

An introduction to
The Jovian Planets

Zach Meisel

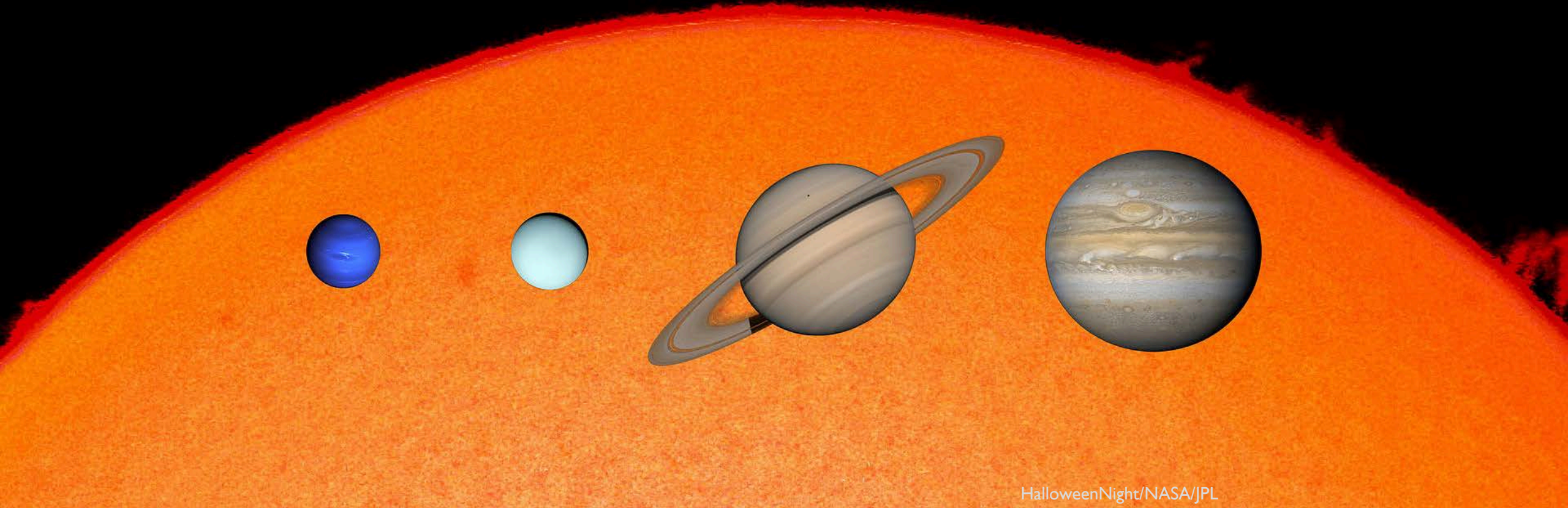
Ohio University - ASTR 1000

the Jovian Planets

...and friends



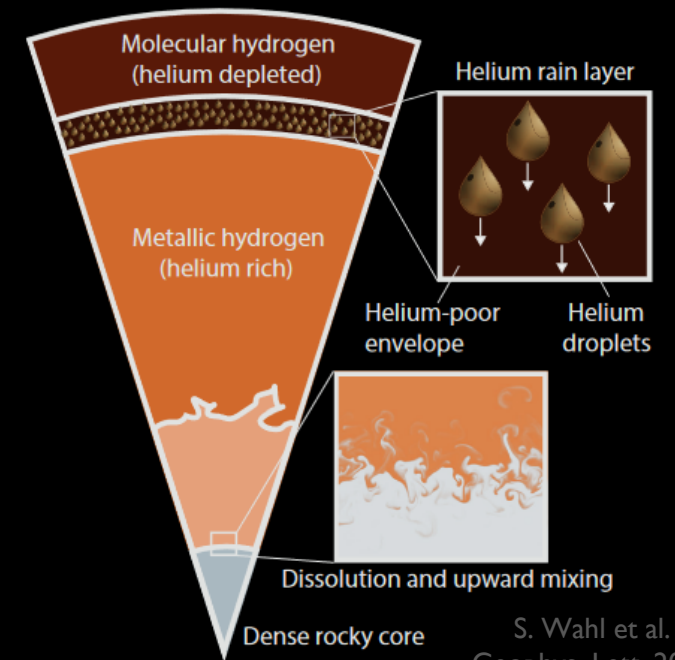
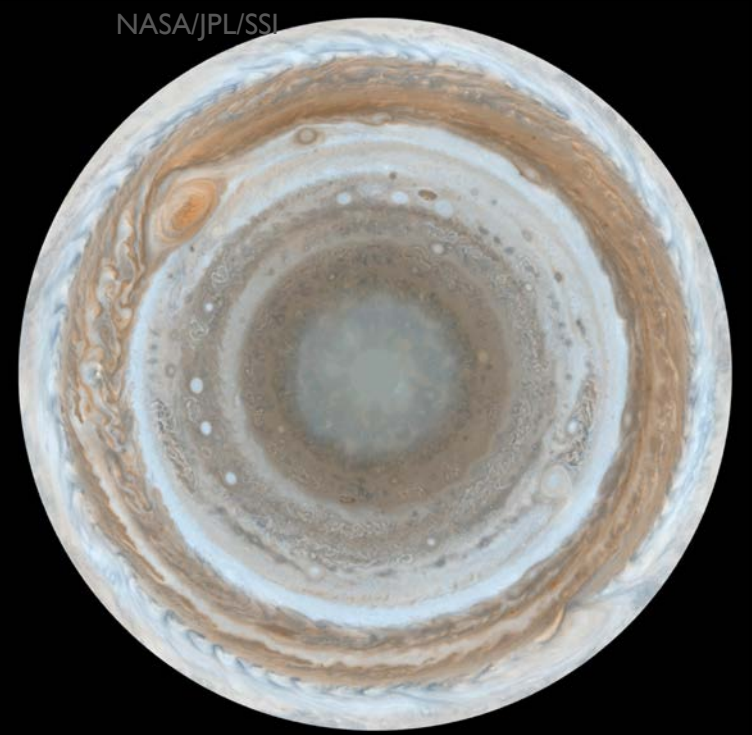
NASA/JPL



