Formation of Planetary Systems

Discovering Exoplanets

Astrometry:
- as massive exoplanets orbit parent star, combined grav. pull causes star to 'wobble' slightly about common centre of gravity
- precisely measuring positions of star allows wobbles to be detected.

Transit Method:
- if exoplanet moves across disc of host star, they cause very small (<1%) drop in brightness perceived in duration of transit
- small fluctuations can be detected over period of time

Radial Velocity Method:
- slight wobbling of star due to exoplanet can be detected as small Doppler shifts
- wavelength of star's spectral lines become redder and bluer
- astronomers use spectroscopy to reveal these small changes

Two essential chemical ingredients for life:
1. carbon - can make interesting compounds
2. water - in liquid state, excellent solvent

Habitable Zone - band in Solar System where liquid water can exist on surface
very small range

3 possible candidates for life in System:
1. Titan - sea of liquid hydrocarbons
2. Europa - contains ocean of liquid water under ice shell
3. Enceladus - plumes of volatile compounds and hydrocarbon erupt

Drake Equation:

number of civilisations in galaxy that might communicate

fraction of stars with orbiting planets

fraction where life evolves

fraction which intelligent civilisations live

$$N = N_S \times f_P \times n_{HZ} \times f_L \times f_i \times f_c$$

N_S: number of stars

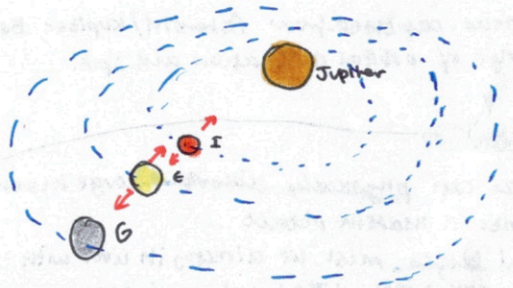
n_{HZ}: Earth-like planets in habitable zone

f_i: fraction where life is intelligent and develops technology

SETI:
→ search for extraterrestrial intelligence
→ scan sky for any radio signal not from Earth
→ none confirmed so far

pros	cons
• better understandings of evolution	• disease
• change how humanity views itself	• kill us (warlike)
• new technologies	

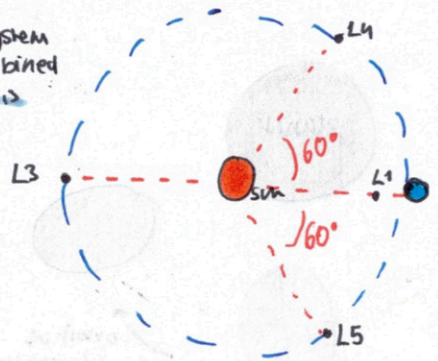
Orbital Resonance:
- in multi-body interactions, some of the orbital periods are special
- e.g. Jupiter the orbital periods of Ganymede, Europa and Io are in the exact ratio of 4:2:1
- regular gravitational tugs on Europa/Io means that they don't orbit Jupiter in circular orbits and tidal heating continues



tidal heating also responsible for molten layers beneath crusts. therefore responsible for active volcanoes and cryovolcanoes visible on surface

Roche Limit - the minimum distance to which a larger satellite can approach a parent body without being torn apart by tidal forces
for bodies of similar composition, its value is approx. 2.5x that of parent body radius

Langrangian Points:
In a two body system where their combined force of gravity is equal to the centripetal force needed to maintain the circular motion of a 3rd body



Points L1, L2, L3 are unstable

L4 and L5 are stable: 60° ahead and behind a body