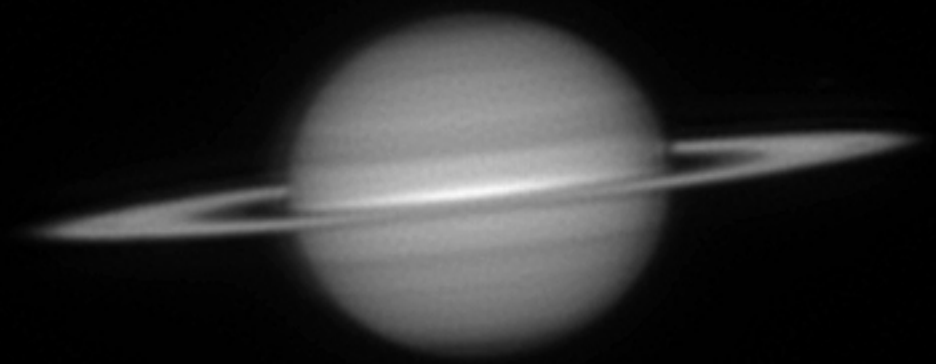
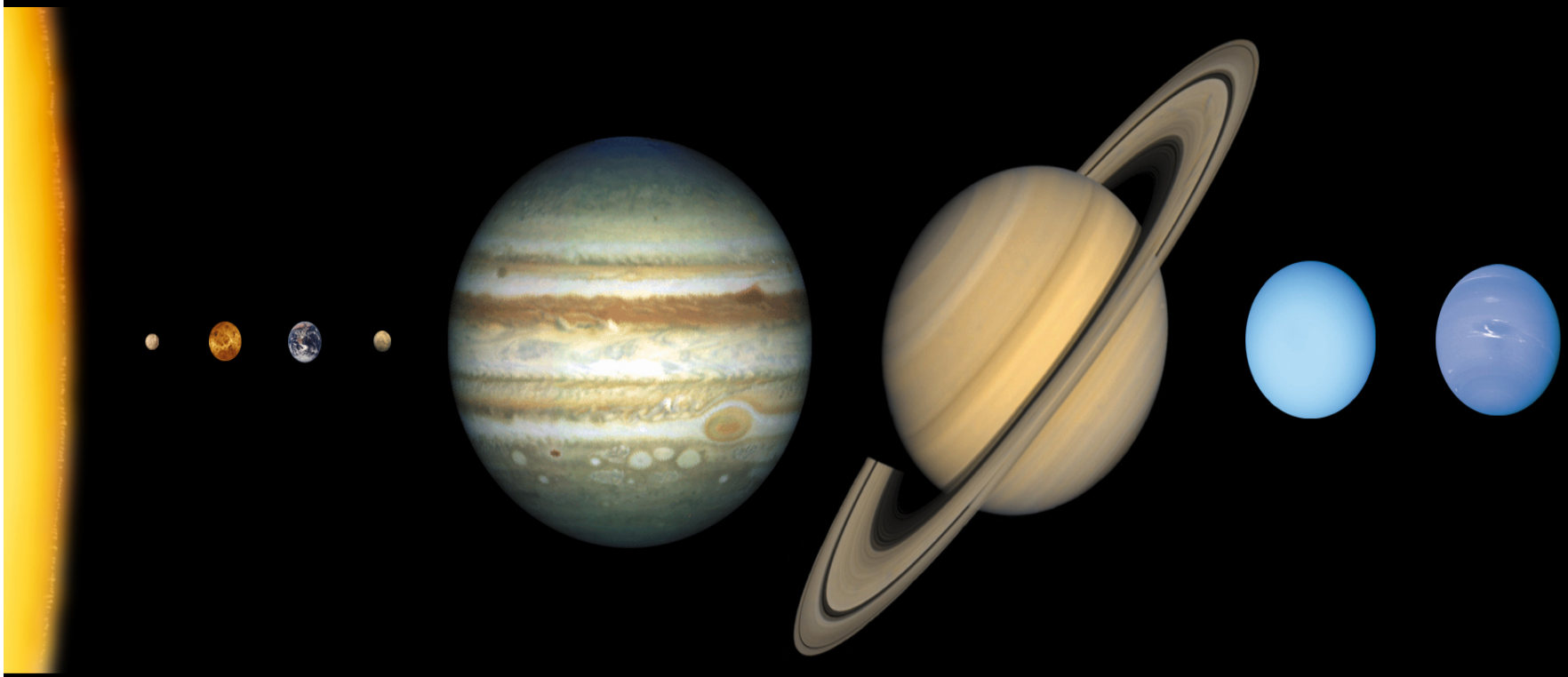
Solar System Series: Saturn



Brian Colville

Peterborough Astronomical Association
Novice Astronomy Class
October 2, 2026
Brett Hardy & Eleanor Malouin

