this result change how we think about our solar system?
- ⦿ What clues does this offer about the formation of planets and systems?

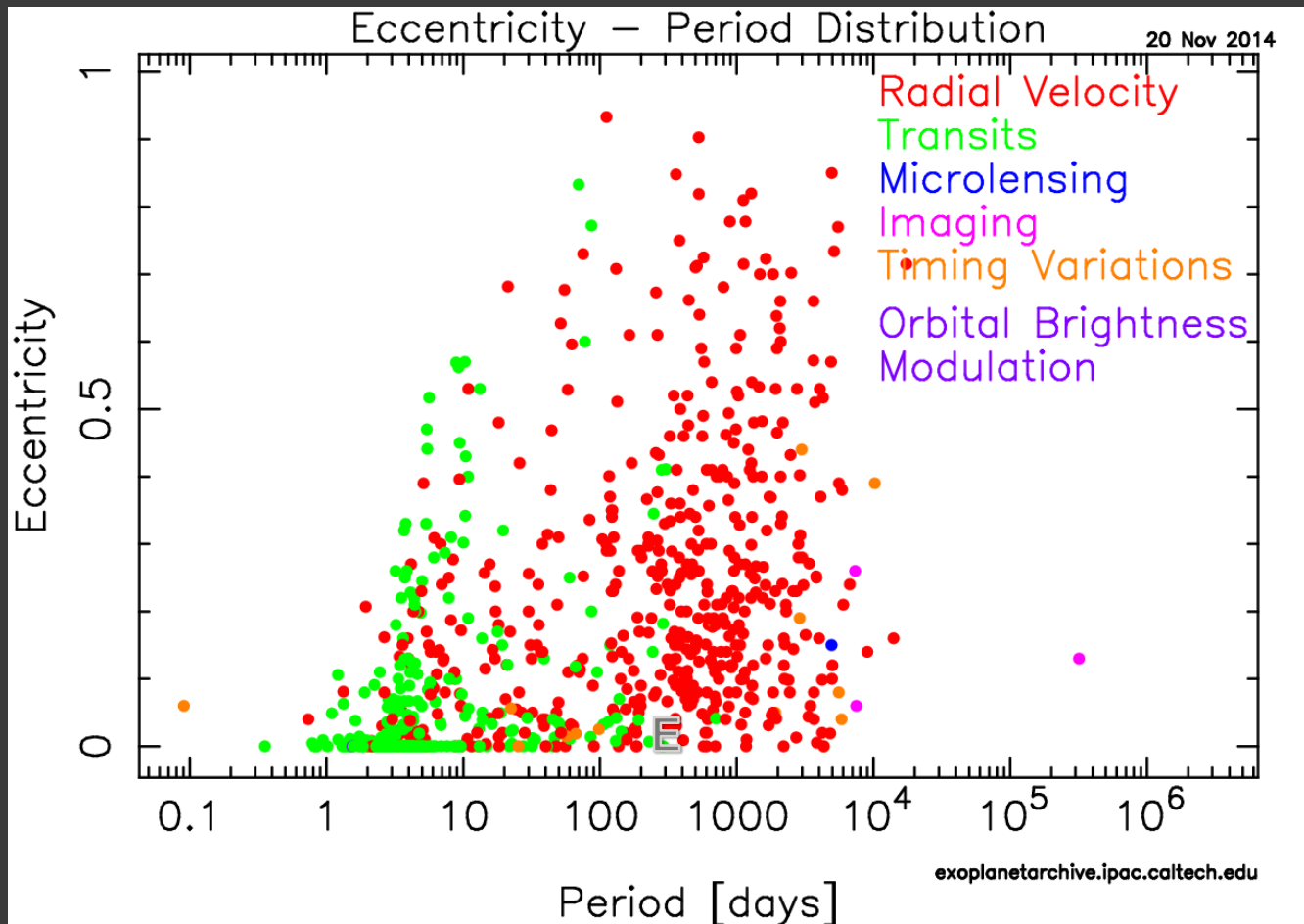
Mass and Period



Planet Radius