HalloweenNight/NASA/JPL

Jupiter ♃

- ~12yr orbit ~5 AU from the sun with ~10hr days
- ~300 M_{\oplus} and ~11 R_{\oplus}
- Substantial rocky core surrounded by a thick layer of liquid metallic hydrogen, which is surrounded by a fluid layer of hydrogen that rains helium and neon
- Stormy atmosphere with ammonia clouds, winds of hundreds of km/h, lightning that is 1000x more powerful than on Earth, and a giant cyclone that is at least 200yrs old known as the Great Red Spot
- Faint ring system of dust
- At least 79 moons, though 99.997% of the mass is concentrated within the four Galilean moons

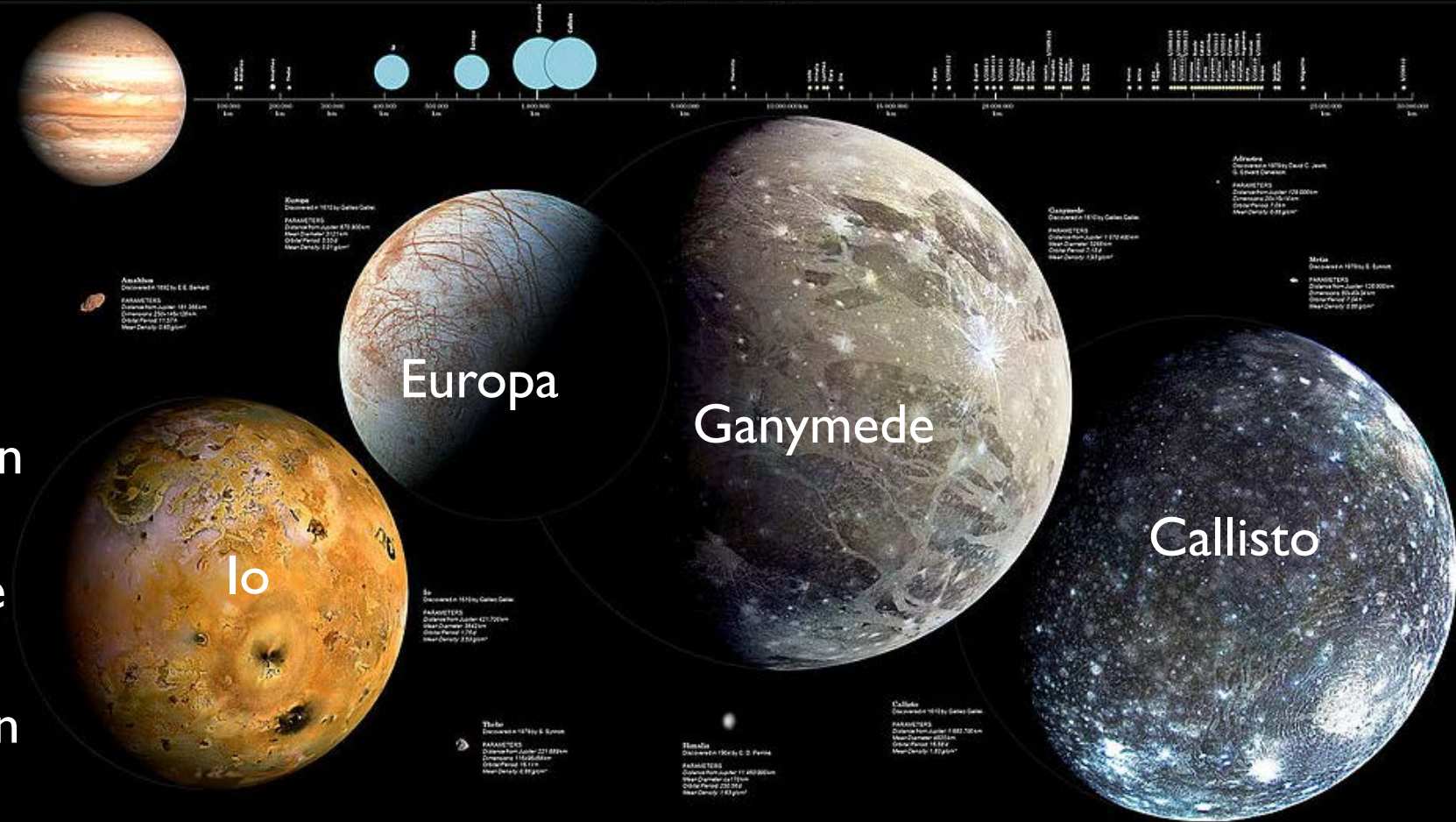


NASA/JPL/Voyager1

S. Wahl et al.
Geophys. Lett. 2017

the Galilean Moons

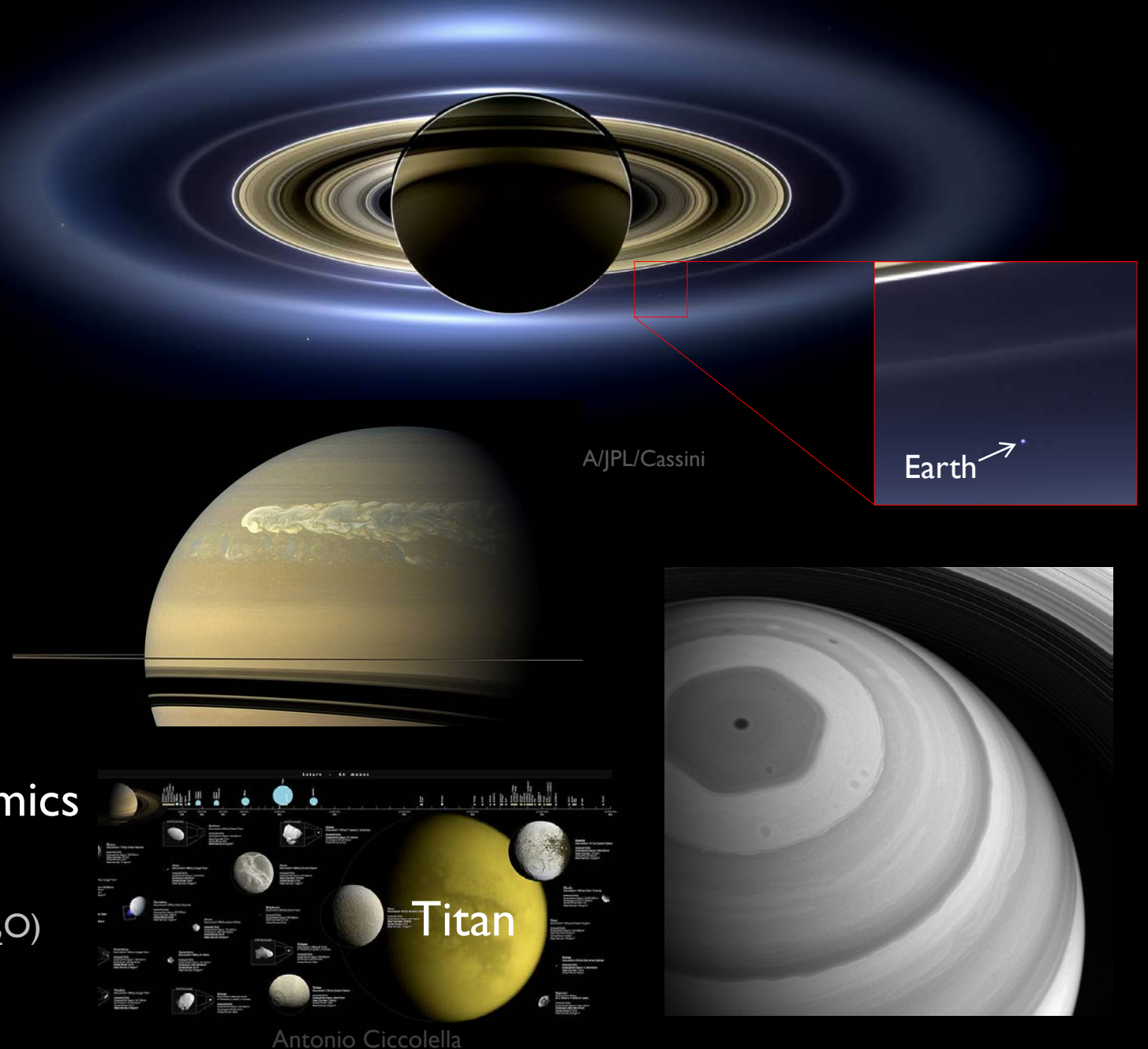
- **Io** is a rocky with >400 active volcanoes, with geology driven by tidal forces
- **Europa** is rocky with a water-ice crust which is thought to cover a subsurface water ocean
- **Ganymede** is larger in volume than Mercury (~1/2 the mass), also has an internal water ocean
- **Callisto** has no geologic activity (no tidal heating), but is thought to have a subsurface ocean. Low radiation levels make it a candidate space exploration base