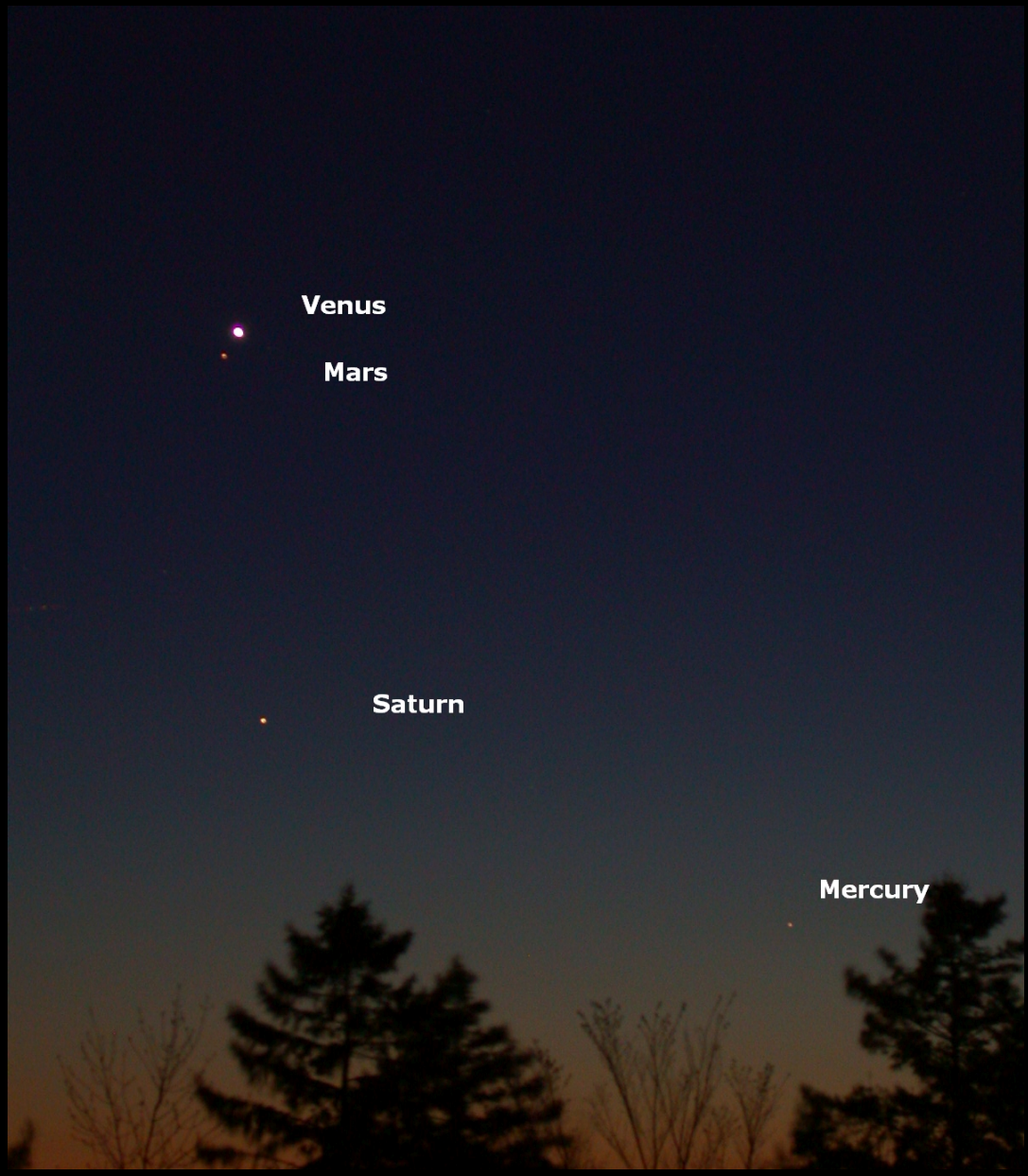
Size Scale



Lunar & Planetary Institute

Saturn By the Numbers

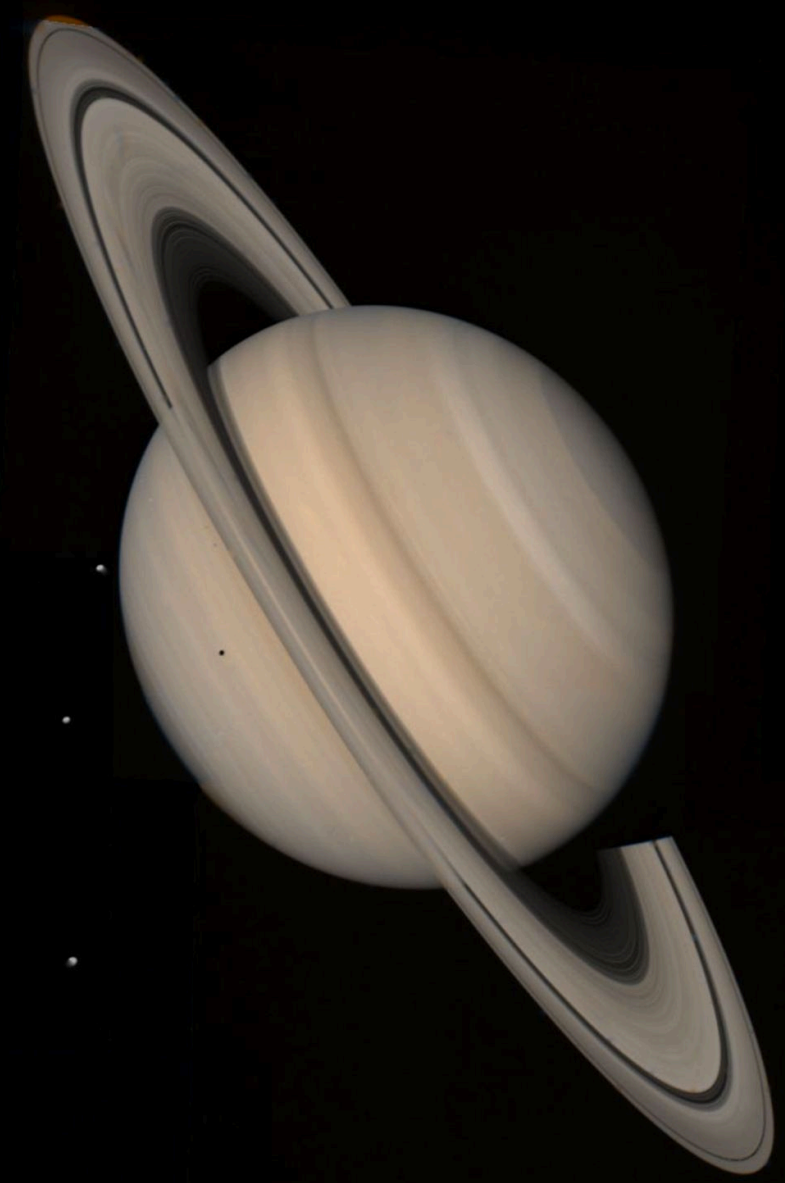
- 6th planet from the Sun
- Has the most moons of any planet in our solar system
- Mostly hydrogen and helium − trace amounts of methane & ammonia
- A planet of extremes
- Second largest planet in our solar system
- Least dense of all the planets
- Diameter: 120,536 km (74,898 mi)
- Second shortest day @ 10.7 hours
- 1 billion 267 million km, 8.5 AU from Sun
- 70 minutes for light to reach Saturn
- One orbit around the Sun takes 29.4 years
- Obliquity 26.7 °
- High speed winds as high as 539 km/h at the equator



