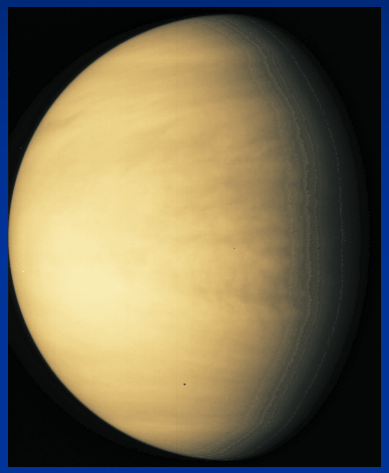
Kuiper Belt Objects

Aaron S. Evans
Stony Brook
May 3, 2002

Inventory of Solar System Naked-Eye Planets

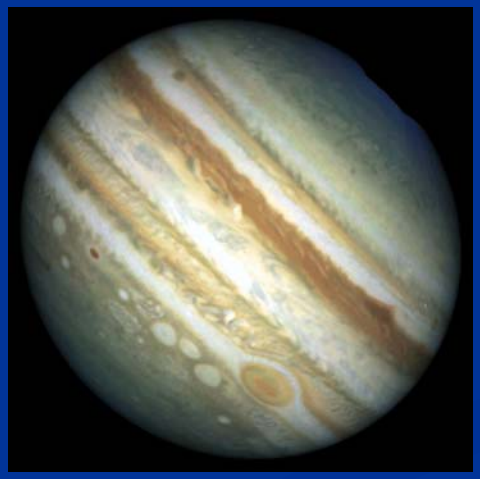
Mercury



Venus

Earth

Mars

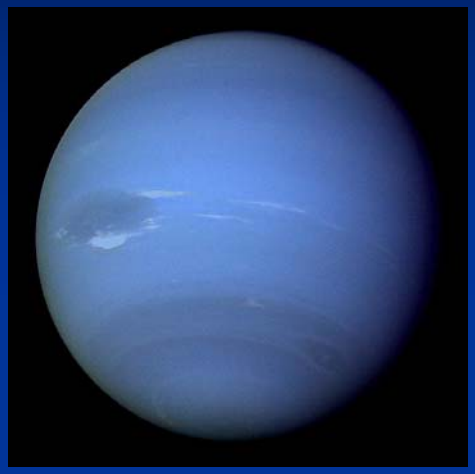


Jupiter

Saturn

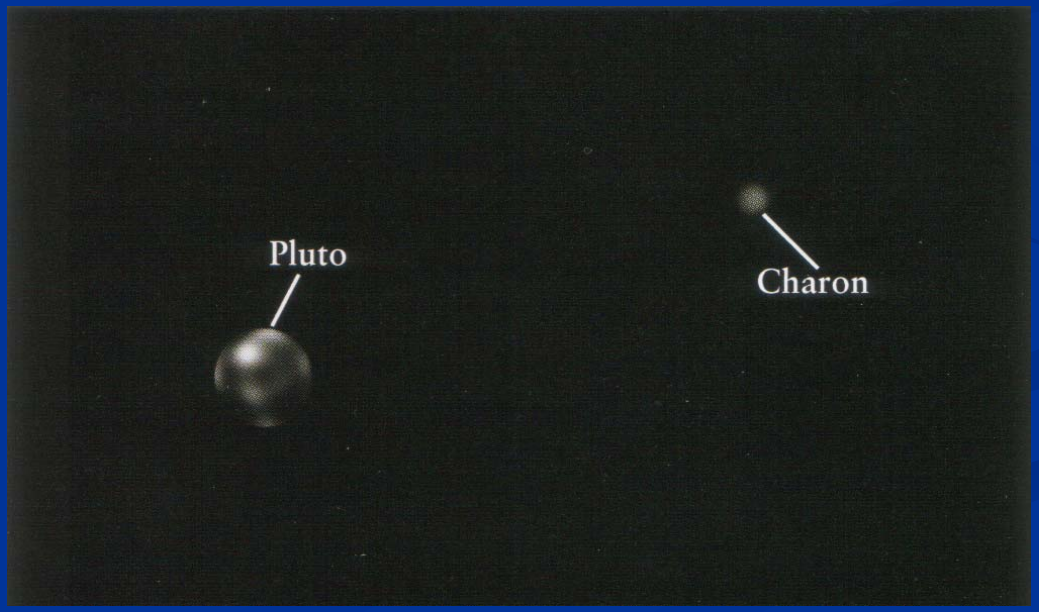
Inventory of Solar System

Uranus
1781

