Week 2, Day B: Exoplanet Properties

A graphical smorgasbord based on
`http://exoplanetarchive.ipac.caltech.edu/exoplanetplots/`

- The documentation says: "In these plots, planets are grouped [sic] by discovery method." Note that "timing variations" includes planets discovered by variations in transit timing, eclipse timing, pulsar timing, or pulsation timing.
- We've already discussed plots
`exo_massperiod.png`
`exo_dischist.png`
`exo_massradius.png`
so we might skip those in class today.
- In plot `exo_eccperiod.png`, is a trend apparent? What might this trend indicate about the dynamics of planetary systems? Specifically:
  (1) What might happen to the orbits of planets far from their host stars? *Hint: it was only a passing thing...*
  (2) What might happen to the orbits of planets very near their host stars? *Hint: a rising tide circularizes all ships?*
- For the data that went into the plot `exo_periodirrad.png`, irradiation at the planet is calculated as:
$$I = \frac{R_s^2\,\sigma\,T_{eff}^4}{1366 \times a^2}$$
where R_s, T_{eff}^4 are the stellar radius and effective temperature and a is the semi-major axis.
Armed with that knowledge, looking at this plot, can you explain the following?:
  (1) the "bimodal" behavior of planetary irradiation as a function of orbital period (*hint: They Might Be Giants*);
  (2) the width of the main locus of points (where all the transit data lie) (*hint: all stars are the same [not]*);
  (3) the fact that no planets discovered via the transit method lie among the long-period, higher-irradiation locus of data points. (*hint: There Might Be No Giants*)

  Hmm, items (1) and (2) above could be an interesting HW problem(s)...
- In plot `kepler_radperiod.png`:

  - Is there a trend in the main locus of points? What are (at least) 2 ways to explain this trend? (*Hint: one involves the "real" properties of planets, and the other involves a selection effect.*)
  - Is there a second locus of points just below $\sim 100\ R_{Earth}$, or is the distribution continuous for radii $> 10 R_{Earth}$? How might one go about distinguishing between these alternatives?
  - Why are many (most? all?) of the "planet" candidates with radii $\sim 10^4 R_{Earth}$ unlikely to be planets?

- In plot `kepler_radtemp.png`, what's so interesting about the inset? What is T_{eq}, and how was it calculated?
- In plot `kepler_raddepth.png`:
  - What explains the width of the main locus of points? (*Hint: are all properties of all stars well known?*)
  - Why is the"hair" on this main locus pointing up and not down? (*Hint: nearly missed that one, didn't you?*)
  - Related to that last Q: why would *any* objects with radii as large as $\sim 10^4 R_{Earth}$ yield transit depths as small as ~ 100 PPM? (What does 'PPM' stand for, anyway?)