

Astronomy 405

Solar System and ISM

Lecture 2:

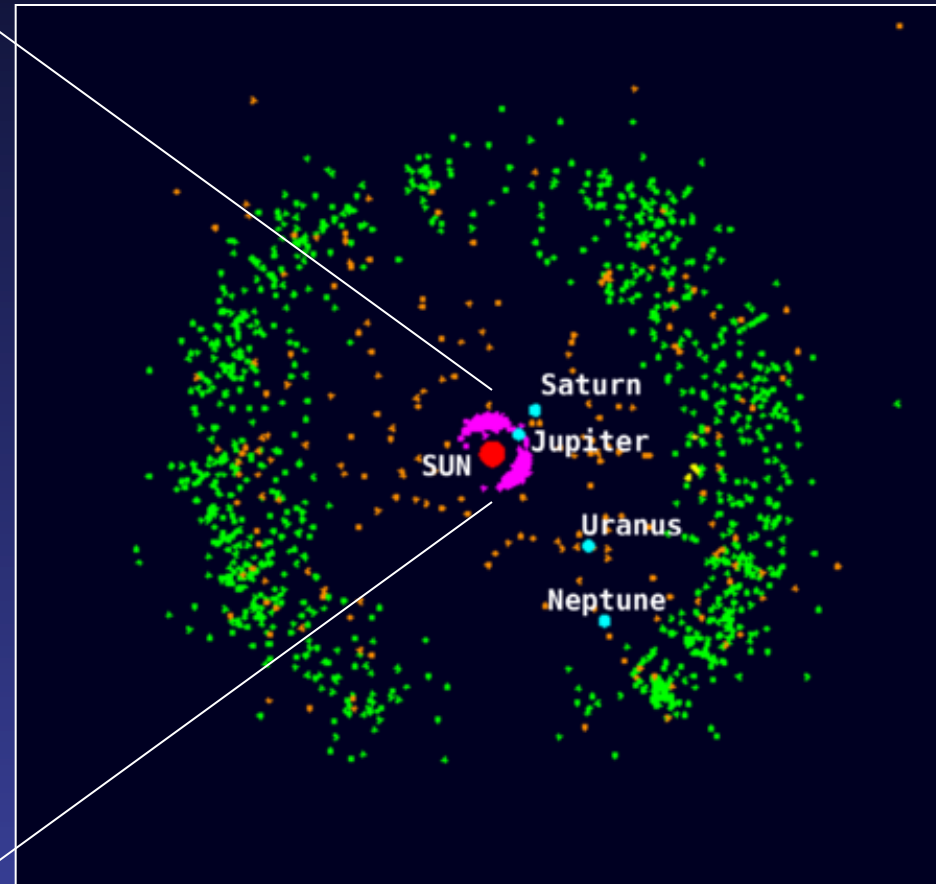
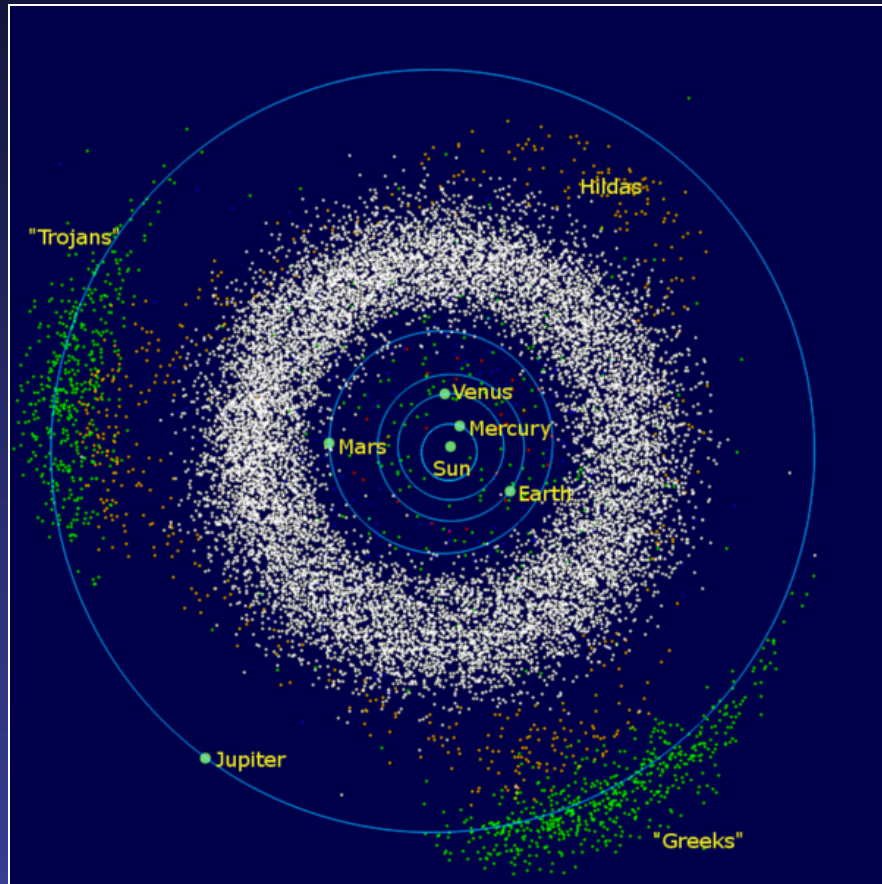
A Brief Survey