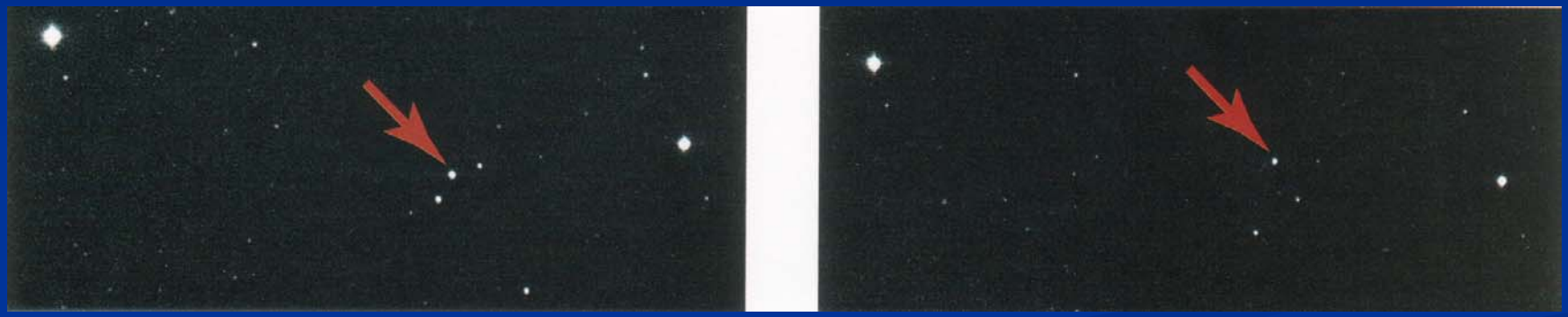


Neptune
1846

Pluto
1930



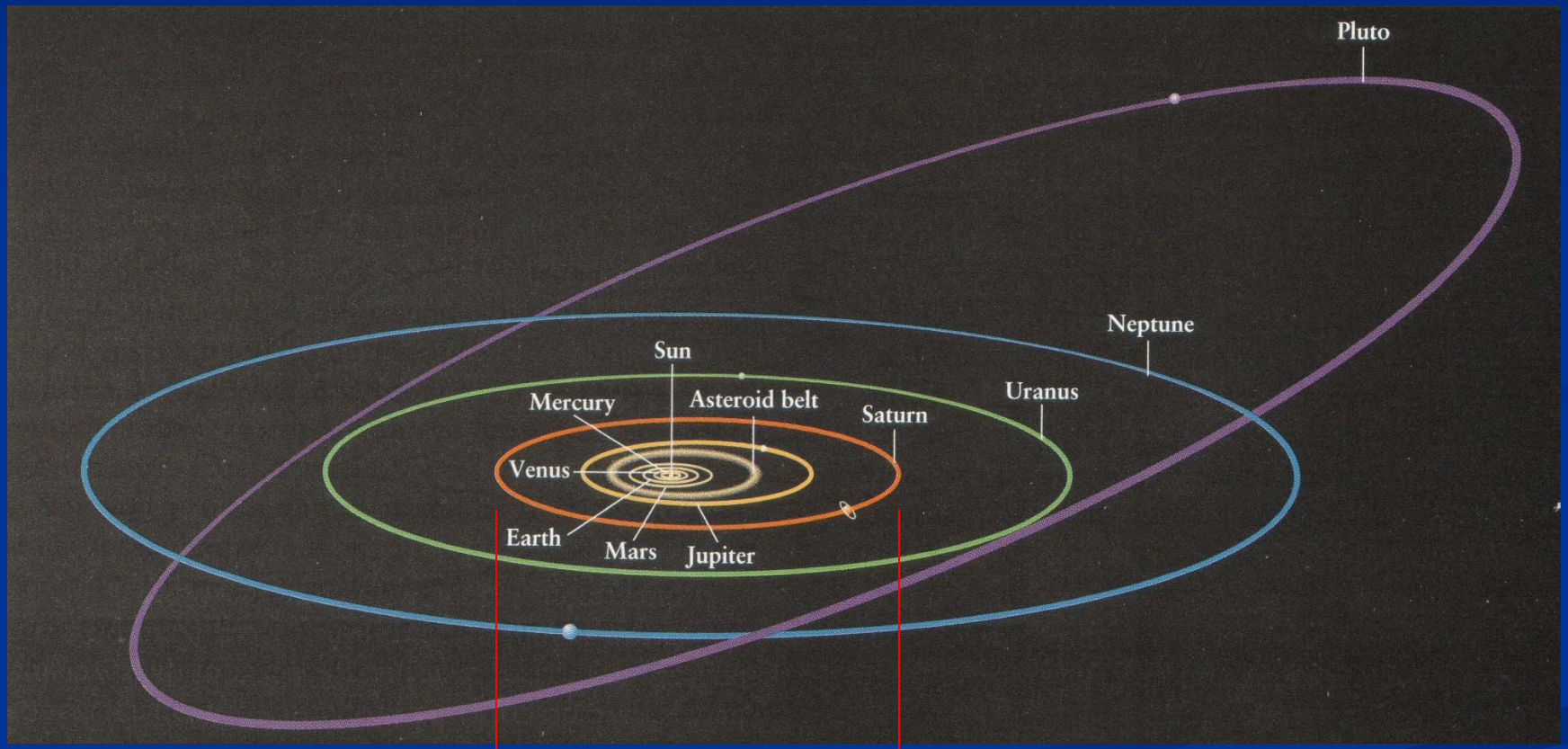
Discovery of Pluto



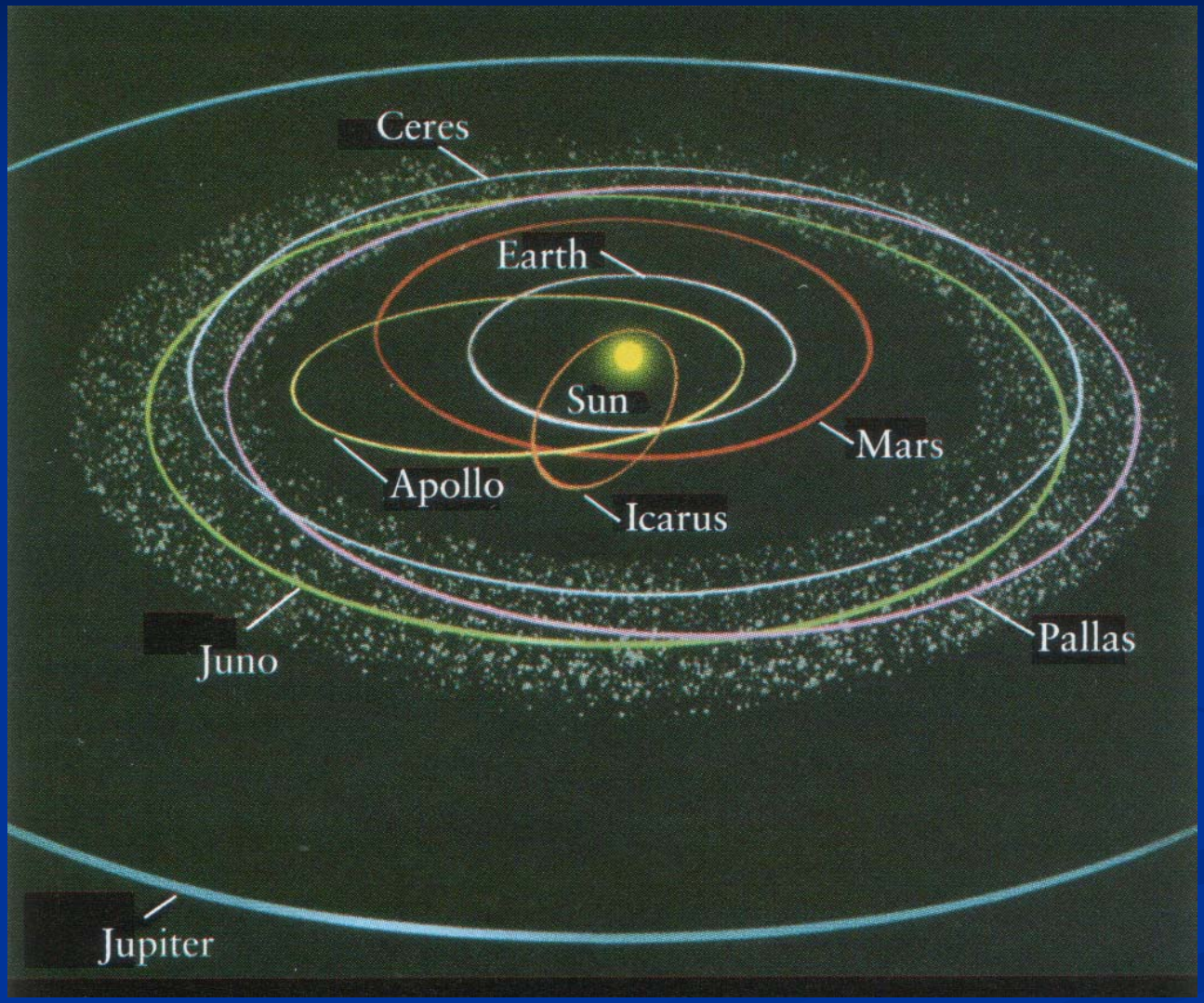
… Via Comparison of Photographic Plates

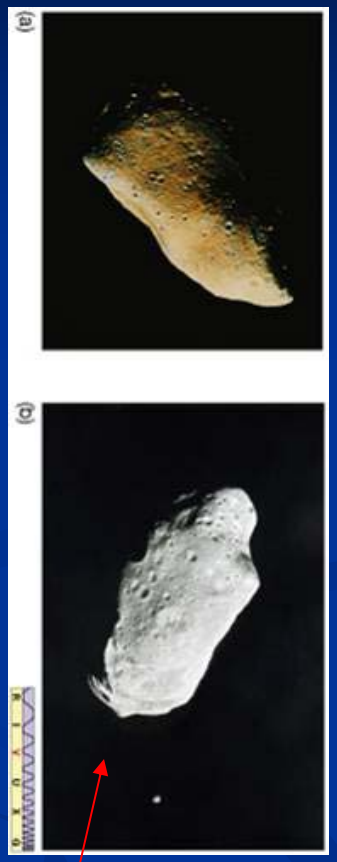
1 AU = Earth – Sun Distance

Orbits of the Planets are in a Plane (Ecliptic) Centered on the Sun



The Asteroid Belt