Antonio Ciccolella

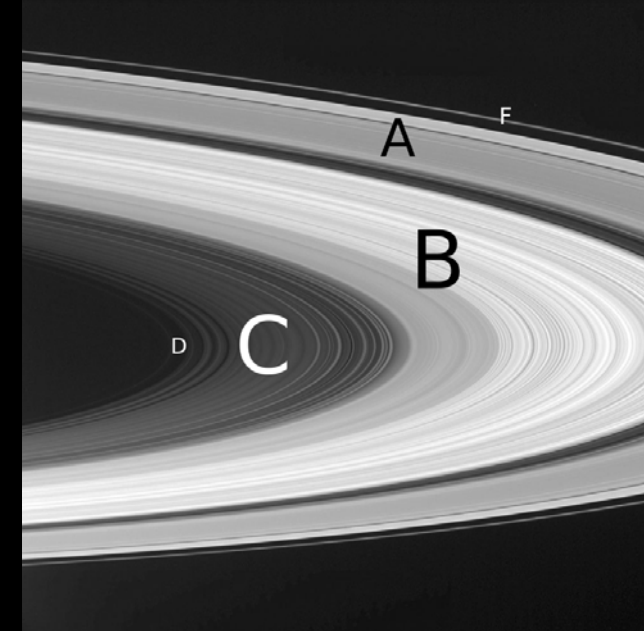
Saturn ħ

- ~29yr orbit ~10 AU from the sun with ~10hr days
- ~95 M_{\oplus} and ~9 R_{\oplus}
- Similar interior structure to Jupiter
- Radiates more heat than it receives from the sun!
- Stormy atmosphere with winds reaching over 1000 km/h
- The north pole exhibits a color-changing hexagonal cloud pattern that appears to be due to complicated fluid dynamics
- At least 82 moons
 - Titan: surface liquid! (ammonia-rich H_2O)
- Prominent ring system

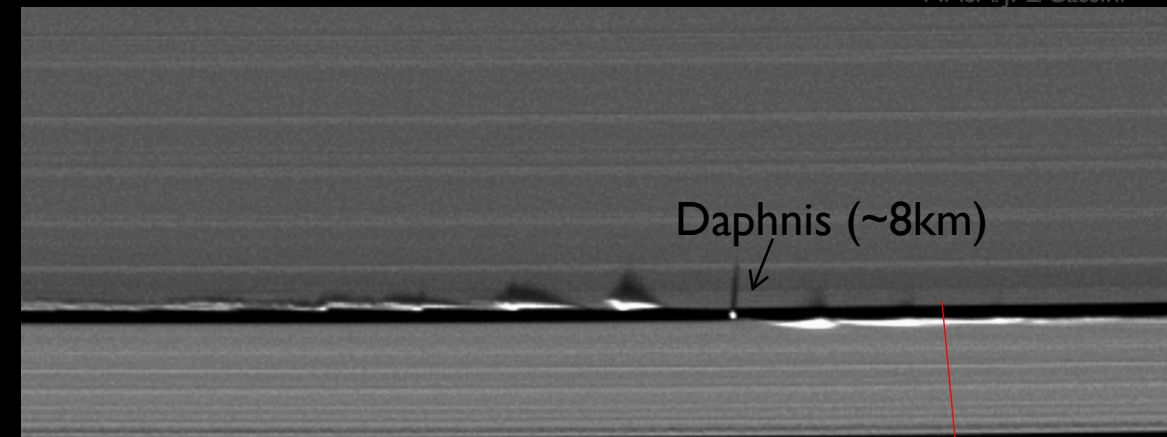
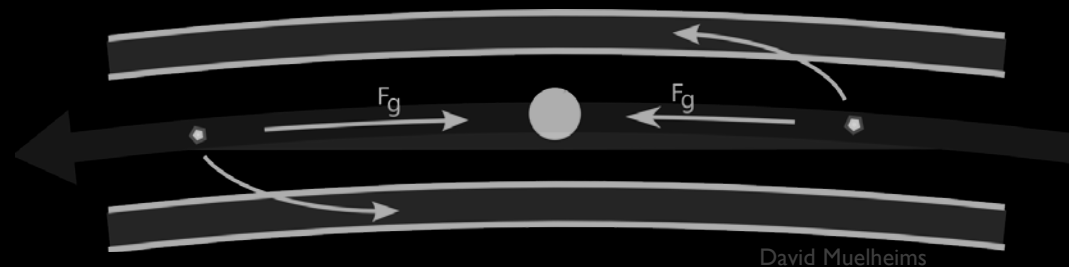