January 16, 2013

Planets in the Solar System

Terrestrial Planets:
Mercury, Venus, Earth, Mars

Jovian (Giant) Planets:
Jupiter, Saturn, Uranus, Neptune
(gas giants) (ice giants)

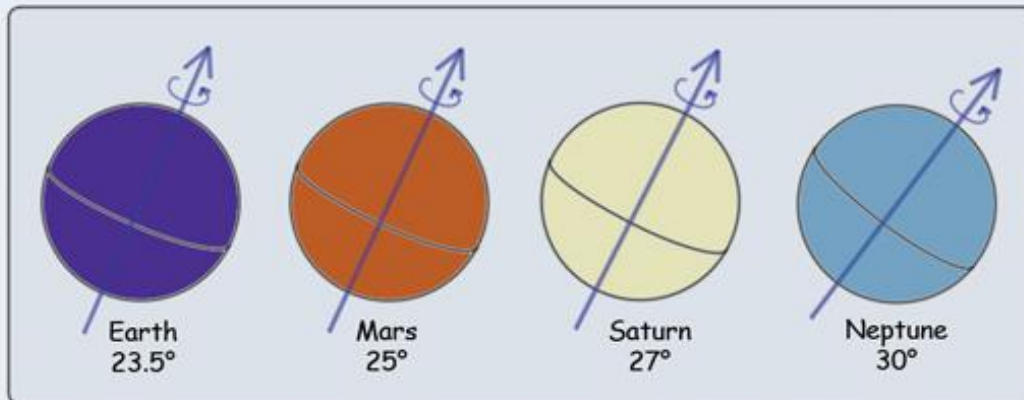
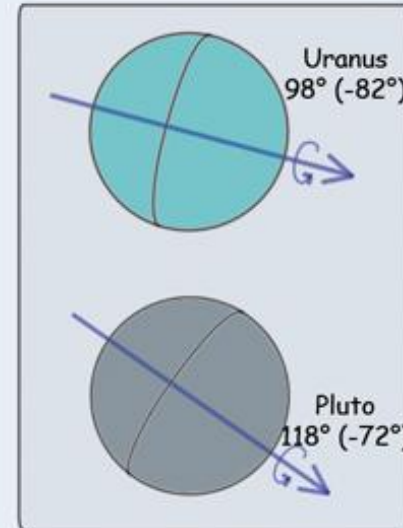
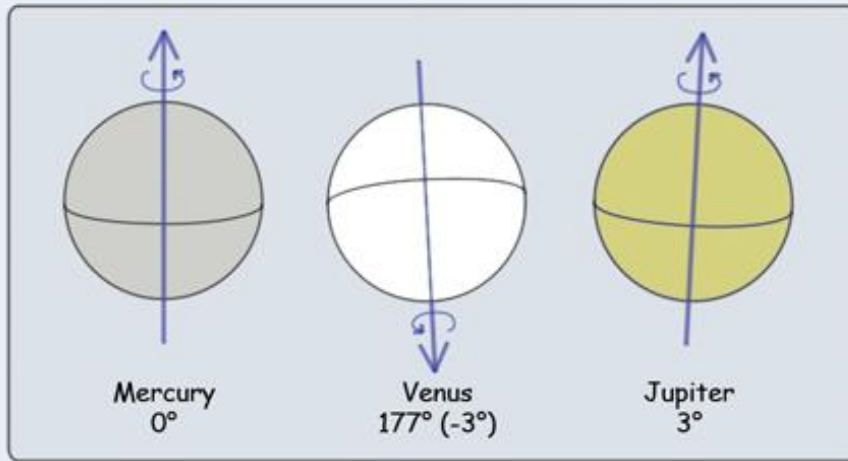