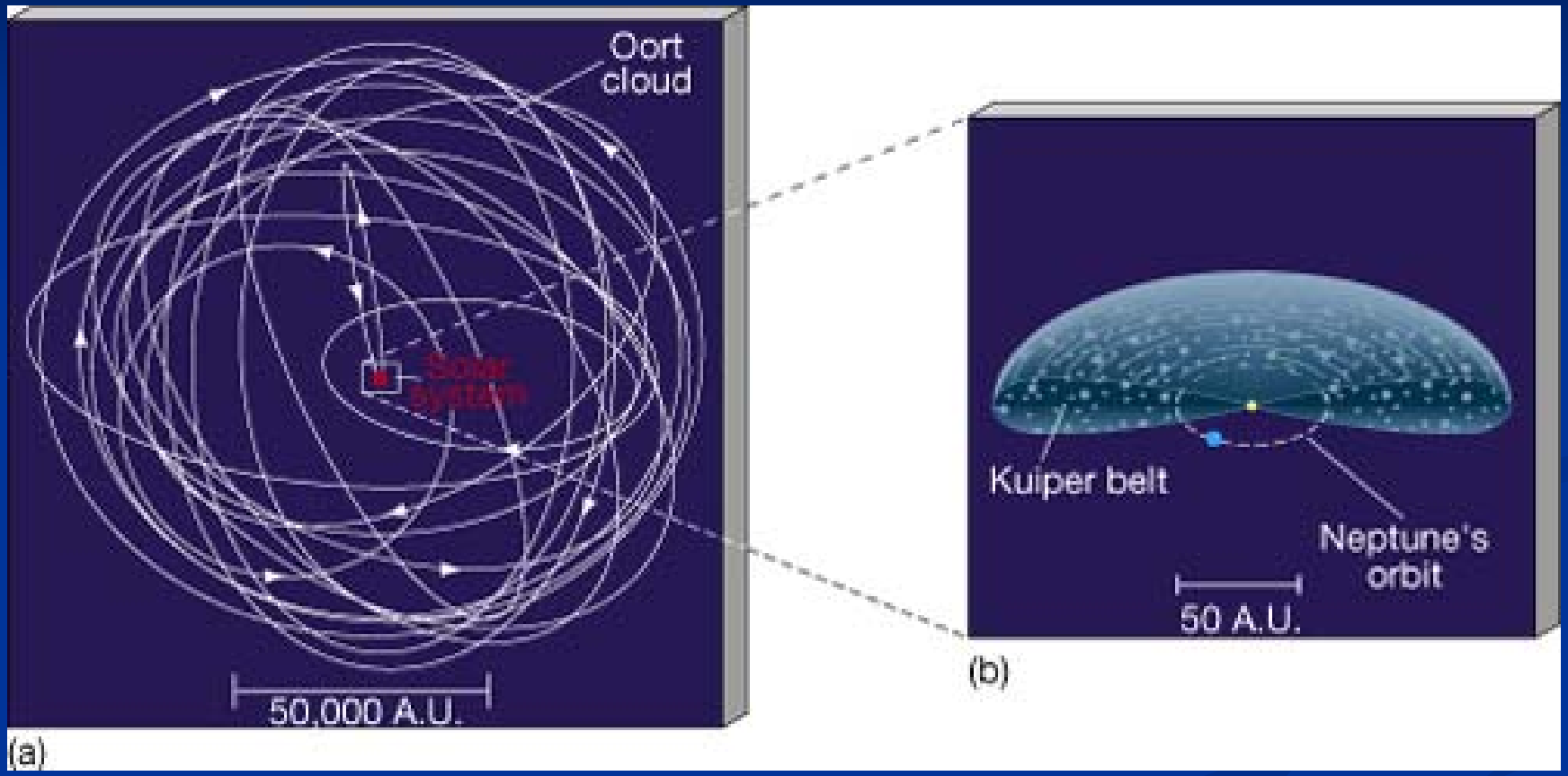


Rock/Metal Composition

Comets

Ice & Rock – Ice Sublimates as Comet Approaches the Sun

Oort Cloud & Kuiper Belt

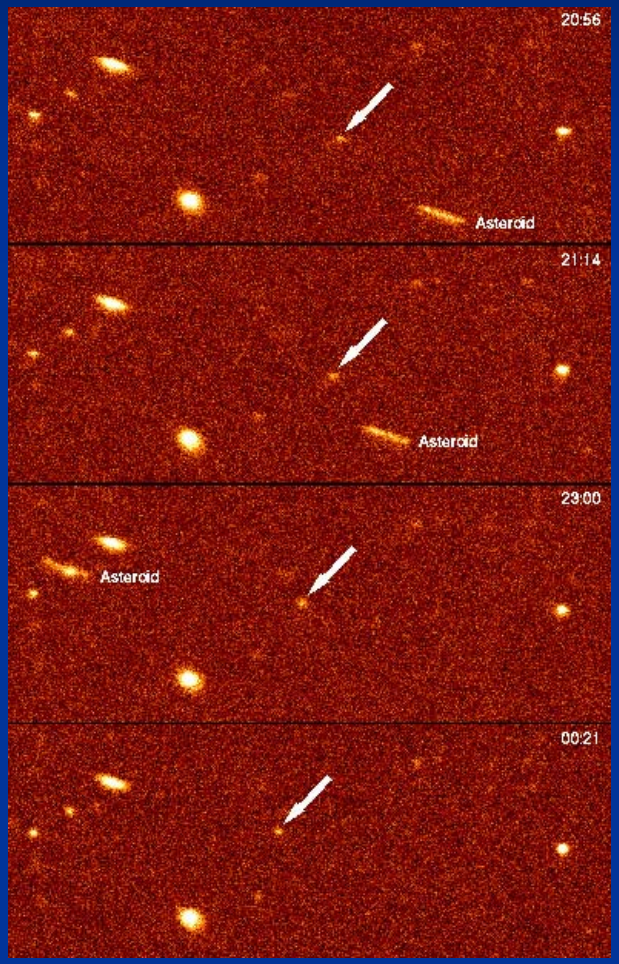


- Long Period Comets – Random Inclinations (Oort Cloud)
- Short Period Comets – Low Inclinations (Kuiper Belt)

Finding Kuiper Belt Objects – The Challenges (ca 1990)