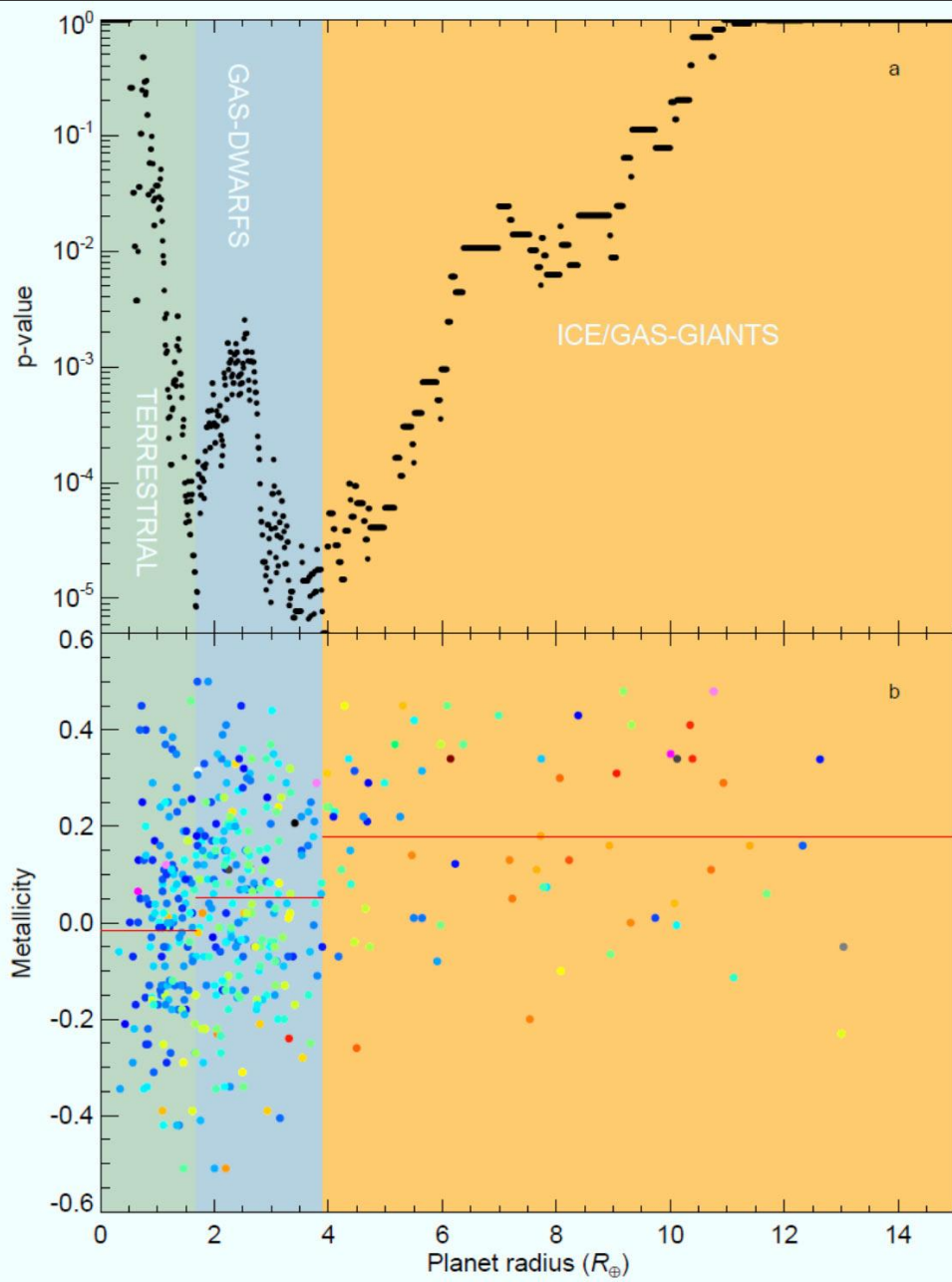
Orbital Eccentricity



Earth Eccentricity: ~ 0.0167

Planet Type

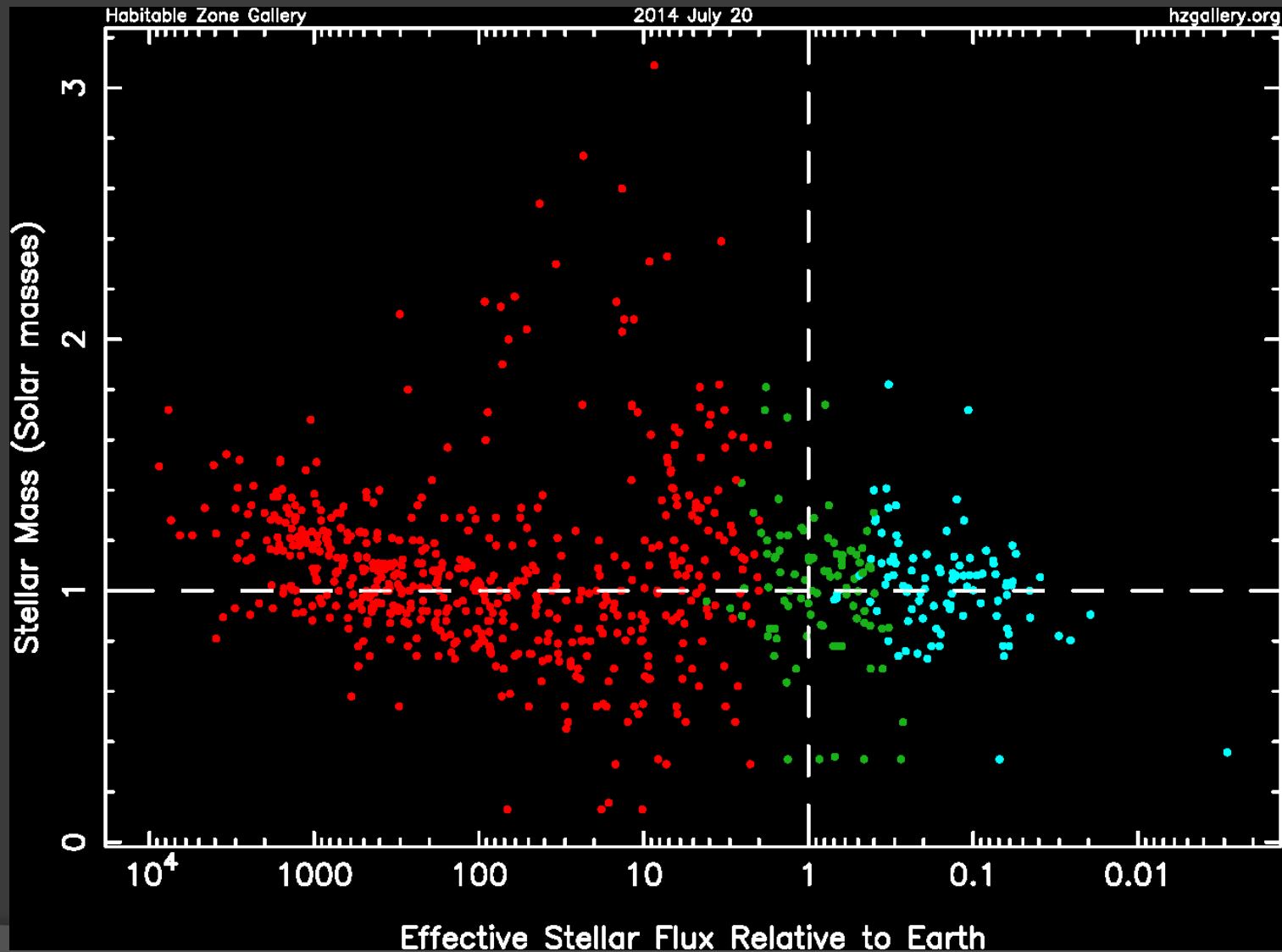
- ⦿ Exoplanets have been divided into three categories
 - Terrestrial ($M_p < 1.7 \text{ Earth mass } M_+$)
 - Gas-dwarfs ($1.7 M_+ < M_p < 3.9 M_+$)
 - Gas-giants ($M_p > 3.9 M_+$)
- ⦿ Relation between host star metallicity and planet type has been shown