Rick Stankiewicz

Surface & Structure

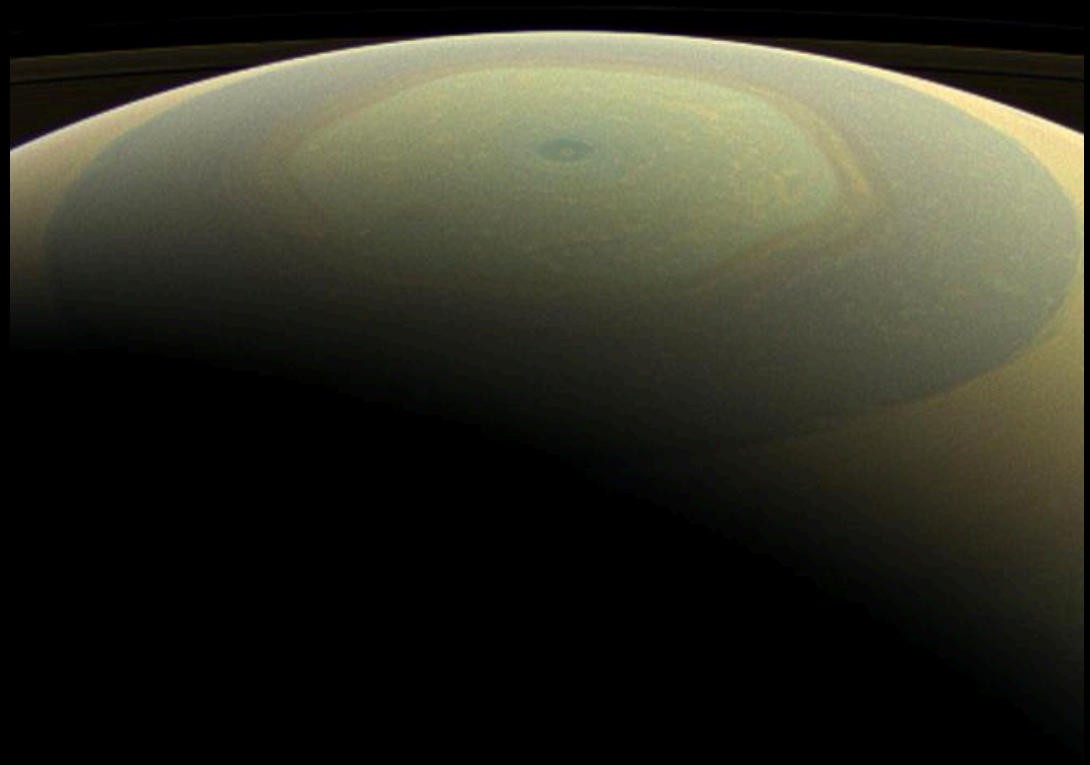
- Gas giant
- Gradually becomes denser toward the centre
- Density lower than water
- Rapid rotation causes Saturn to be flattened at the poles