Saturn's Rings

- Most substantial ring system in the solar system
- $\sim 10^{19}$ kg of mass, mostly water-ice crystals up to \sim m in size
- Main rings are $\sim 75,000$ - $140,000$ km from the center of Saturn, with thicknesses generally a few km, but up to $\sim 1,000$ km in some places
- Ring “gaps” mostly just have lower density of material, and are formed by moons & gravitational interactions
 - These moons are “shepherd moons”

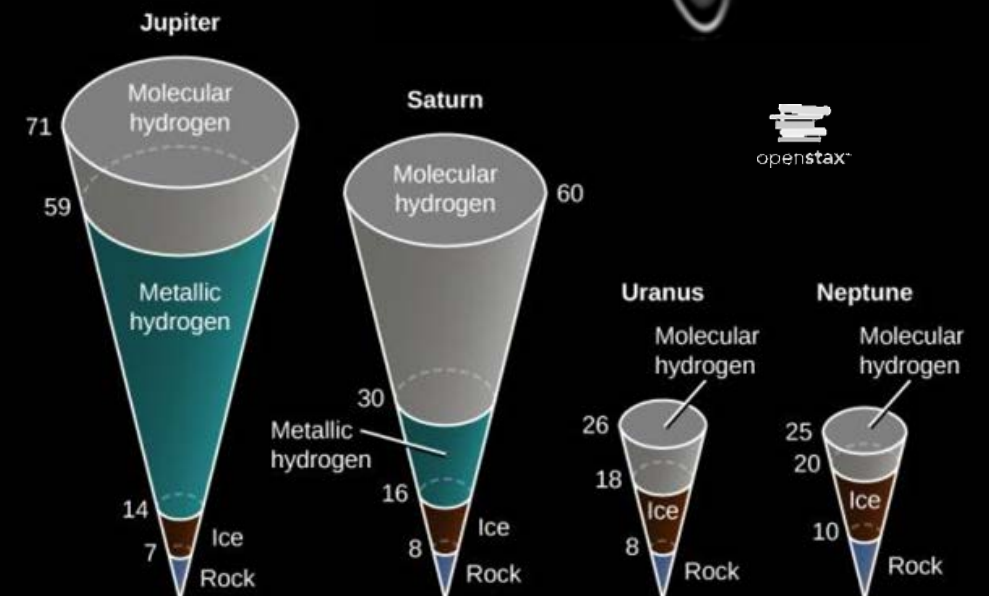
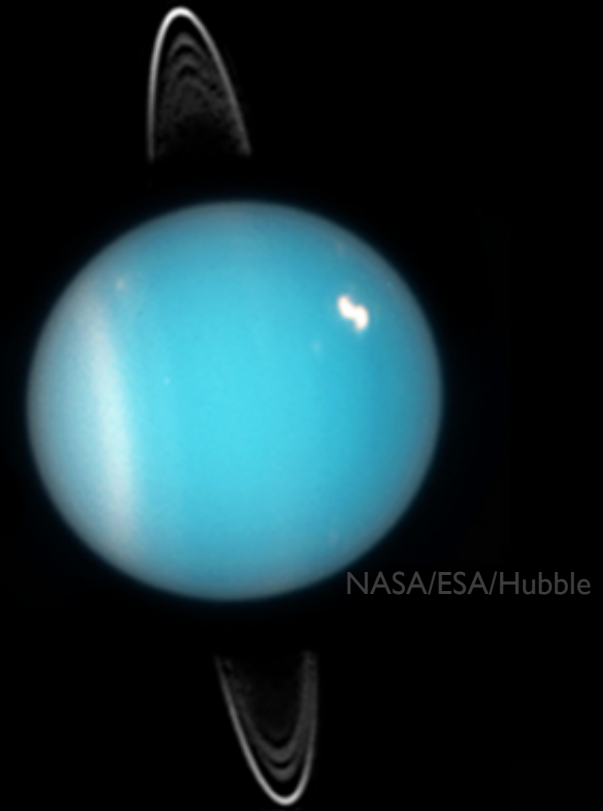
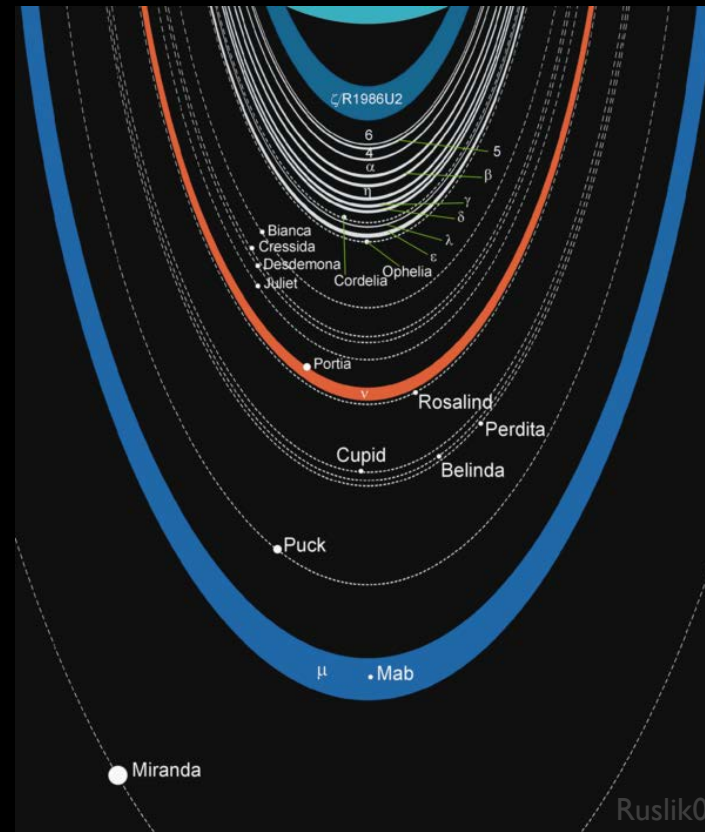