General Characteristics of the Planets

Characteristic	Terrestrial	Giant
Basic form	Rock	Gas/Ice/Rock
Mean orbital distance (AU)	0.39 - 1.52	5.3 - 30.0
Mean surface temperature (K)	215 - 733	70 - 165
Mass ($M_{\oplus}$)	0.055 - 1.0	14.5 - 318
Equatorial radius ($R_{\oplus}$)	0.38 - 1.0	3.88 - 11.2
Mean density (g cm^{-3})	3.9 - 5.5	0.69 - 1.64
Sidereal rotation period	24h - 243d	9.9h - 17.2h
Number of known moons	0 - 2	13 - 63
Ring system	no	yes

*Most of these differences are caused by their different distances to the Sun.
Rotation (period and axis) can be affected by other factors.*

Rotation axes are inclined differently. Collisions may have caused the large axis tilts.



The seven largest satellites:

Earth - Moon

Jupiter - Io, Europa, Ganymede, Callisto

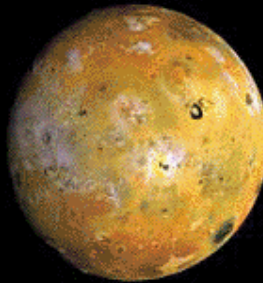
Saturn - Titan

Neptune - Triton

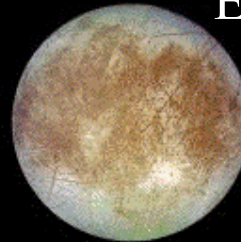
Moon



Io



Europa



Ganymede



Callisto



Titan



Triton



The Asteroid Belt (2 - 3.5 AU)

It was predicted by the Titius-Bode rule:

Planet	Titius-Bode Distance (AU)	Actual mean Distance (AU)
Mercury	$(4 + 3 \times 0)/10 = 0.4$	0.39
Venus	$(4 + 3 \times 2^0)/10 = 0.7$	0.72
Earth	$(4 + 3 \times 2^1)/10 = 1.0$	1.00
Mars	$(4 + 3 \times 2^2)/10 = 1.6$	1.52
Ceres	$(4 + 3 \times 2^3)/10 = 2.8$	2.77
Jupiter	$(4 + 3 \times 2^4)/10 = 5.2$	5.20
Saturn	$(4 + 3 \times 2^5)/10 = 10.0$	9.58
Uranus	$(4 + 3 \times 2^6)/10 = 19.6$	19.2
Neptune	$(4 + 3 \times 2^7)/10 = 38.8$	30.05
Pluto	$(4 + 3 \times 2^8)/10 = 77.2$	39.48

Comets, Kuiper Belt Objects, Oort Cloud

Comets - dirty snowballs of ice and dust

- orbits with large eccentricities

- heated near perihelion

=> coma + gas and dust tails



Two types of comets:

period < 200 yr

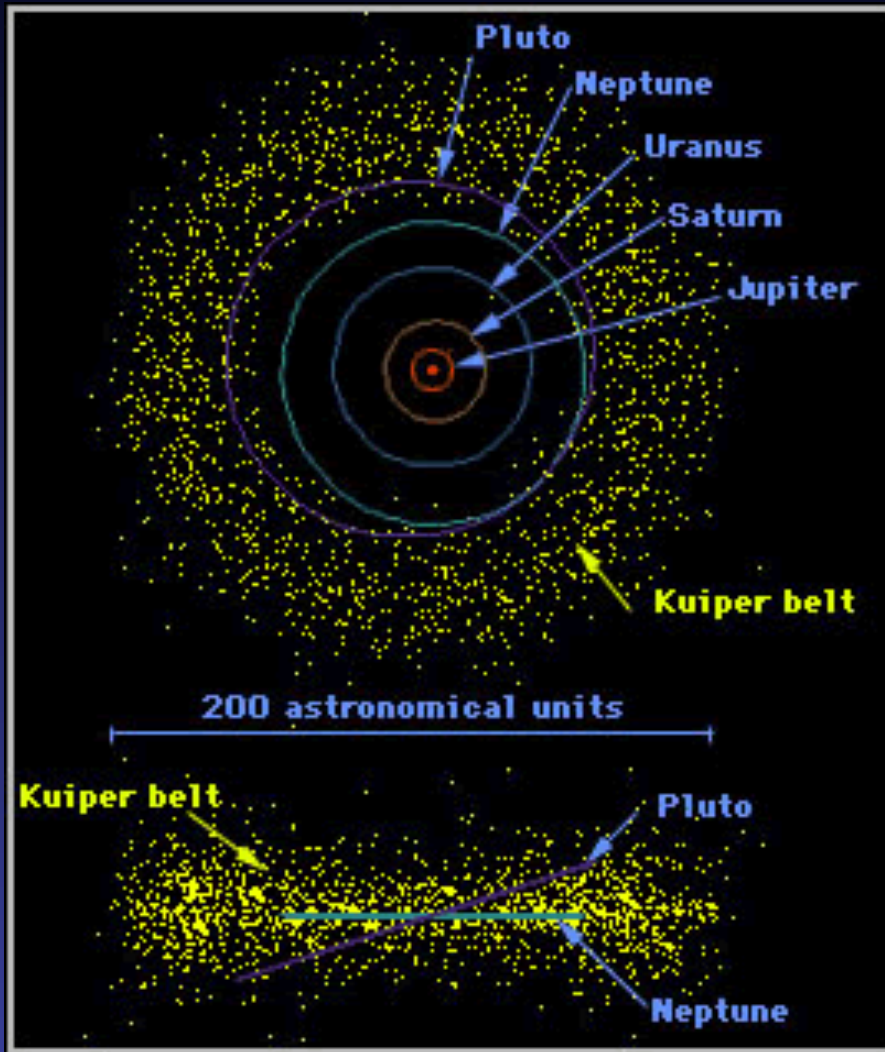
period > 200 yr

short-period

long-period

Kuiper Belt

Oort Cloud



Kuiper Belt Objects (KBOs)
Trans-Neptunian Objects (TNOs)
30-1000 AU from the Sun



Two types of comets:

period < 200 yr

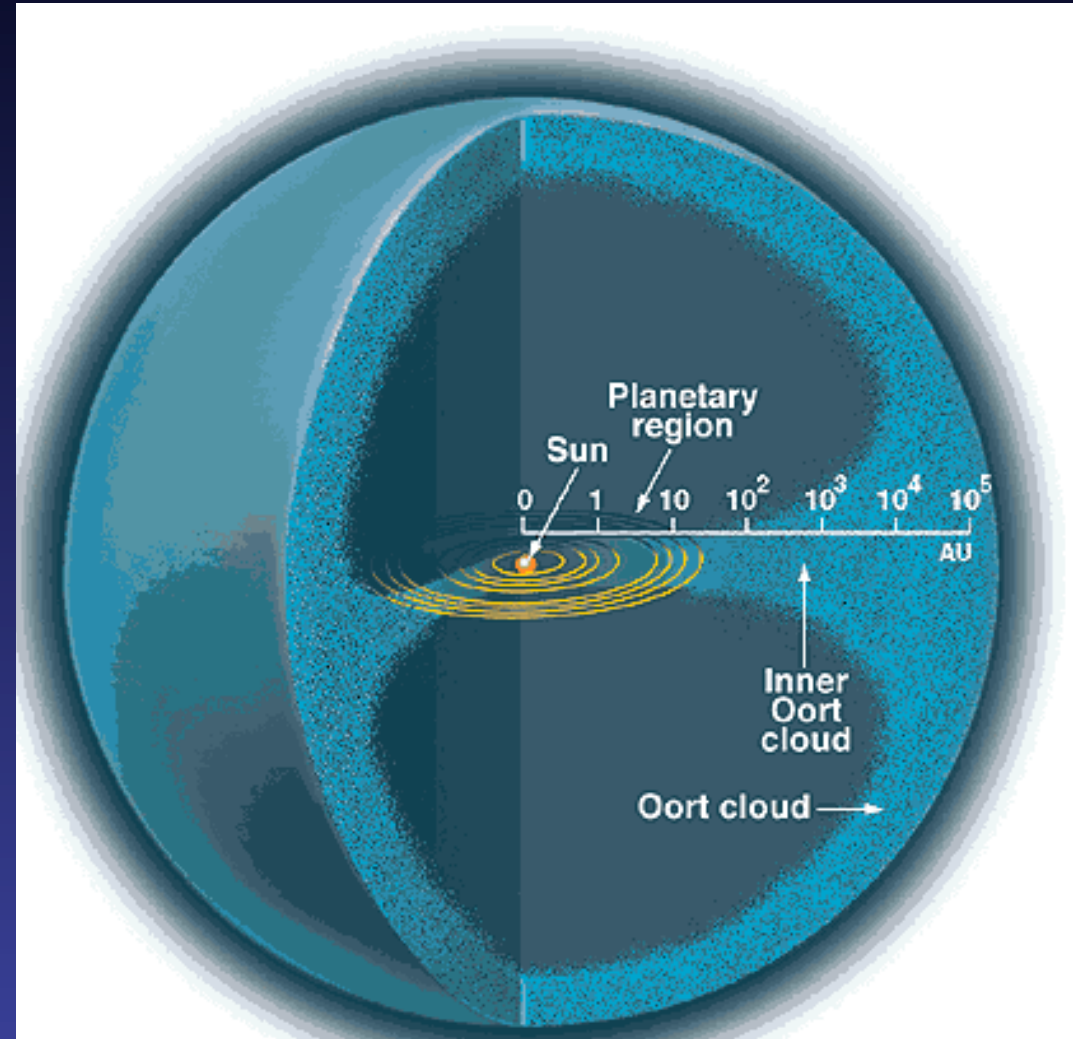
period > 200 yr

short-period

long-period

Kuiper Belt

Oort Cloud



Oort Cloud

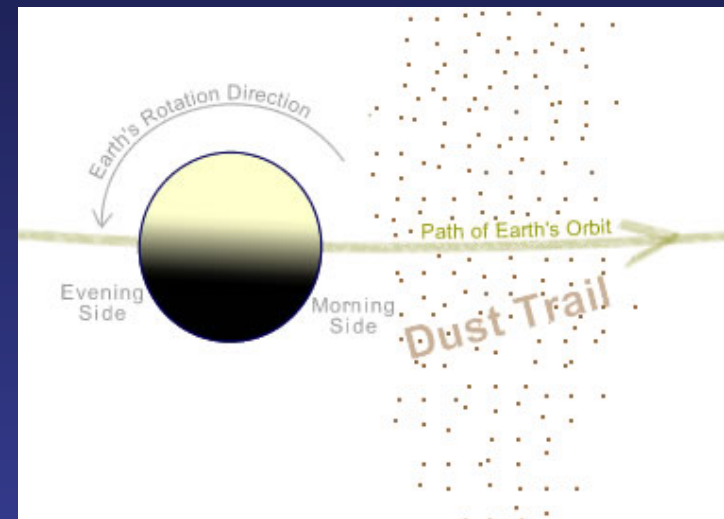
- spherically symmetric
- 3000-100,000 AU
- none have been detected “at home” in the cloud
- detected as comets near perihelion

