Uranus and Neptune – gas giant twins

Uranus
19.2 AU from Sun
Diameter 4 x Earth
Mass 14.5 x Earth
Density 1.3 gm/cm$^3$

Neptune
30 AU from Sun
Diameter 3.9 x Earth
Mass 17 x Earth
Density 1.6 gm.cm$^3$

Discovery 1781 Uranus Caroline & William Herschel
1846 Neptune Adams and Le Verrier
Uranus -- peculiar orientation – axis of rotation tilted ~ 98° plus retrograde rotation
Images from Voyager 2

Atmosphere/cloud tops
Extremely cold ~ -360F
H, He, methane ammonia frozen out

Neptune – bands and spots internal heat source not present in Uranus
Moons

Uranus 21

Neptune 8

Triton
Rings -- systems of thin dark rings

Serendipitous discovery of rings of Uranus 1977 during occultation of a star 11 rings

Neptune – occulted image
2 rings
Pluto and the trans-Neptunian objects or Kuiper belt objects

Search for the 9th planet

Motivated by Bode’s law, the discovery of Neptune

Discovery in 1930

Discovery of moon Charon in 1978 permitted accurate measurement of mass and size
39.5 AU from Sun
Diameter ~0.2 x Earth, Moon = .27 Earth
Mass 0.002 x Earth, Moon 0.012 Earth
Density 1.9gm/cm³
Orbit, highly elliptical and inclined 17° to ecliptic
Trans-Neptunian or Kuiper-belt objects

Numerous small, icy bodies beyond Neptune’s orbit similar to Pluto and Charon in density and composition

Some are small and cometary-like, over 1000 objects now known in the Kuiper-belt

Recent discoveries – during past 10 yrs rival Pluto in size. Most recent Eris also called Xena

New Designation -- Dwarf Planet

Spherical, orbit not cleared of debris
New Horizon Mission 2015

A diverse and varied terrain

Charon

Gases (methane/nitrogen) from Pluto deposited on Charon, radiation strips H, leaving C → tholins