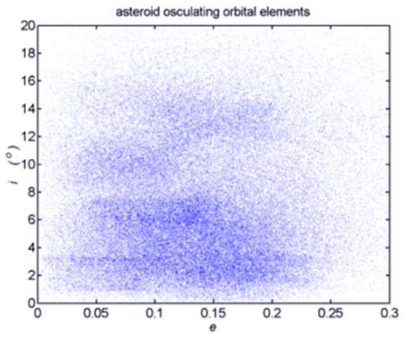
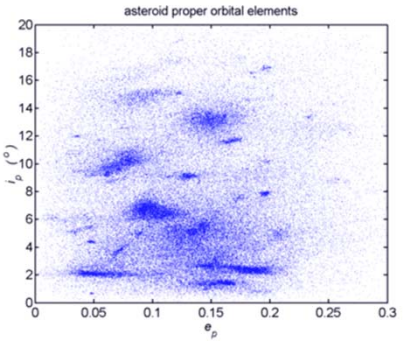
Asteroid families—7 Feb

- Next homework on Fri.
- Asteroid families
- Formation of the solar system
  - Why are terrestrial planets dense?

Proper orbital elements

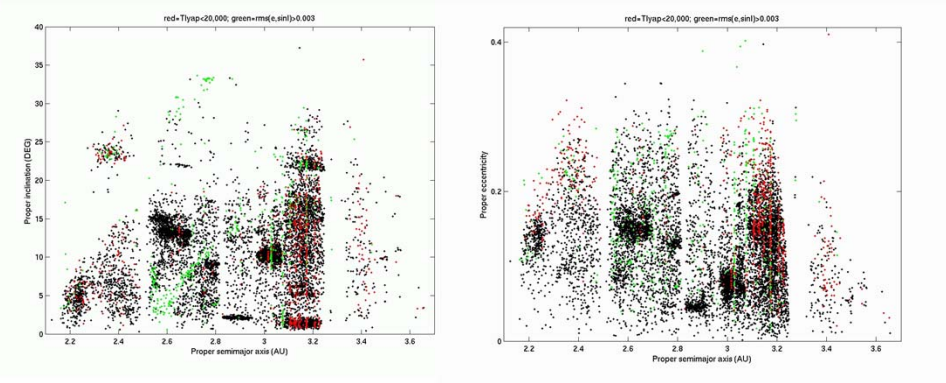
- Other bodies affect the motions of an object in the solar system.
  - Other planets pull on Earth
  - Planets pull on the asteroids.
- Motion separates into
  - a time-varying part (called osculating)
    - depends on the position of other bodies
  - an unchanging part (called proper or free)
    - averages out positions of other bodies