NASA/ESA/Cassini

Atmosphere

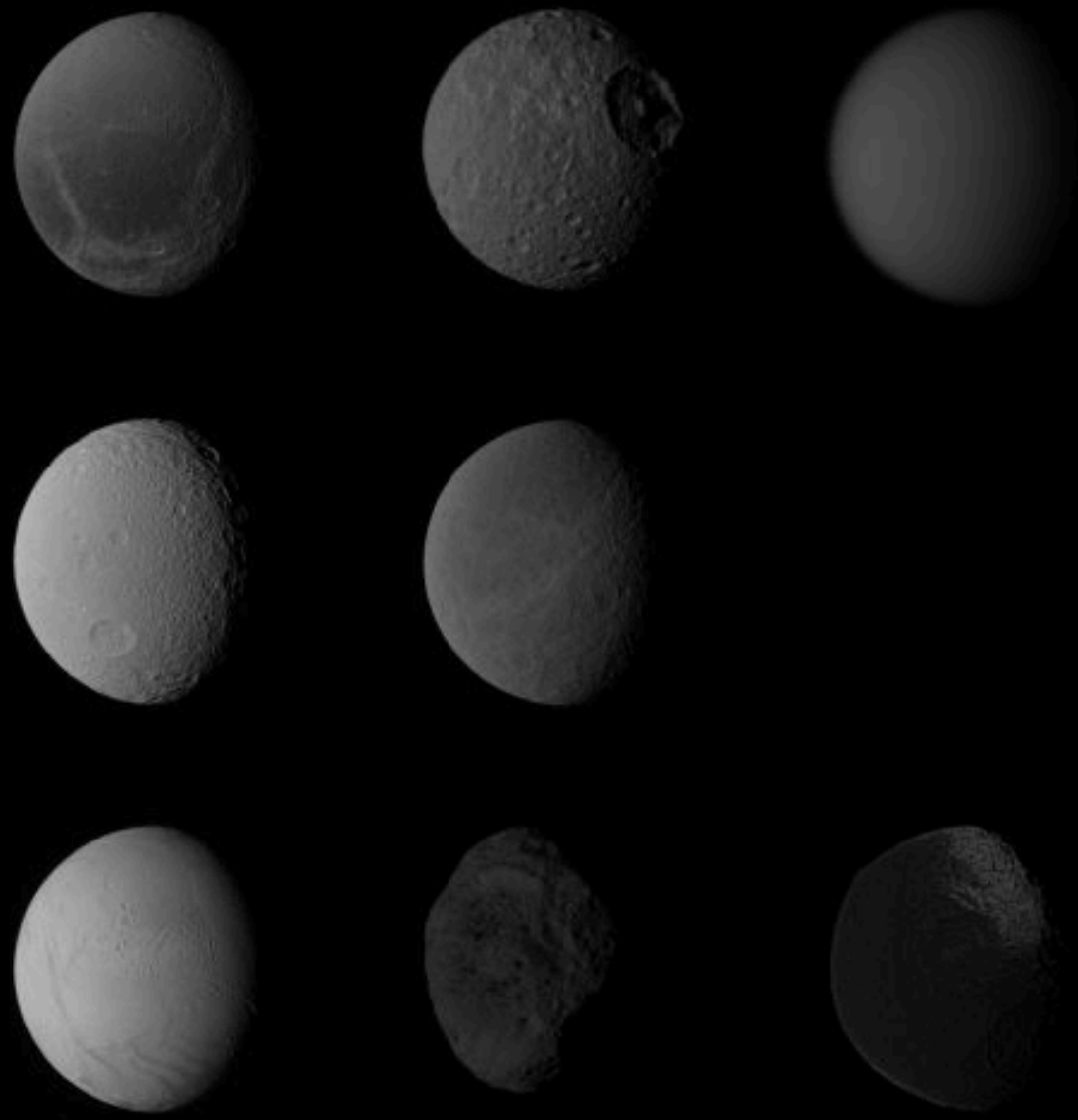
- Mostly hydrogen (96%) and helium (3%) – trace amounts of methane & ammonia
- Upper cloud layers of mostly ammonia ice
- Farther down, water and ammonium hydrosulfide form clouds
- Deeper in its interior enormous pressure transforms hydrogen into a liquid metallic state
- Core probably composed of solid rock and metal
- Subtle dark and light bands
- High winds with speeds reaching 1,800 km/h (1,100 mph) at the equator
- Enormous storms like the recurring Great White Spot
- Giant hurricanes at both poles
- Discovery of north polar hexagon
- Recent discovery of south pole decagon shaped jet stream



NASA/ESA/Cassini

Moons

- At least 293 moons
- 63 have formal names
- Vary enormously in size, composition and geological activity
- 7 largest: Titan (5,150 km), Rhea (1,528 km), Iapetus (1,469 km), Dione (1,123 km), Tethys (1,062 km), Enceladus (504 km), Mimas (396 km), Hyperion (270 km)
- Moons influence the rings, magnetosphere and gravitational environment

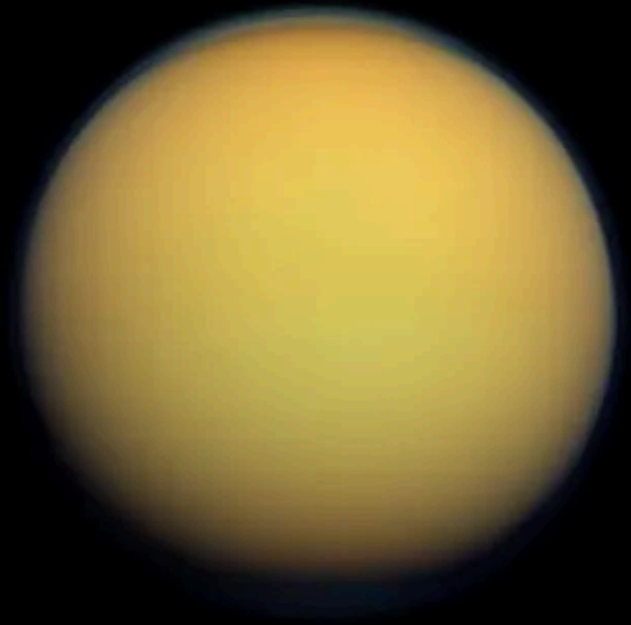


NASA/EAS/Cassini (not to scale) - Top: Dione, Mimas, Titan Middle: Tethys, Rhea, Bottom: Enceladus, Hyperion, Iapetus

Moons Continued

Titan

- Saturn's largest moon
- Second largest in the solar system
- Only moon with a thick atmosphere
- Thick nitrogen-dominated atmosphere
- Thick orange-brown haze produced by complex organic chemicals created when sunlight and energetic particles interact with atmospheric nitrogen and methane
- Has a weather cycle similar to Earth's but based on methane
- Subsurface global water ocean beneath outer icy shell
- Rivers, lakes and seas made of liquid methane and ethane
- Potential for life?
- Huygens probe sampled atmosphere and surface
- Dragonfly Mission to explore with a nuclear-powered rotorcraft
- Launch scheduled for 2028 for a 2034 landing
- Will investigate its atmosphere, surface, chemistry and habitability