NASA/JPL/Cassini



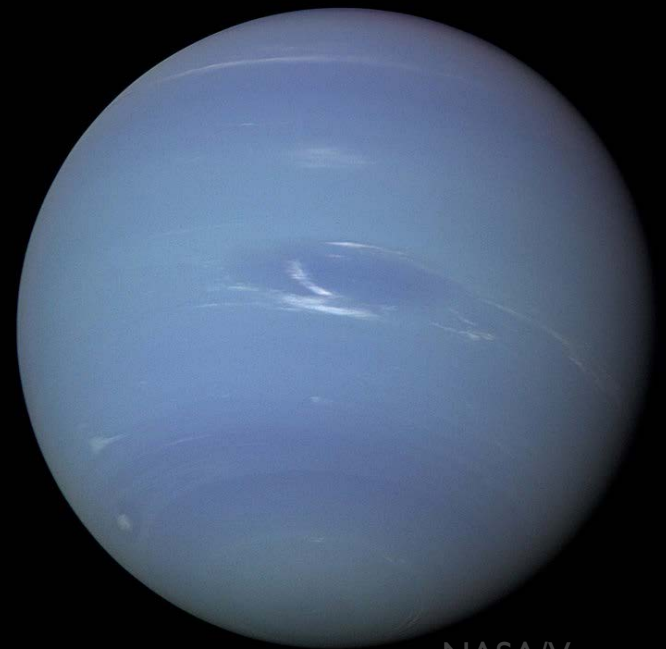
Uranus ♅

- ~84 yr orbit ~19 AU from the sun with ~17hr days, tilted at ~98° (compare to Earth's ~23°)
- ~15 M_{\oplus} and ~4 R_{\oplus}
- Composition much icier than Jupiter & Saturn
- Methane in the atmosphere give it the blue color
- Relatively complex ring system containing at least 27 moons