http://en.wikipedia.org/wiki/Proper_orbital_elements

Proper elements of asteroids

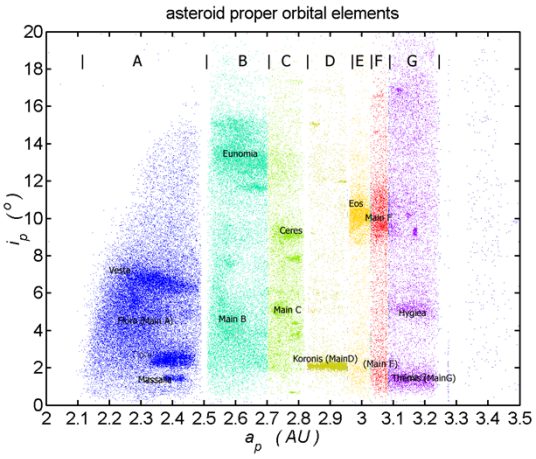


Black: Proper elements are well defined.
Red: chaotic.
Green: resonant

http://hamilton.dm.unipi.it/astdys/

Hirayama (1918) families

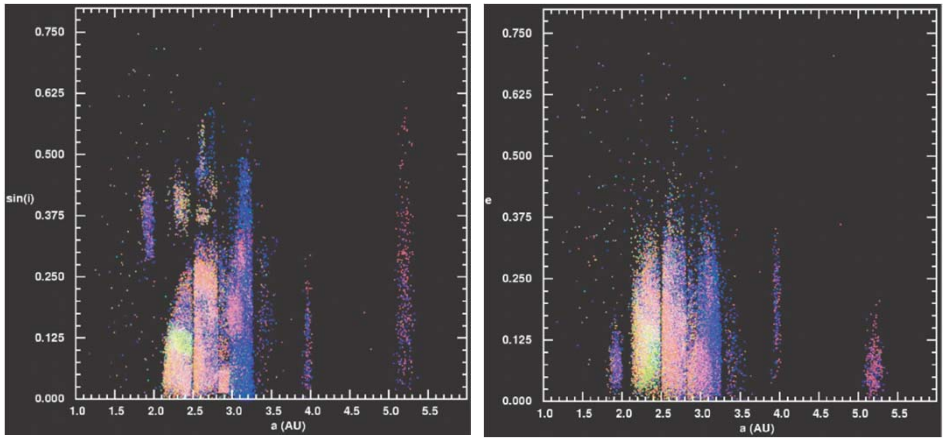
- Families have similar proper orbital elements and similar composition.
- What is a likely history of a family?

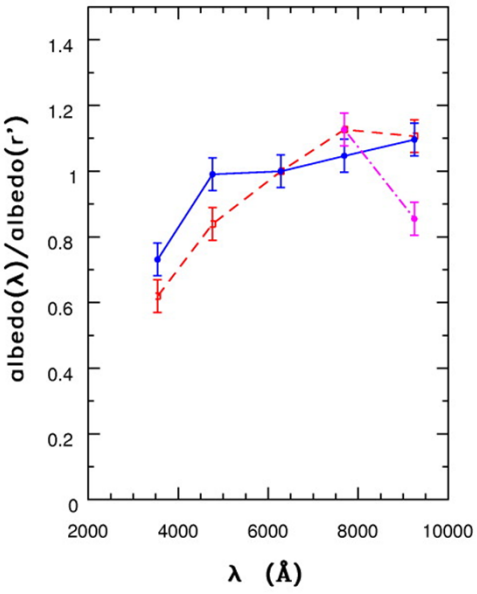


Wikipedia

Asteroids in SDSS

- SDSS is a survey of the entire northern sky at several epochs at several wavelengths.
- Asteroids: Gy. M. Szabó1,*, Ž Ivezić2, M. Jurić3, R. Lupton3, 2007, MNRAS 377, 1393
- Families have the same composition
  - Color indicates color of asteroid.

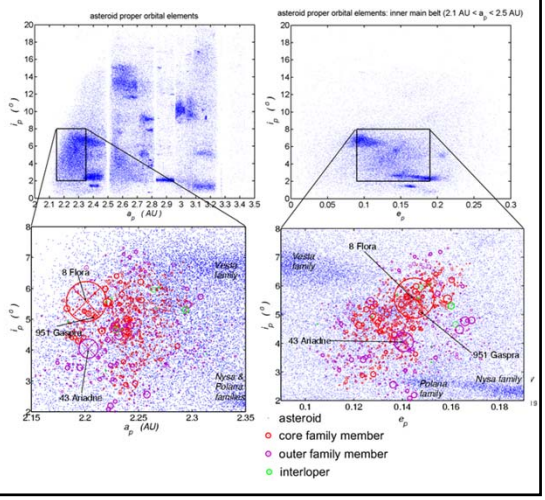




IVEZI, et al, 2001, AJ 122, 2749

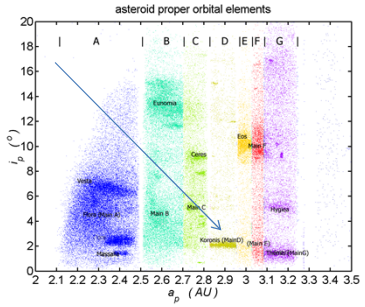
Flora family

- Discovered by Hirayama
- Asteroid 8 Flora (130km)
- 951 Gaspara (6km)
  - S type