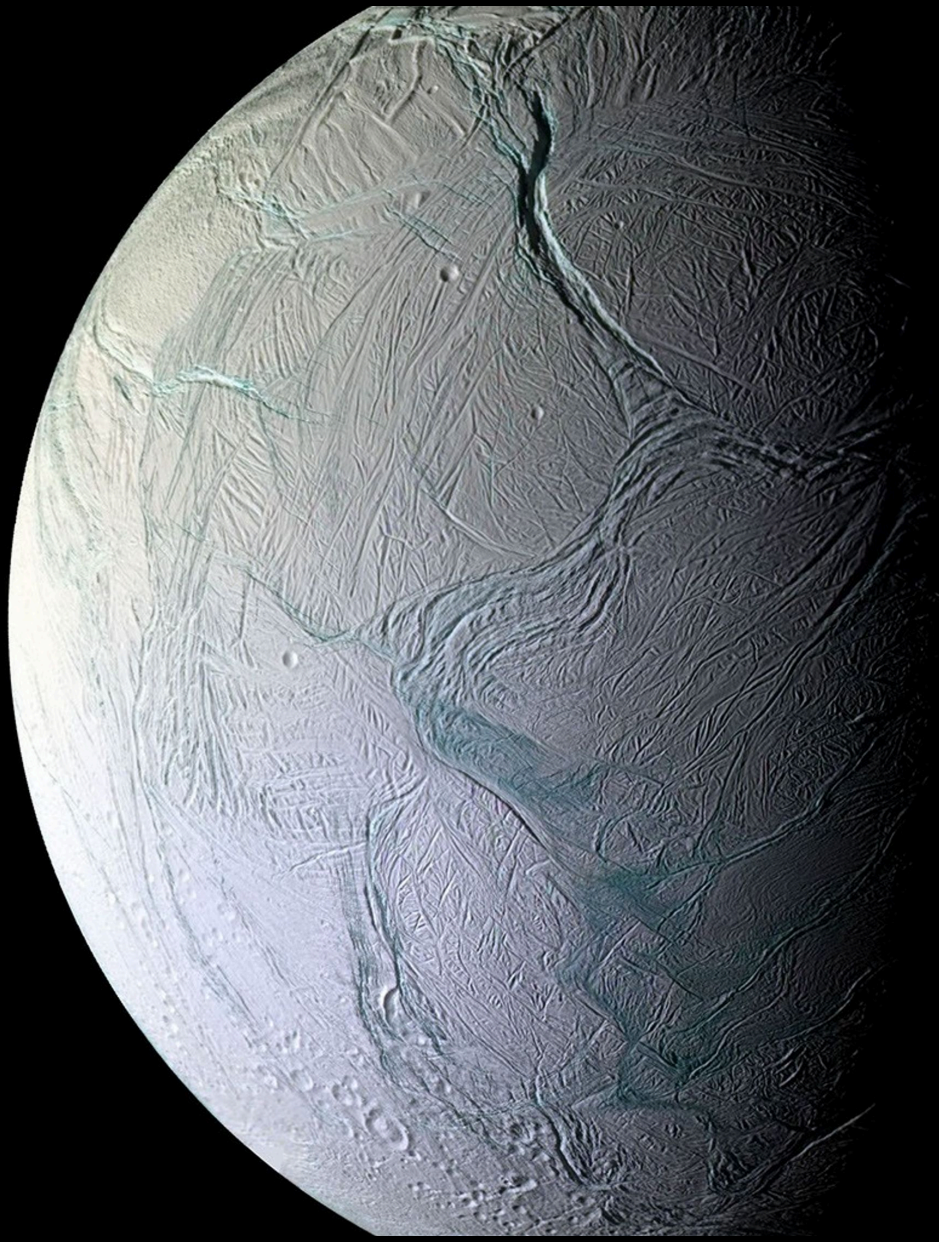


NASA/JPL-Caltech/Space Science Institute

Moons Continued

Enceladus

- Small ice covered moon
- The most reflective moon in the solar system
- Ice shell estimated to be at least 18 km thick
- Global salty ocean of liquid water
- Geyser-like jets spew water vapour, ice, salts, and organic molecules from fractures at the south pole into space
- Fractures are nicknamed “tiger stripes” because of their long, parallel appearance
- Samples analyzed by the Cassini spacecraft show chemicals to support life
- Enceladus is the source of material for Saturn’s faint E ring



NASA/ESA/Cassini

Moons Continued

Hyperion

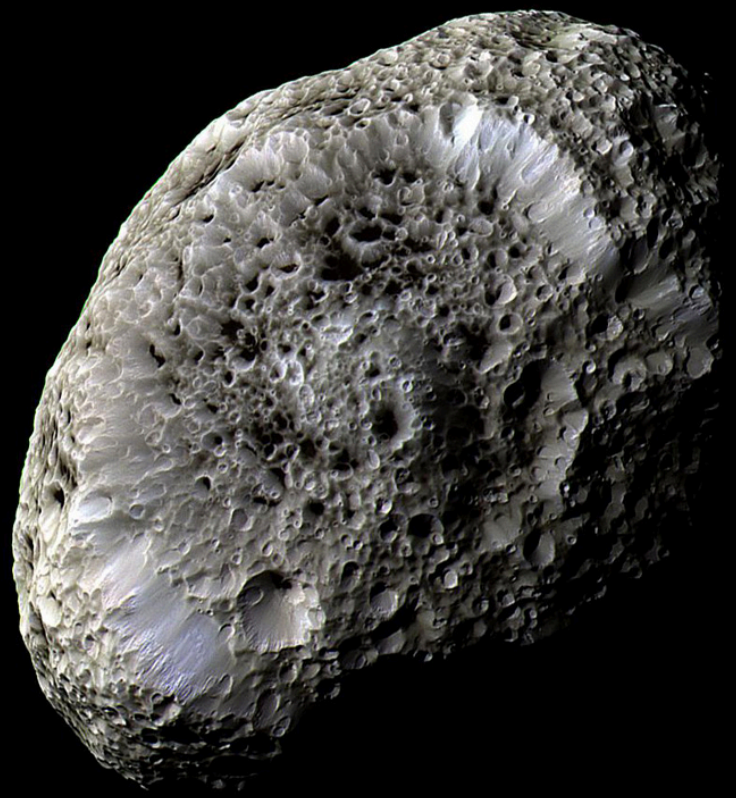
- Largest of non-spherical moons
- Eccentric orbit
- Likely a remnant of a larger moon that was destroyed by an impact