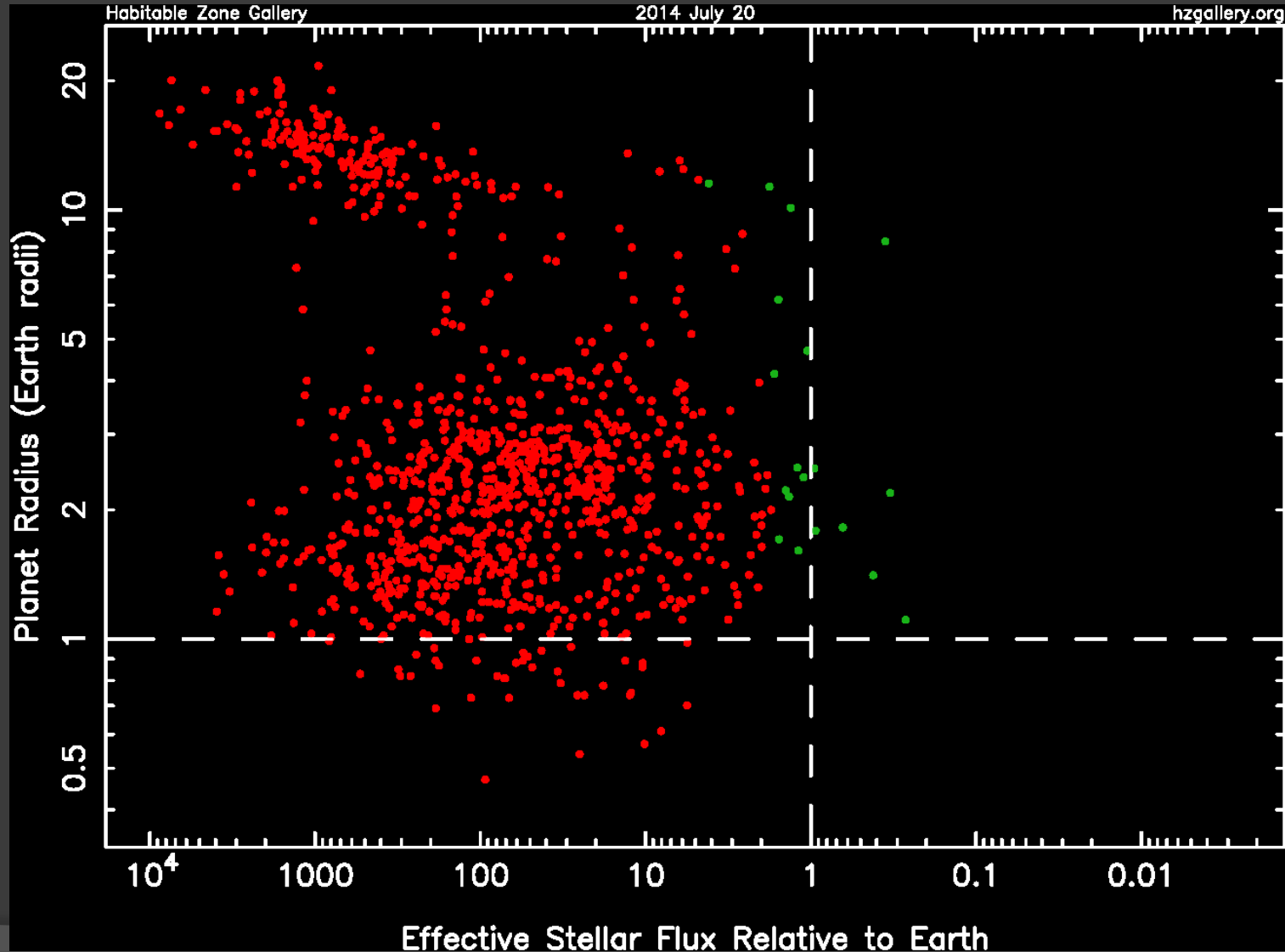
Habitability

- ◎ Planets have been found in regions around stars that may be habitable
 - Such regions receive the correct amount of radiation for liquid water to be present