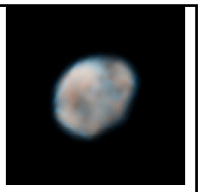
Koronis family

- Identified by Hirayama



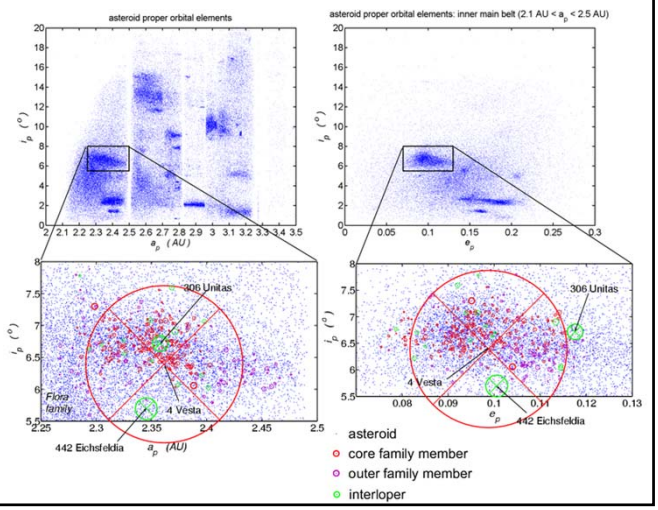
Ida & Dactyl, Galileo, NASA

Vesta family



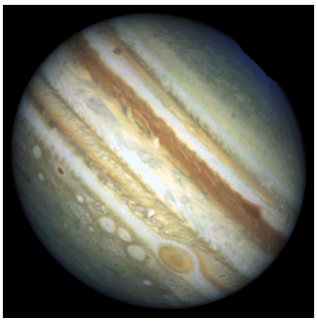
Vesta HST

- Asteroid Vesta is a member
  - 530km
  - 2nd largest asteroid
- Asteroid 1929 Kollaa & 2045 Peking
  - 7 km



Formation of the solar system

- Big subject, which we will discuss later
- Why are the planets near the sun dense (rock) and the farther planets less dense (like water)?

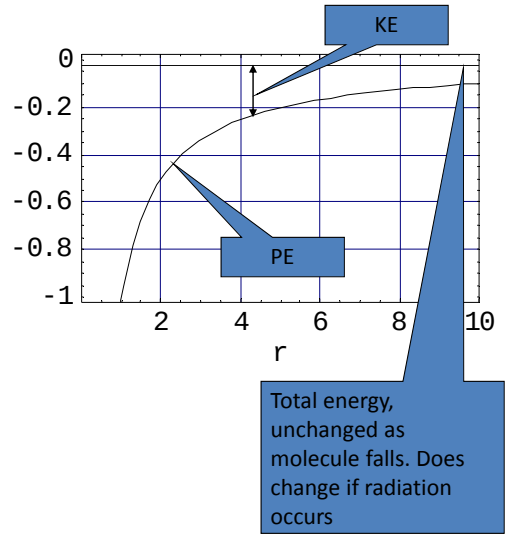


Jupiter; 1.3 gm/cm3

Mercury; 5.4 gm/cm3

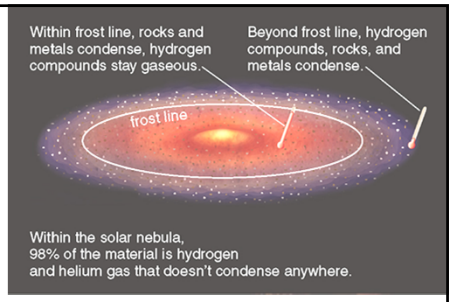
Collapse of the Protosolar Cloud

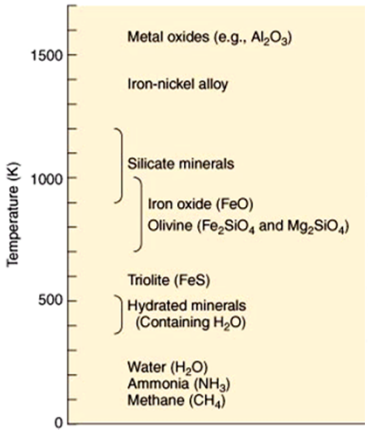
- I am a hydrogen molecule in the cloud that will become the solar system.
- My energy is kinetic (due to motion) and potential (due to gravity).
  - Energy = KE + PE
  - KE is proportional to v^2
  - PE depends on distance r to center of cloud
- When I fall from r = 5 to r = 1, my KE (and temperature) increases by a factor 5.



Thermal history of the Solar System

- Terrestrial vs. giant planets
- Asteroids vs. comets





Evaporation Temperatures