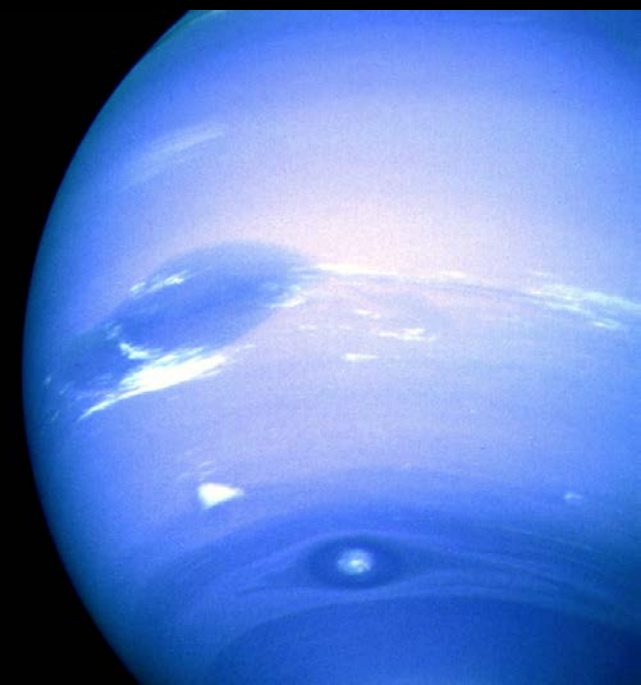
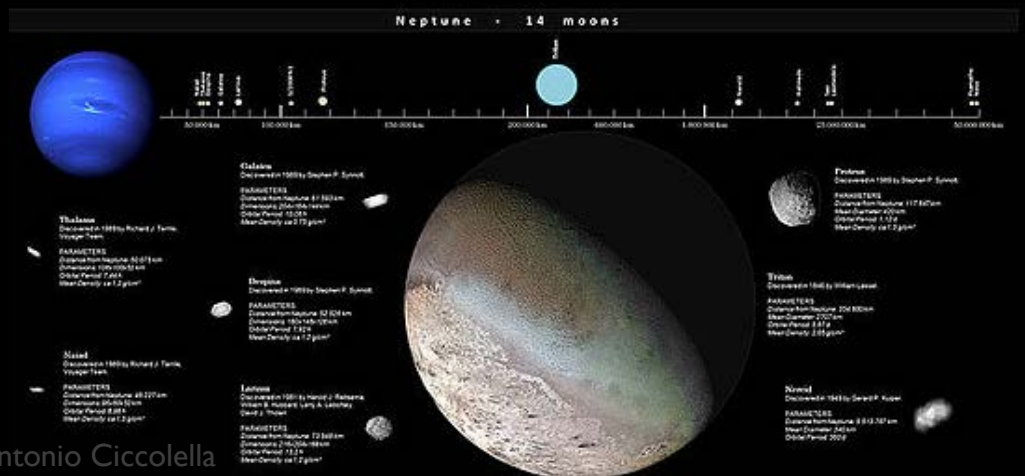
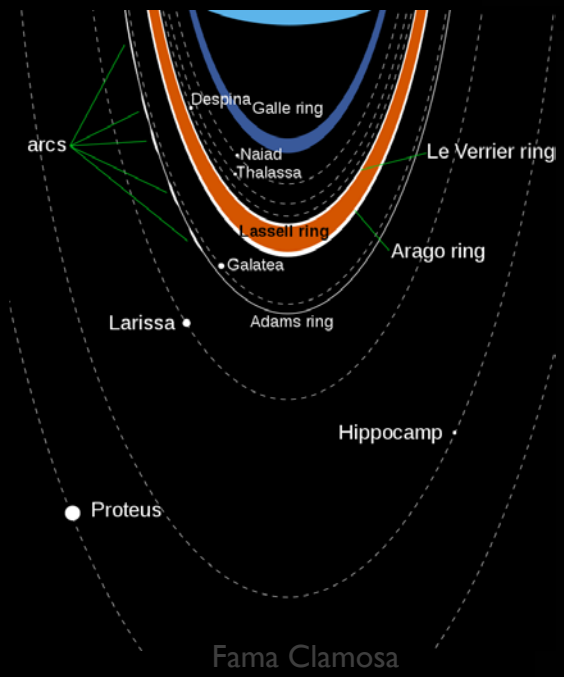


Neptune ψ

- ~165 yr orbit ~30 AU from the sun with ~16hr days
...so far away it was predicted due to perturbations in Uranus's orbit rather than by observation
- ~17 M_{\oplus} and ~4 R_{\oplus}
- Composition similar to Uranus, with atmospheric methane also causing the blue color
- Stormy atmosphere with ~2,000 km/h winds (the fastest in the solar system) and sustained cyclones
- Simple ring system & 14 moons, of which Triton is by far the largest