Meteoroid - fragments from asteroid collisions

Meteor - meteoroid entering and burning in the Earth's atmosphere

Meteorite - meteor that survived the entry and reached the ground

Meteor Shower - Earth moving through the dust trail left along a comet's orbit



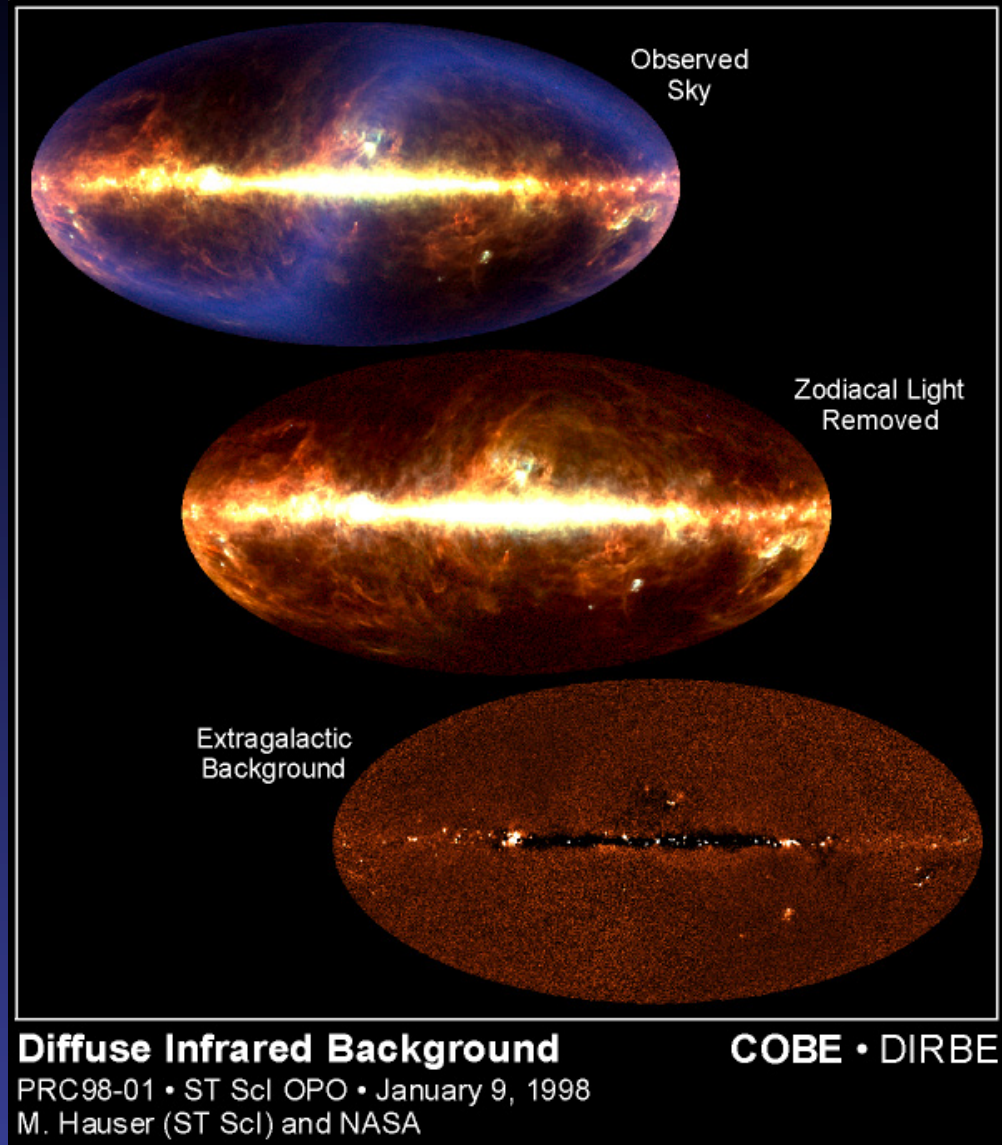
What is the best time to watch a meteor shower?