Pandora

- Potato-shaped
- Covered in dust-sized ice particles

Pheobe

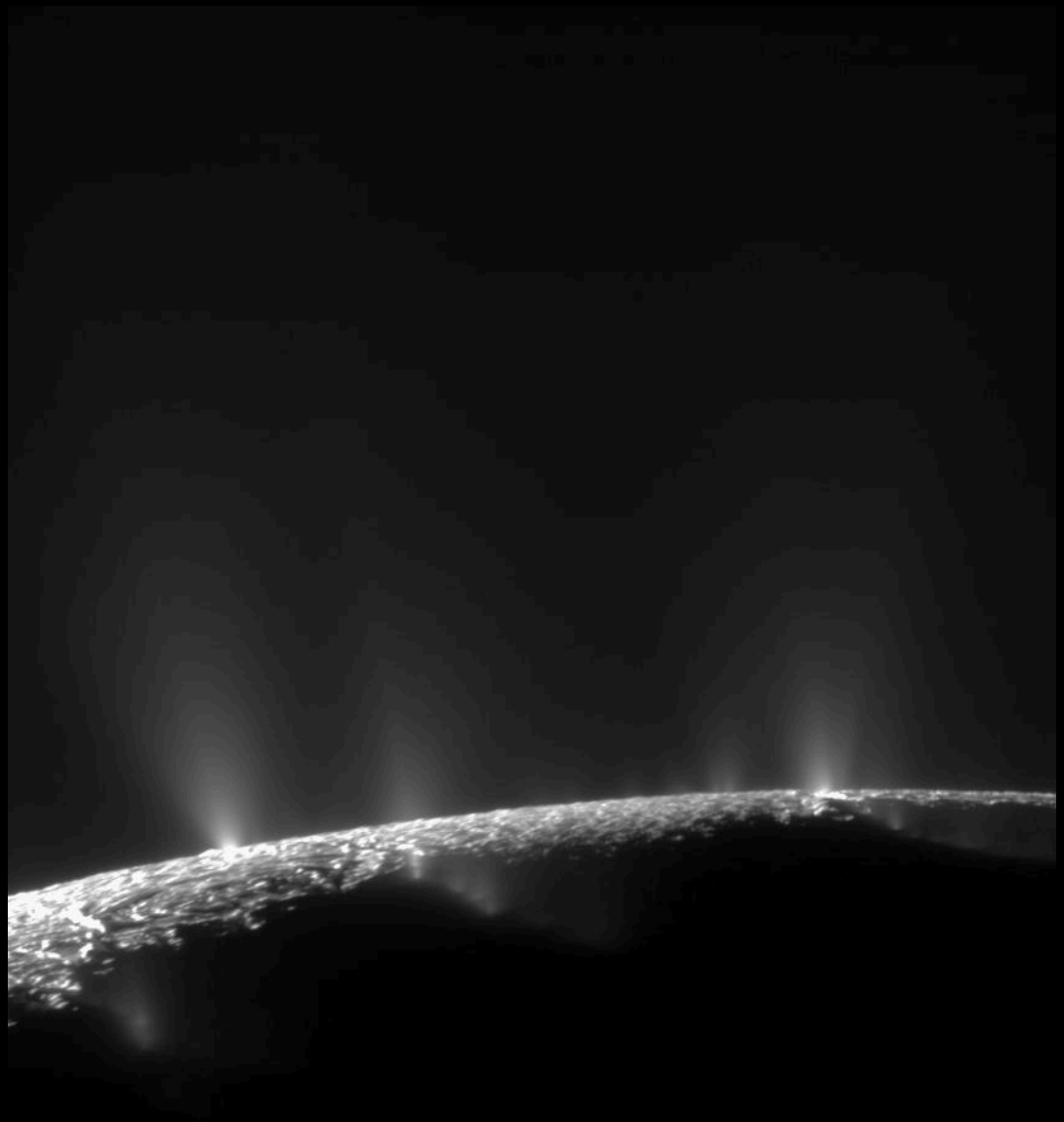
- $1/16^{th}$ the size of Earth's Moon
- Orbits in a retrograde motion
- Suspected to be a captured Centaur from the Kuiper Belt



NASA/ESA/Cassini

Life in our Solar System?

- Enceladus has a global subsurface ocean below a thick icy crust
- All the ingredients for life are thought to be present:
  - energy from tidal heating due to Saturn's gravity
  - liquid water
  - nutrients from water's interaction with a rocky core
- Let's not forget Titan and the Dragonfly Mission