- Very Faint
- Large Areas Must be Surveyed to Find KBOs

The First KBO



- Discovered in 1992
- D. Jewitt & J. Luu
- Large field of view CCD Images

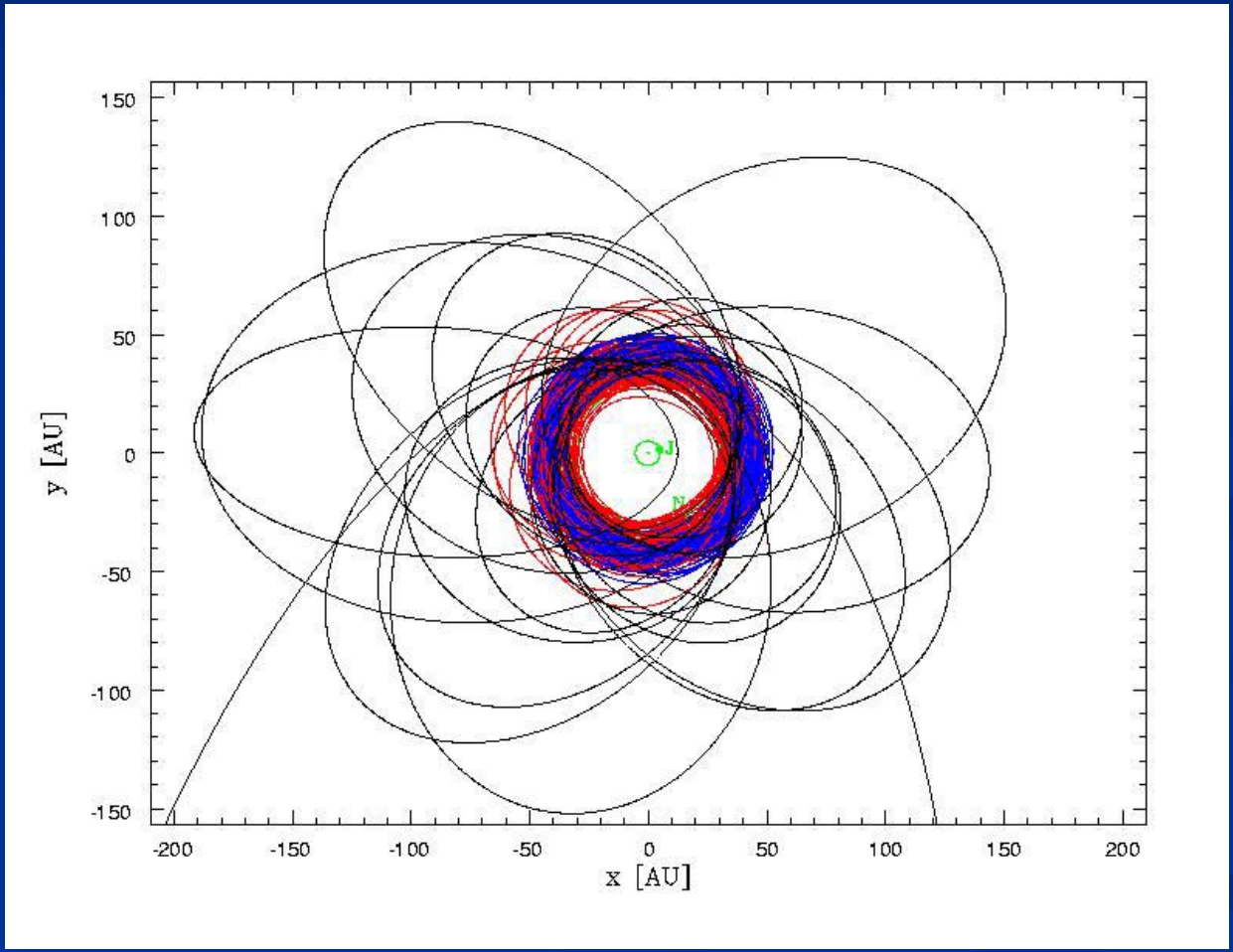
The Kuiper Belt Movie

Observations taken with the Big Throughput Camera
at the Blanco 4-meter Telescope, Cerro Tololo, Chile
May 28 & 29, 1998

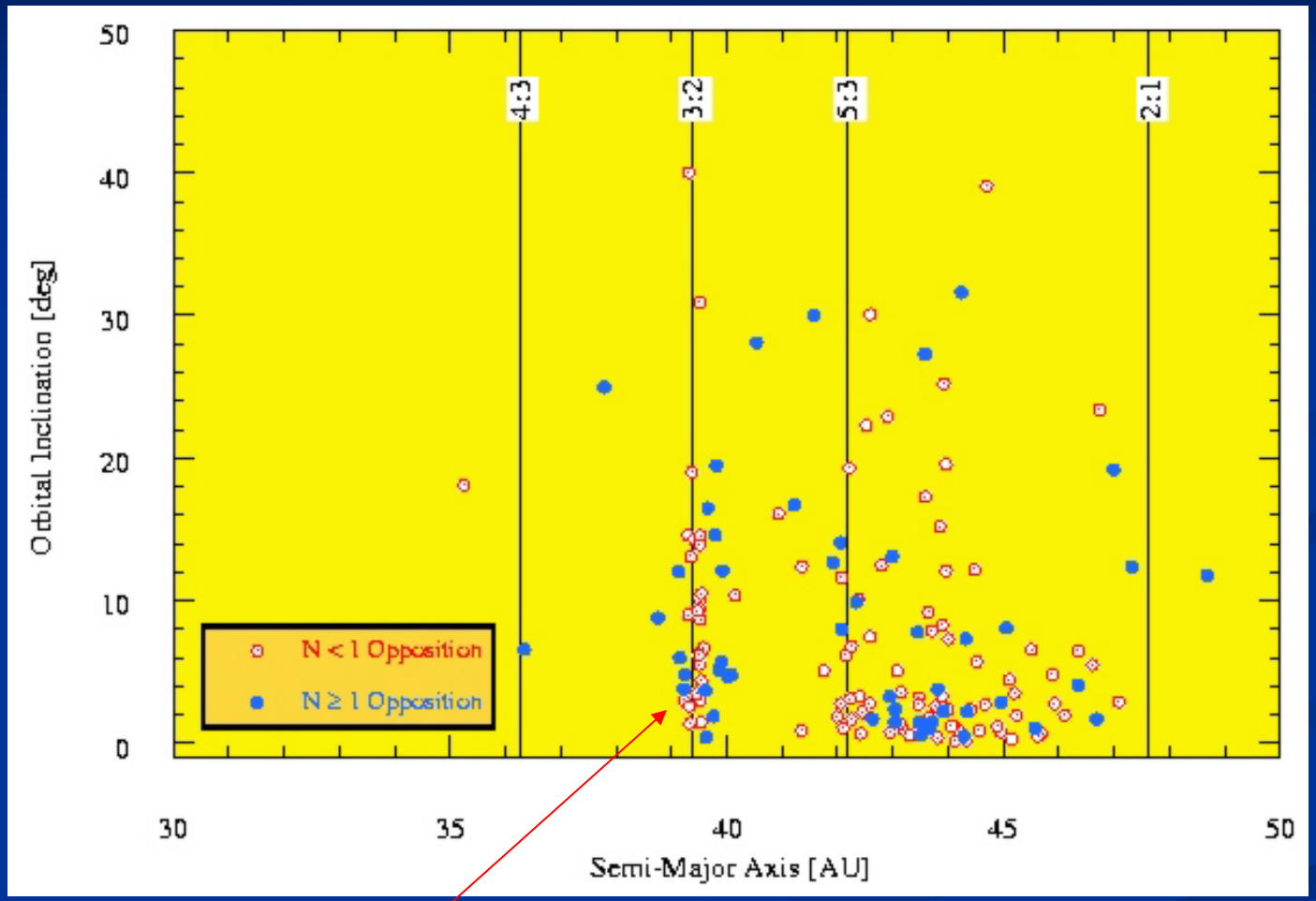
Observations by:
Lynne Allen & Michael Jarvis