Debris Disk - Dust in the Ecliptic Plane

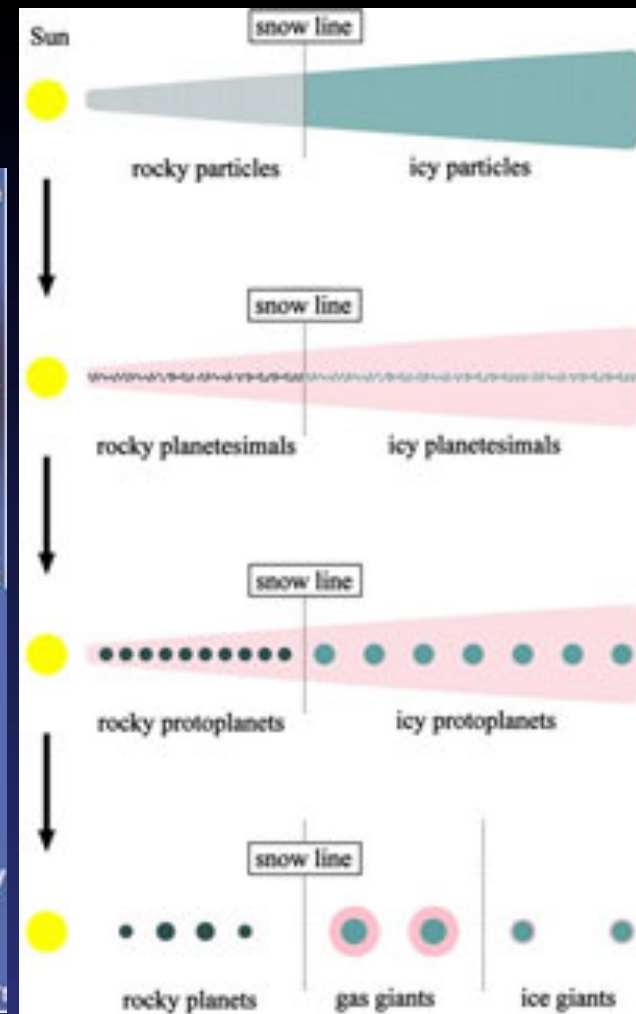
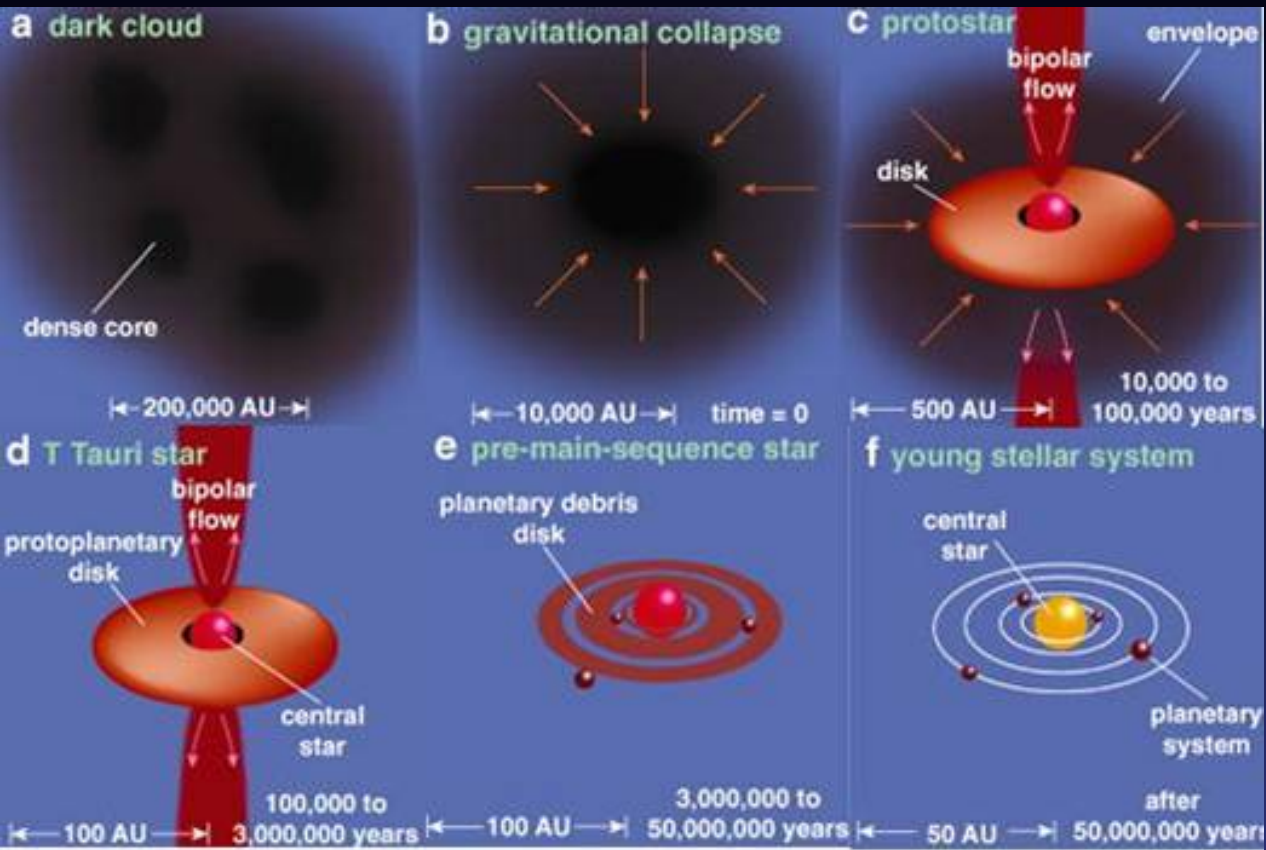


Zodiacal Light

- scattered sunlight in optical
- blackbody emission in IR



Solar System Formation



Young Earth colliding with a Mars-like planetesimal $\Rightarrow$ Earth+Moon

Venus colliding with another planetesimal $\Rightarrow$ rotation axis reversal

Rocky debris $\Rightarrow$ asteroids

Icy debris $\Rightarrow$ Kuiper Belt Objects; Oort Cloud

Gravitational interactions can send debris inward or outward.