

Important Ideas Covered in Class

Solar System

- Solar system inventory
 - Different types of planets: how are they different?
 - Small objects: Rings, KBOs, asteroids, meteorites, etc.
 - Moons
 - Minor planets
- Solar system structure
 - Heliosphere
 - Sizes
 - Orbital properties
 - Mass and Angular Momentum distribution

Exoplanet Observations

- Observational techniques
- Observational biases for each technique
- Think about where in the Galactic field you will start a survey using any one of the techniques
- What are the planet properties learned using any of the techniques?
- How about combinations?

Orbital Dynamics

- Basic equations
 - Newtonian
 - Kepler's laws: Can you prove them?
 - problems based on various conservation laws
- Energy dependence of types of orbits
 - Conic sections
- Different types of orbits
- Idea of Hill sphere
- Chaos and stability conditions
- Mean motion resonances
 - Conditions, why important, observations?
- Non-gravitational forces
- Orbit around mass losing stars

Protoplanetary Disks

- Basic physics
 - Scaling laws to determine aspect ratio
 - Physical effects determining the disk structure
- Possible source of viscosity
- Shakura-Sunyaev disk model
 - Idea behind it
 - Given disk properties can you determine the aspect ratio, and various timescales?
- Expected spectral energy density observed for a star with a disk
 - Given some observed SED, can you extract disk properties?
- Can you compare expected disk properties between two stars with different properties?

Planet Formation

- Distinct stages of planet formation
- Various mechanisms
- What is known and what is not known, can you write a review on the proposed theories?
- Different regimes of growth
 - Gravity/Shear dominated
- Meter-size barrier
 - Timescales and speeds for radial drift
 - Proposed theories to overcome it
- Conditions for giant planet formation
 - Collapse of atmosphere
- Pros and cons for core-accretion and GI paradigms for giant planet formation

Planet Orbit Evolution (Planet-Disk Interaction)

- Migration
 - Types
 - Dominant physical effect(s) responsible for different types
 - Timescales for migration
 - Given disk properties can you calculate the Torque experienced by a planet of some given mass?
 - Can you convert that to a migration timescale?
 - Effects of various disk properties including magnetic field, temperature, surface density, turbulence on migration direction and rate (qualitative picture)
- Different types of resonances raised in a disk due to planet

Planet Orbit Evolution (Planet-Planet Interaction)

- Stability criteria
 - Hill, Resonance overlap, Gladman
 - What are the physical differences between these criteria?
- Nature of evolution
- Planet-planet interactions and observed exoplanet (especially giants) properties
 - Eccentricities, inclinations
- Evidence in the Solar system for dynamical history
 - Could planet-planet scattering have taken place?
 - How about planet-planetesimal scattering?
 - Read the uploaded papers on Nice, and Grand Tack models.