Data Reduction & Graphics by:
Gary Bernstein & Brandon Preblich

Orbits



Inclinations

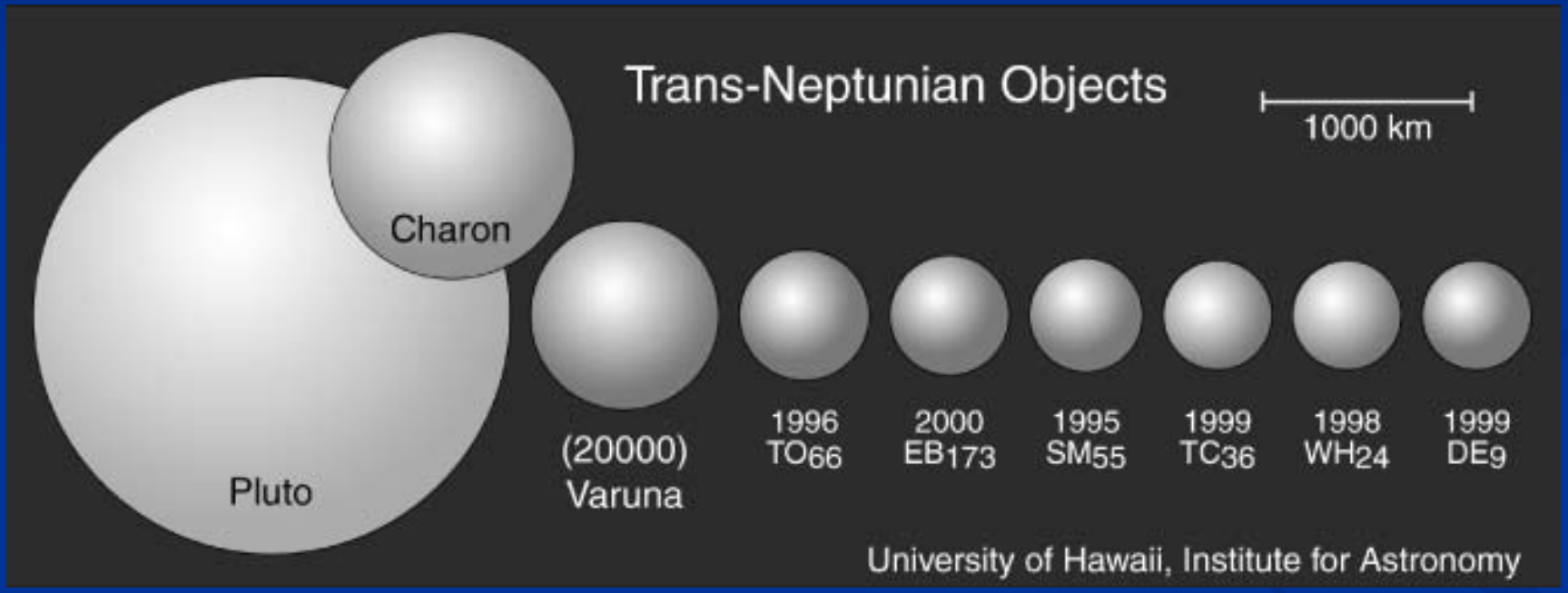


Plutinos

Size Ranges

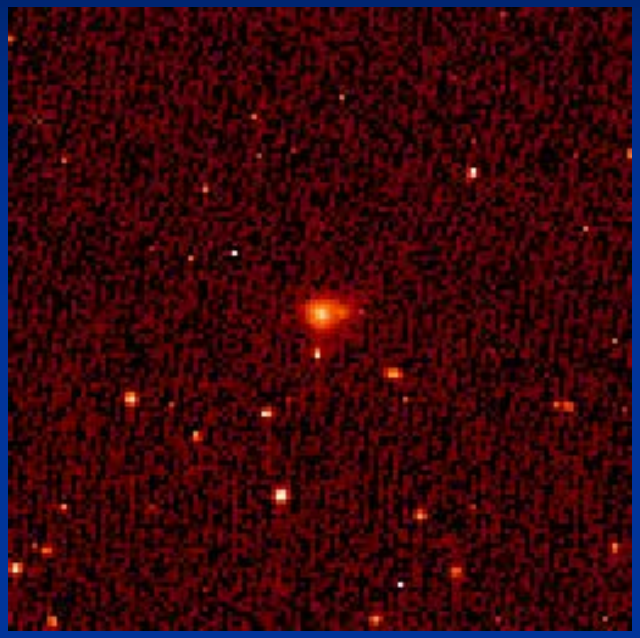
- 10 billion with Sizes > 1 km
- 30000 with Sizes > 100 km
- 10 with Sizes > 1000 km (Pluto ≈ 2200 km)