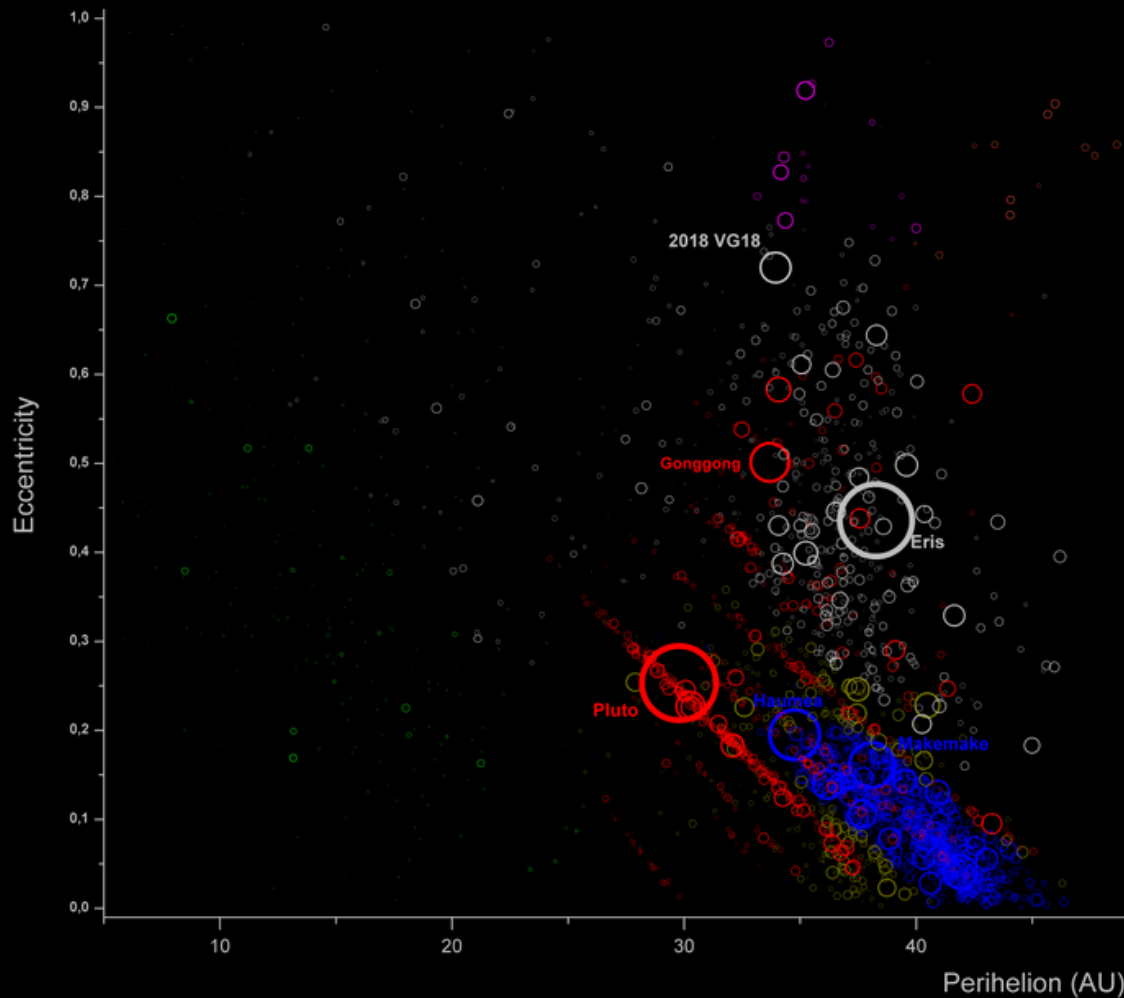


NASA/Voyager 2



the Kuiper belt

dwarf planets (with their own moons) & smaller, mostly icy, often with eccentric and high-inclination orbits



Trans-Neptunian Objects

- Cubewano
- Resonant object
- Scattered disk
- Sednoid
- Centaur
- Extreme detached disk
- Extended scattered disk
- Other TNO

Lexicon

the Oort Cloud

- Mostly spherical distribution of mostly icy planetesimals located ~0.1-1 ly away from the Sun
- Hypothesized as the source of long-period comets, since these have unstable orbits (will be ejected or crash into the sun) and boil-off/break-up
...so there needs to be a “safe” reservoir somewhere
- Based on comet properties, thought to be ~5 M_{\oplus} -worth of ice