NASA/ESA/Cassini

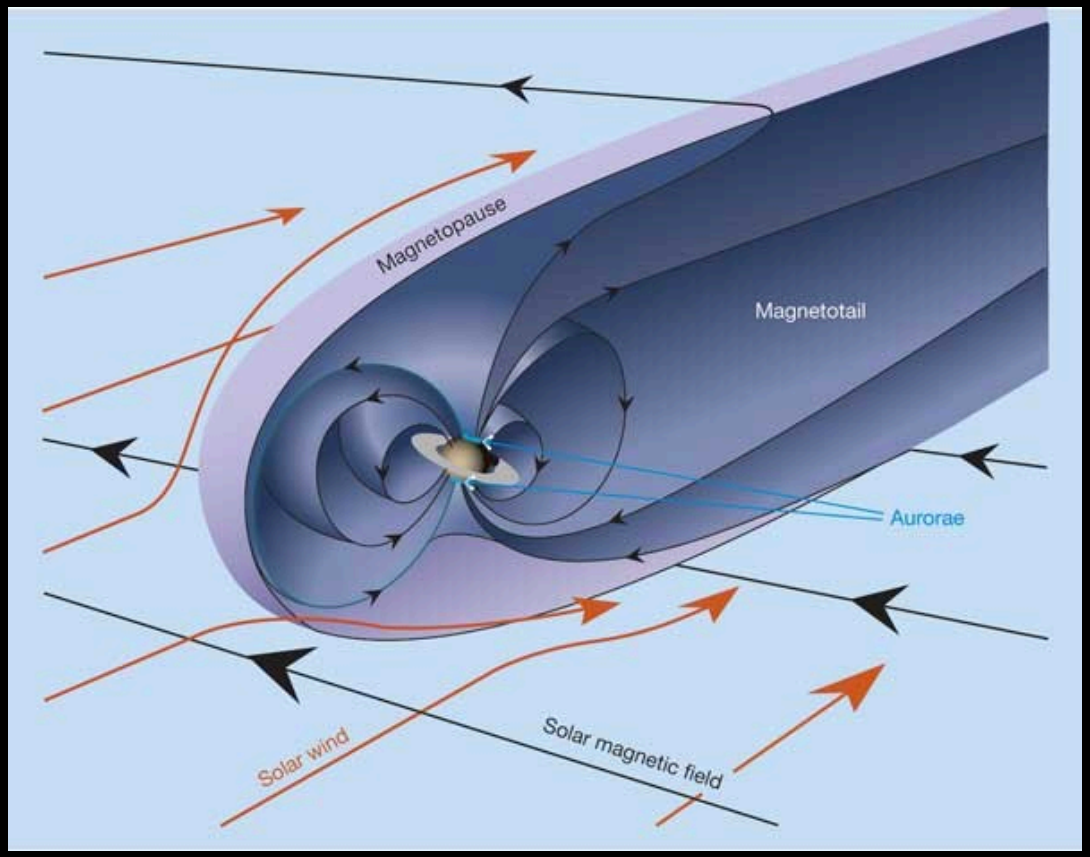
Ring System

- Saturn is magnificent in an eyepiece and the most photogenic of our planets
- Its extensive ring system is composed of almost pure water ice
- Impurities consist of dust and small rocks
- Particle size ranges from dust sized to the size of a bus
- Scientists believe the rings to be made up of comets, asteroids and ancient moons that were captured by Saturn's gravity
- Ring system divided into 7 major rings: D,C,B,A,F,G & E
- A,B & C are the brightest
- The Cassini Division is a prominent gap between the A & B rings
- There are countless smaller ringlets and gaps
- Rings span over 400,000 km, roughly the distance from Earth to the Moon
- Despite the rings massive size, they are only about 30 metres thick
- Rings are kept structured partly by the gravitational influence by Saturn's moons
- Pandora and Prometheus help shape the narrow F ring
- Rings may be relatively young and are being diminished due to infalling of material called ring rain

NASA Cassini

Magnetosphere

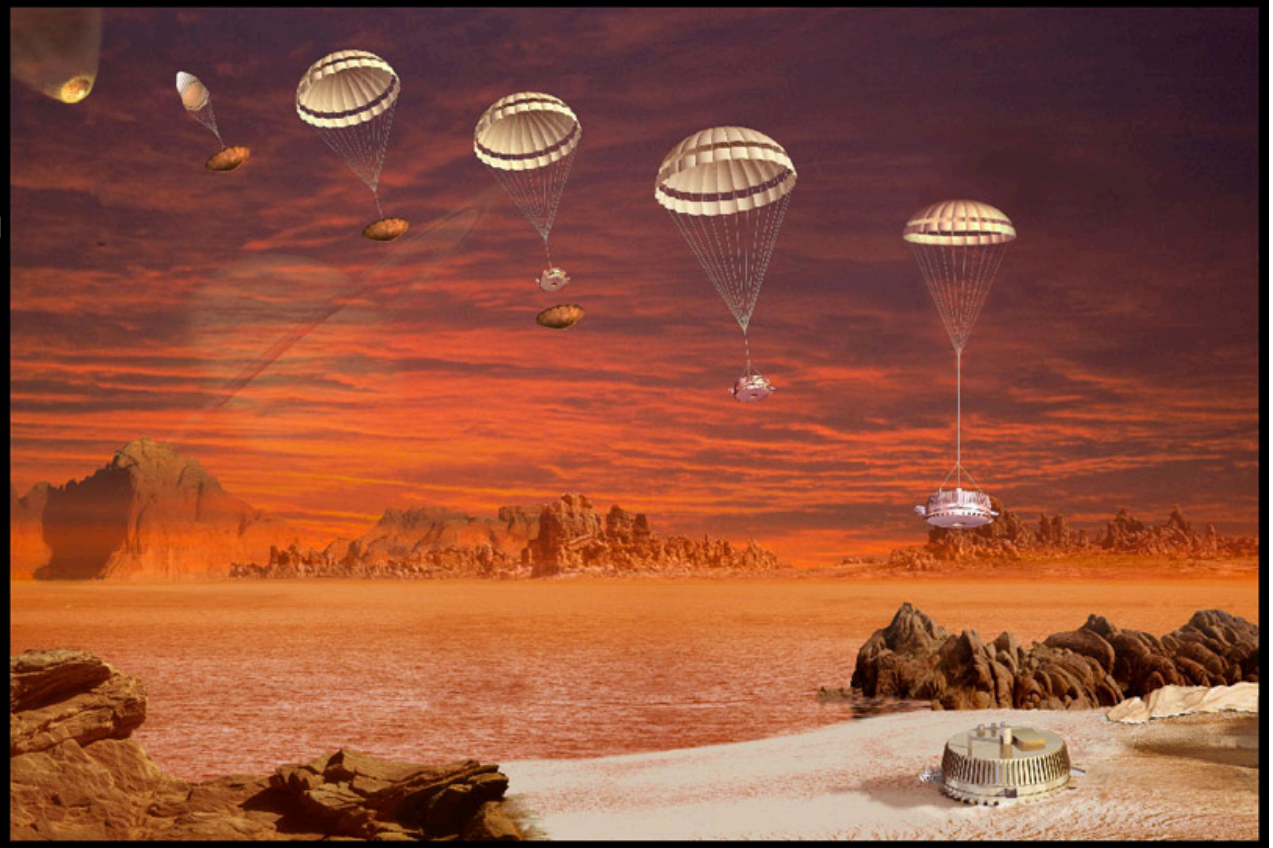
- Saturn has a powerful magnetosphere generated deep inside
- Traps charged particles creating intense radiation belts
- Responsible for aurorae at the planet's poles
- Deep in the atmosphere hydrogen gas is compressed into a liquid
- Electrons are squeezed off the hydrogen atoms making it act as a conducting metal
- Saturn's fast rotation creates electrical currents with the liquid metallic hydrogen producing an intense magnetic field
- Enceladus plays a major role providing material (plasma) fueling the magnetosphere