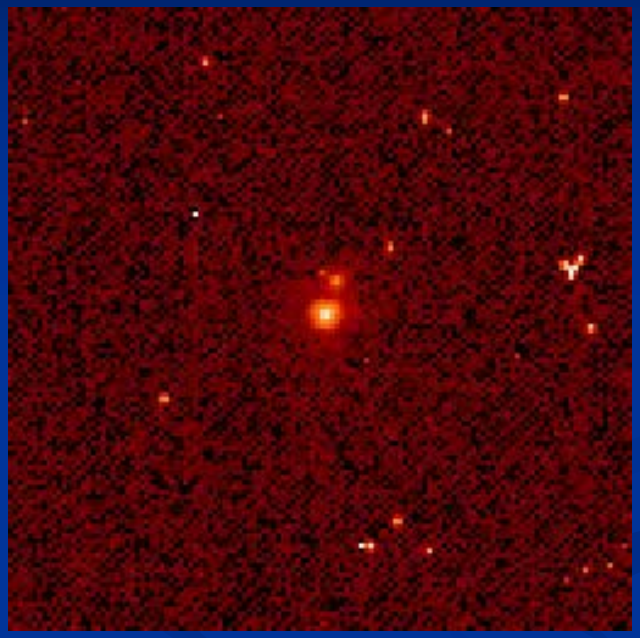
Large KBOs: Varuna

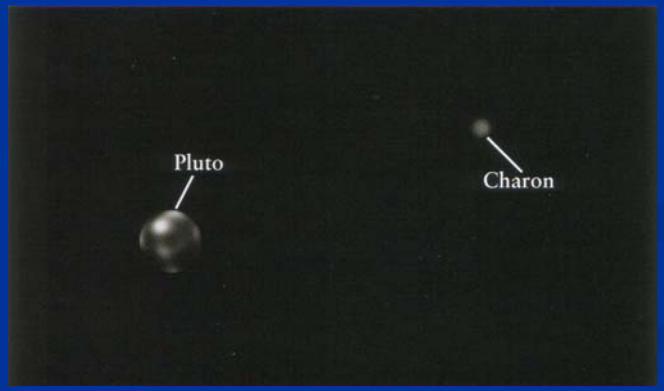


Diameter is 40% Pluto's Diameter

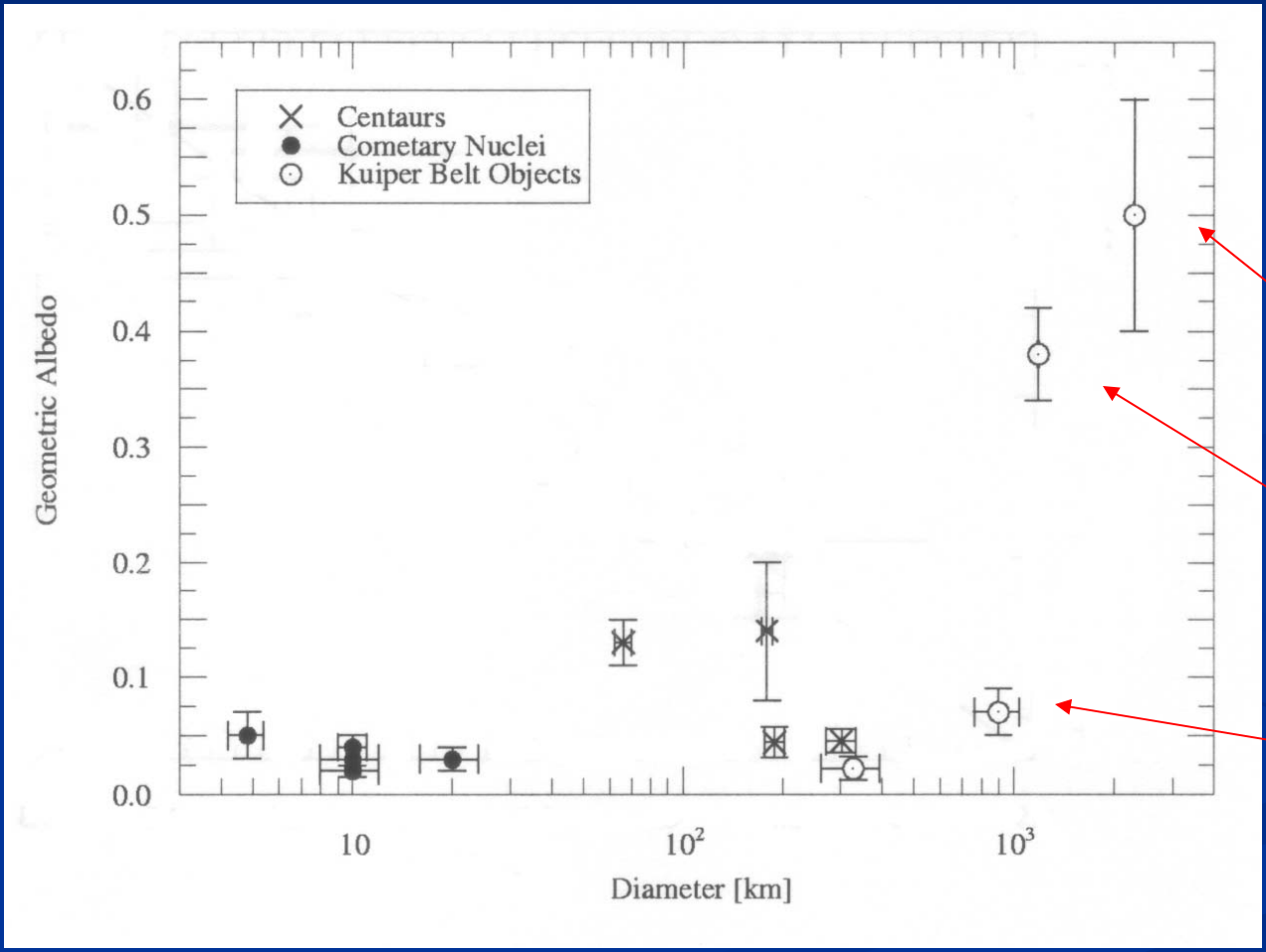
Binary Kuiper Belt Objects







Albedo – Reflectivity of Solar Light

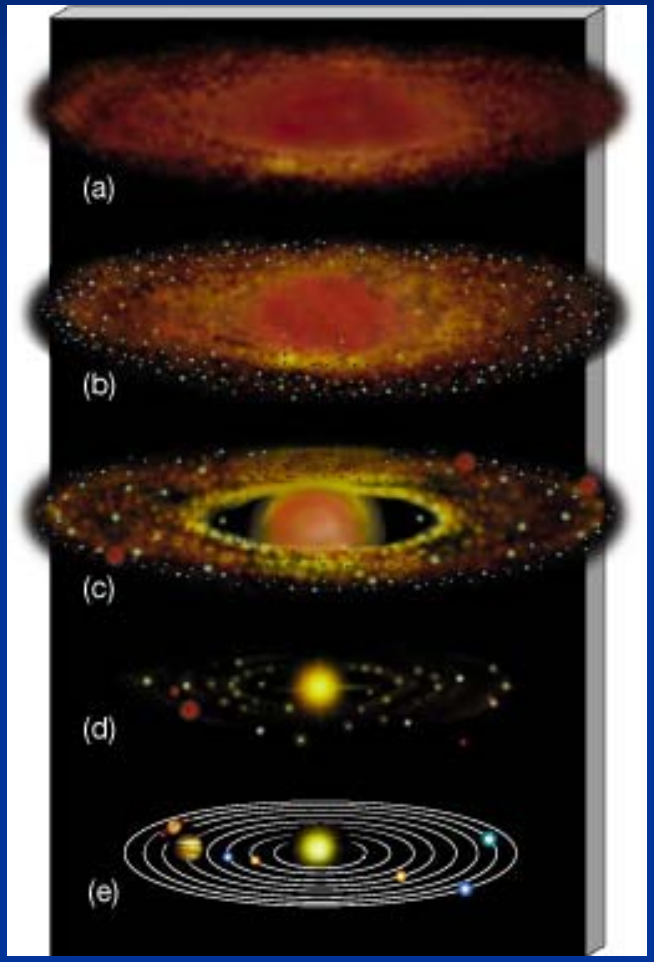


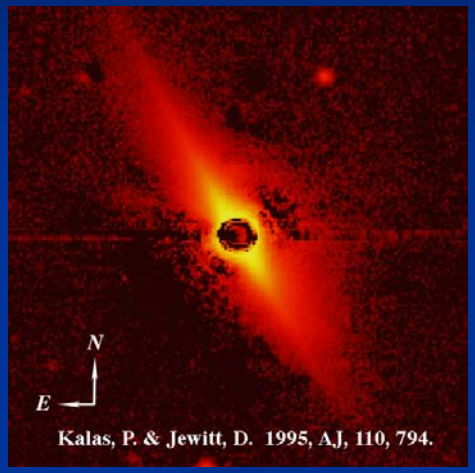
Pluto

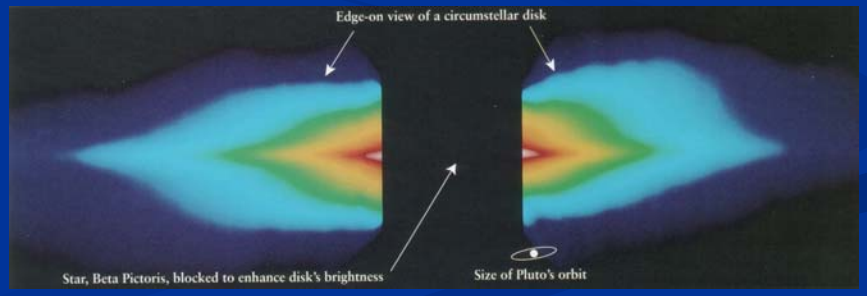
Charon

Varuna

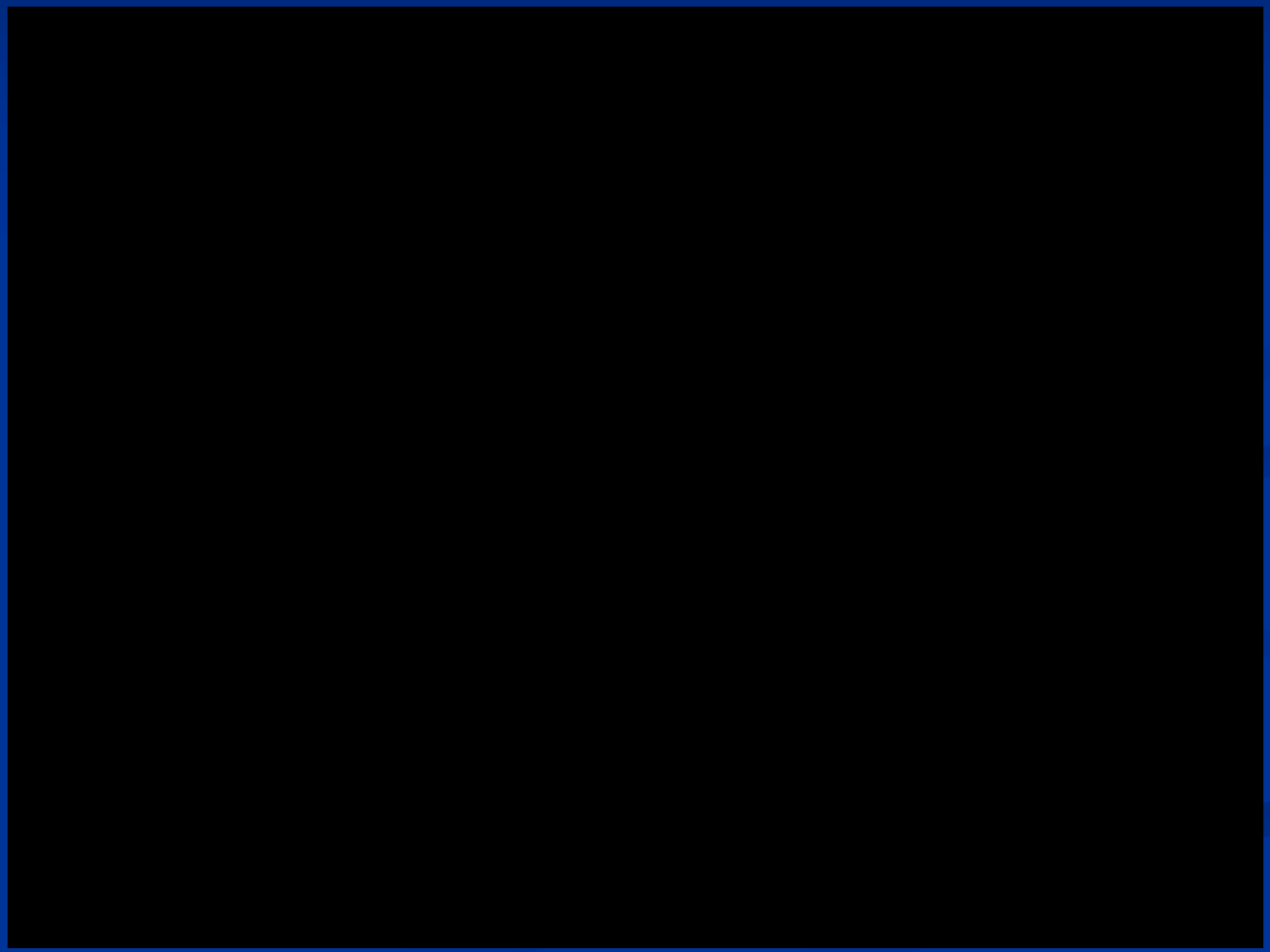
Formation of Solar System





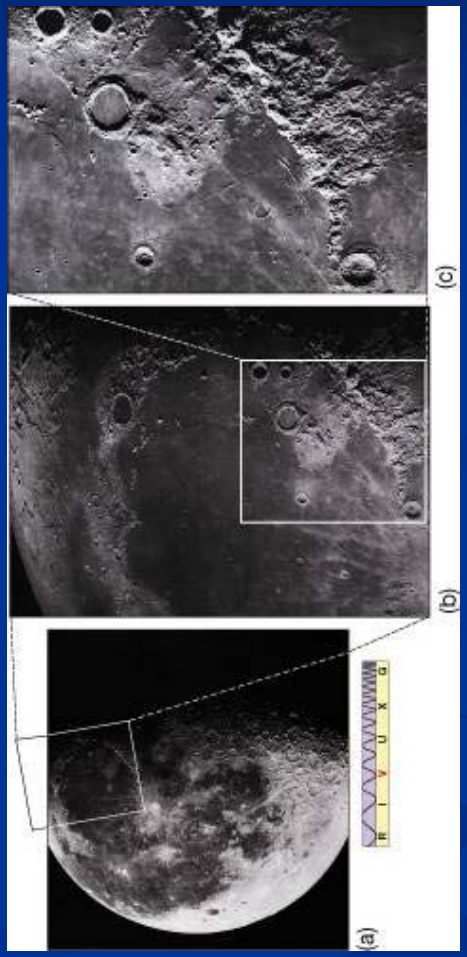


Formation of the Solar System