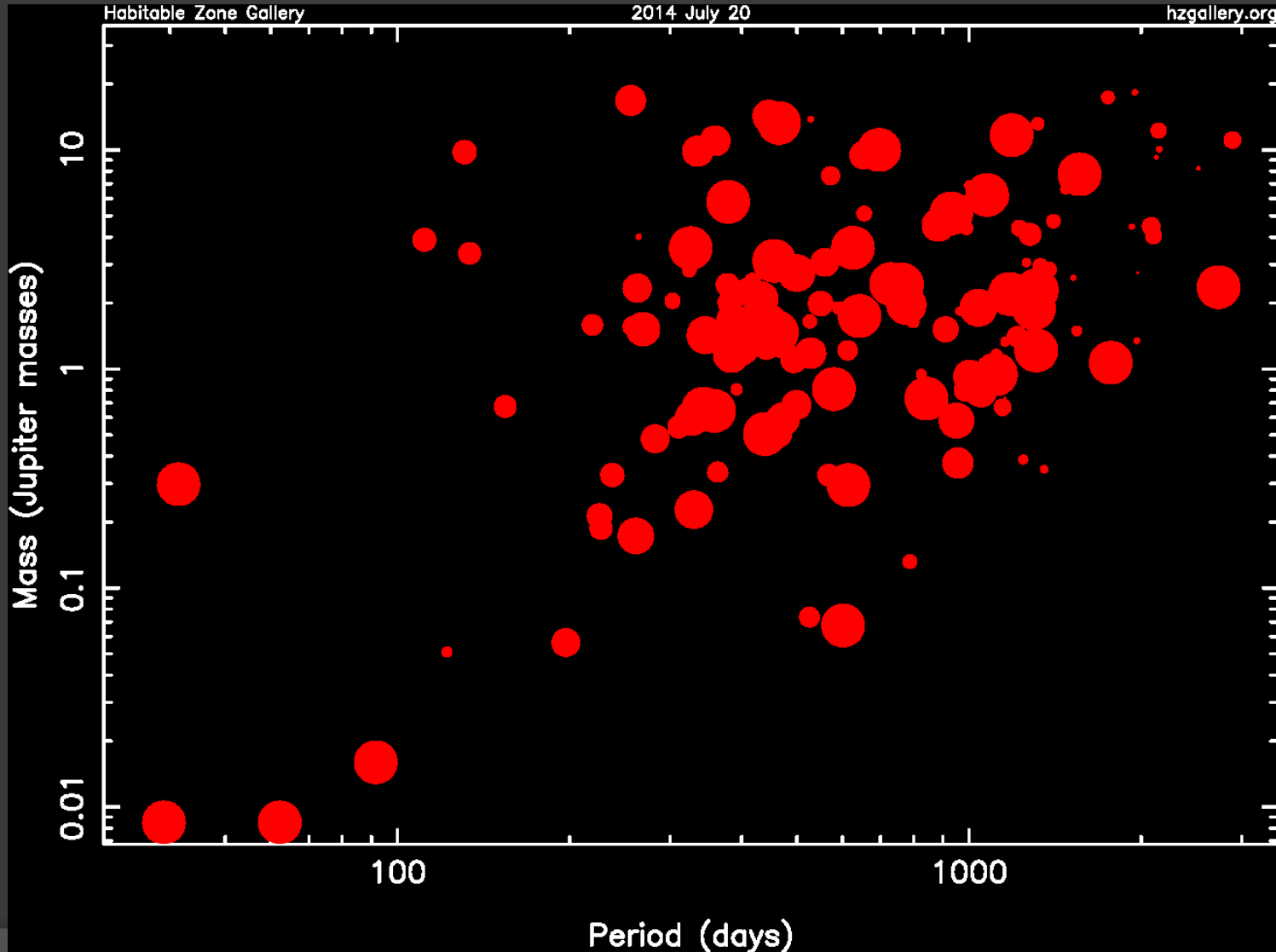
Stellar Flux vs Stellar Mass



Stellar Flux vs Planet Radius



Period and Mass of habitable planets



Miscellaneous

⦿ Rings

- Difficult to detect and confirm
- Possibility of “warped” ring system

⦿ Shape

- Small orbital radii could lead to less spherical planets

⦿ Moons

- [Candidate for a moon around a rogue planet announced](#)

Future

- ⦿ One of the fastest changing fields in science
- ⦿ Techniques to detect exoplanets continue to develop
- ⦿ More exoplanets continue to be discovered
- ⦿ Improving our understanding of the universe

Questions

- ⦿ What are the chances that we will discover a planet that has life on it?
- ⦿ Will we ever travel to one of these planets that have been discovered?
- ⦿ Do the demographics discovered confirm any theories about planet formation?

Resources

- ◎ <http://planetquest.jpl.nasa.gov/>
- ◎ http://www.nasa.gov/pdf/412508main_What.Is.a.Planet.Lithograph.pdf
- ◎ <http://en.wikipedia.org/wiki/Exoplanet>
- ◎ <http://exoplanetarchive.ipac.caltech.edu/exoplanetplots/>
- ◎ [Three regimes of extrasolar planets inferred from host star metallicities](#)
- ◎ <http://www.hzgallery.org/>