Nature

Exploration

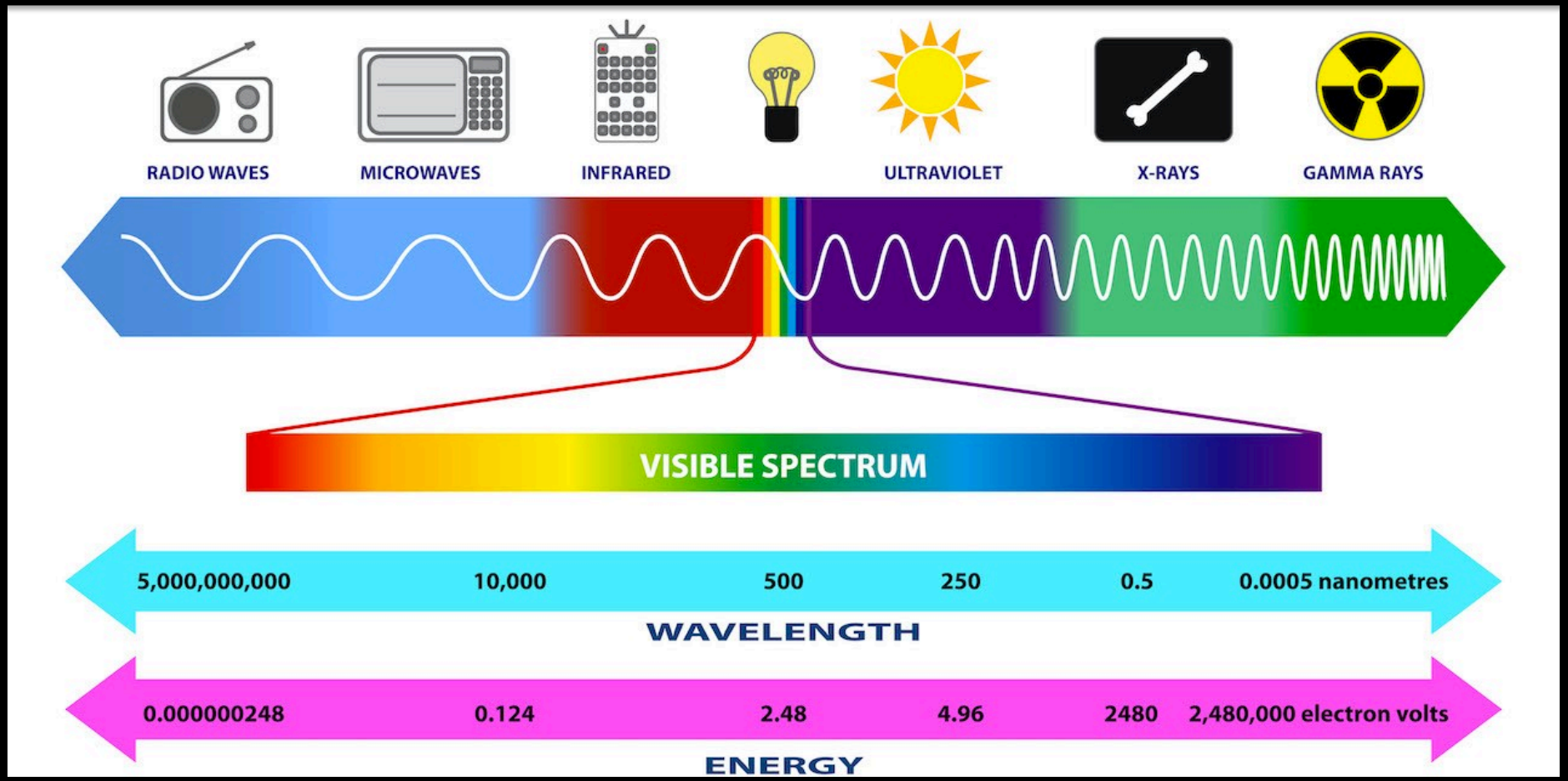
- Pioneer 11 spacecraft
  - flyby September 1, 1979
  - discovered a new ring and magnetic field
- Voyager 1
  - flyby February 17, 1998
  - Discovered 5 new moons and the G ring
- Voyager 2
  - flyby August 1981
  - Improved information on the rings and atmosphere
- Cassin/Huygens
  - Orbiter and lander
  - Entered orbit July 1, 2004
  - studied Saturn for 13 years
  - Huygens probe landed on Titan January 14, 2005



Engineering.com

Observing Opportunities

- Saturn at opposition October 4
- Rises at 19:02 and is up all night

Brian Colville

Novice Astronomy Class
November 6, 2026
The Electromagnetic Spectrum