Accretion & Bombardment are Important in the Early Solar System

Mercury

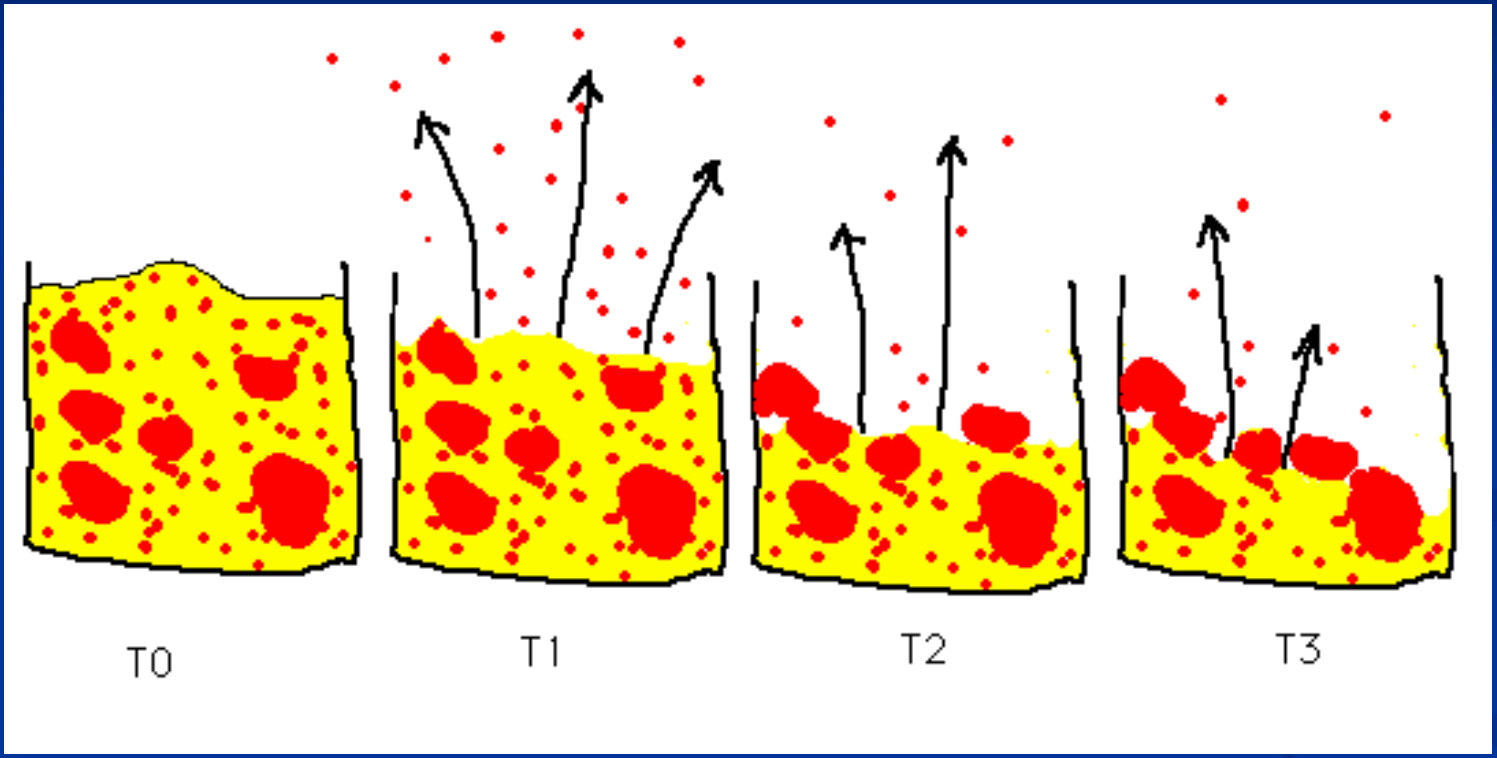


Moon

Origin of the Kuiper Belt

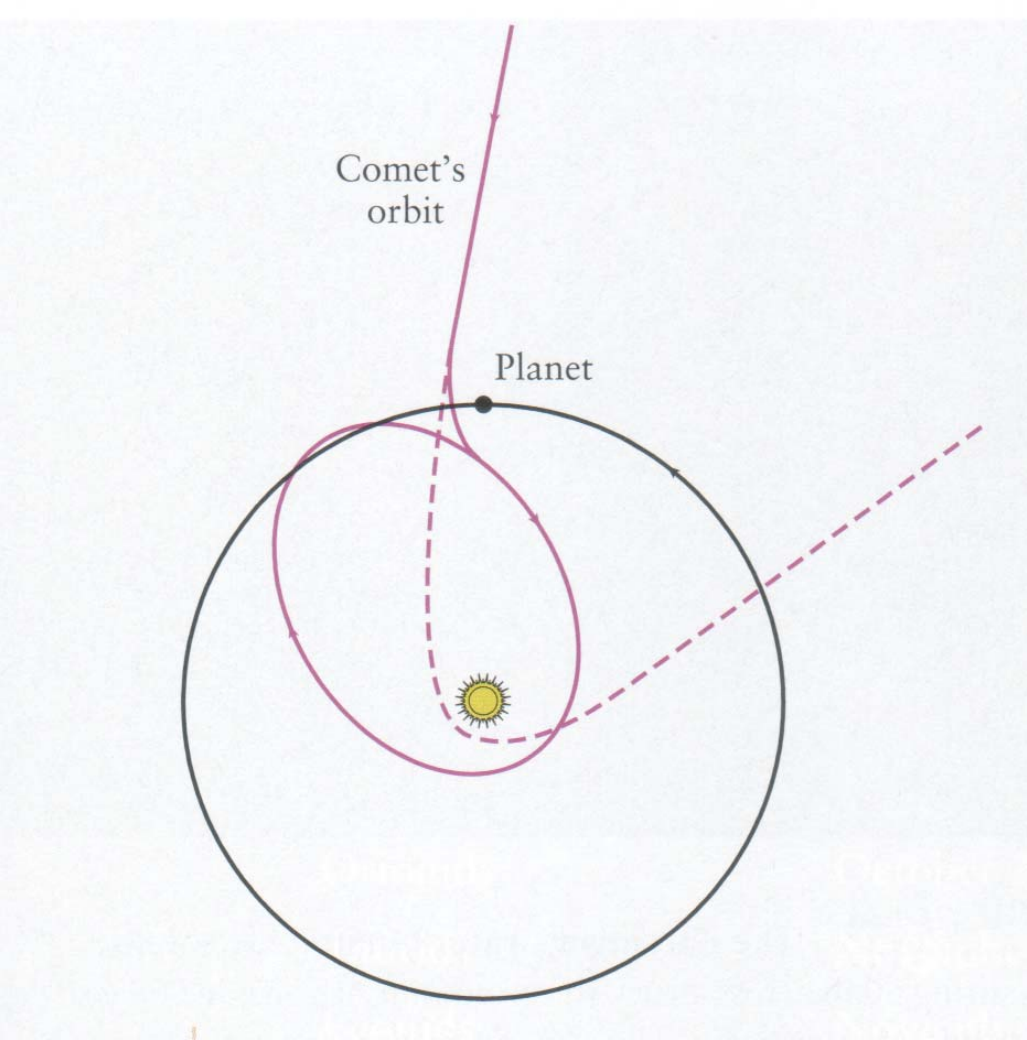
- Planetesimals whose accretion was disrupted by the formation of Neptune
- Neptune stirred up the motions of KBO, causing more collisions

The Fate of Comets



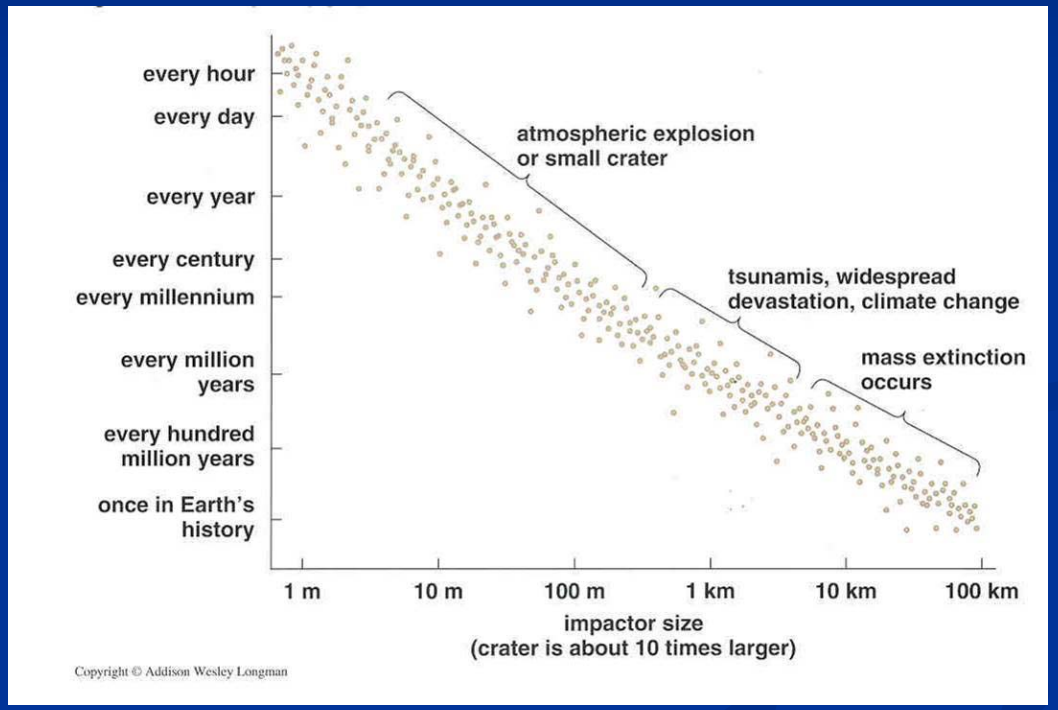
- Complete Evaporation
- Dead Comet

The Creation of Near Earth Asteroids



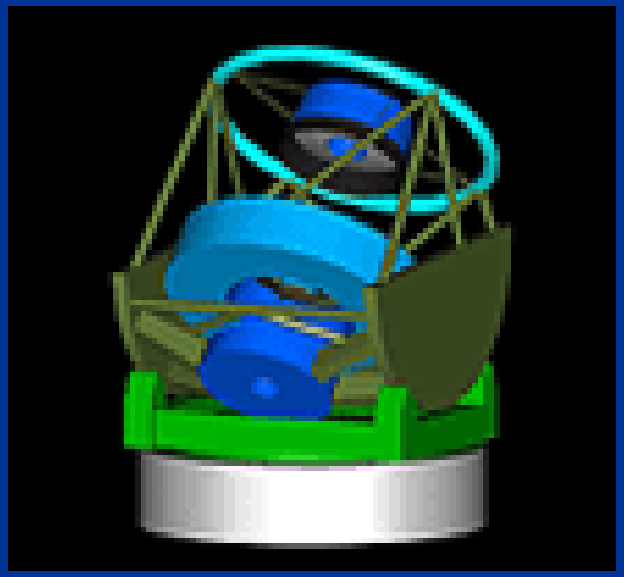
Near Earth Asteroids

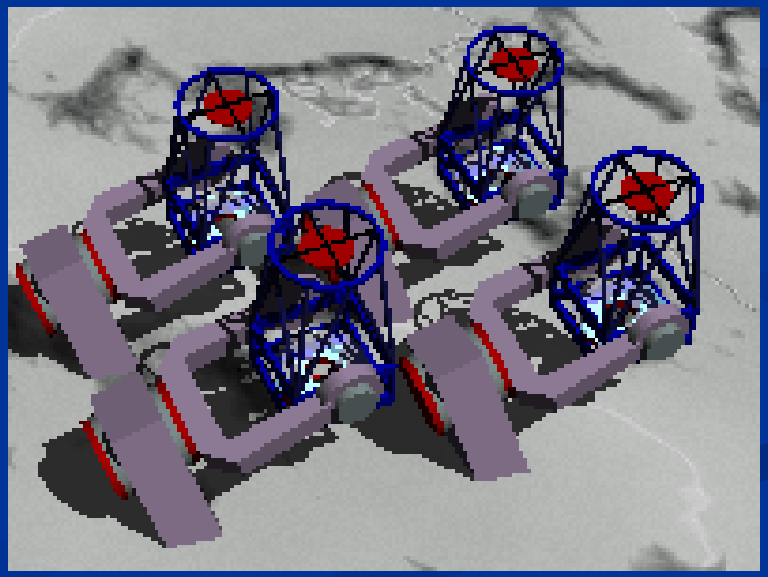
10 – 50 % are Dead Comets



Survey Telescopes

- LSST – Large Aperture Synoptic Survey Telescope (8.4 m aperture, 7 sq. degree field)
- POI – Panoramic Optical Imager (1.5 m aperture, 7 sq. degree field)





Summary

- KBO are the best know representation of the composition of the early solar nebulae.
- Pluto has orbital properties very similar to KBOs, and is considered by many to be the largest KBOs presently known
- KBOs are also a likely Reservoir for Near Earth Asteroids

Popular Books

- Beyond Pluto, by John Davies (2002), Cambridge University Press