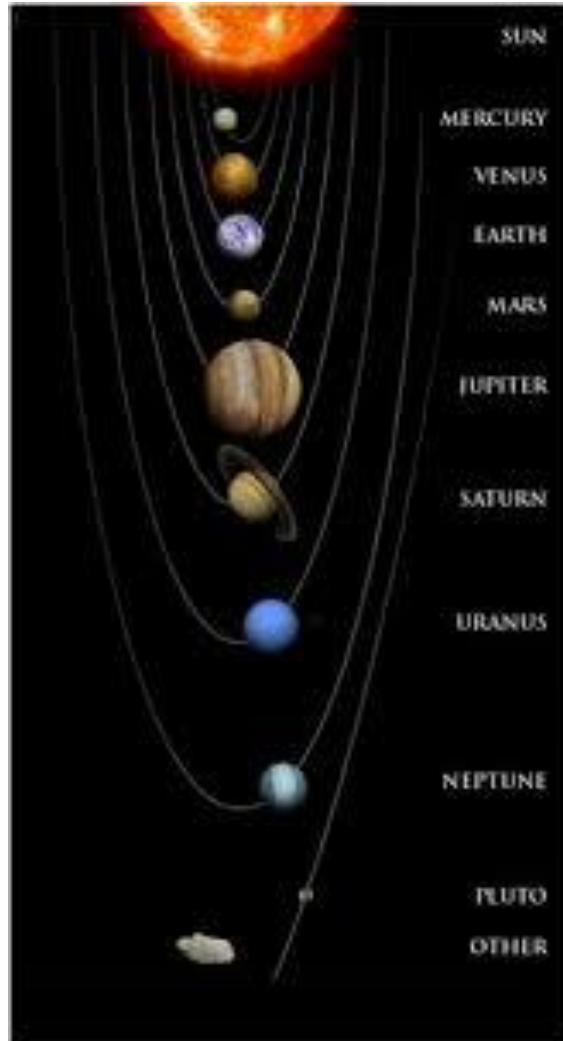


# Jupiter

# 4

The Fifth Planet from the Sun

# The Fifth Planet from the Sun



# The Fifth Planet from the Sun

## Historical Times

- Jupiter was known to astronomers of ancient times
- The Romans named it after their god, Jupiter
- 1610 – Galileo Galilei makes the first detailed observations
- Simon Marius claimed to have seen Jupiter's moons around the same time but Galileo published first!

# The Fifth Planet from the Sun

## Recent Times

- 1973 : Pioneer 10 (launched 02/03/1972) was first to cross asteroid belt and fly past Jupiter
- 1979 : Voyagers 1 & 2 (launched 05/09/1977) discover Jupiter's faint rings, several new moons and volcanic activity on Io's surface
- 1992 : Ulysses (launched 06/10/1999) swung by Jupiter

# The Fifth Planet from the Sun

## Recent Times

- 1994 : Astronomers observe comet Shoemaker-Levy 9 collide with southern hemisphere
- 1995-2003 : Galileo spacecraft (launched 18/10/1989) drops probe into atmosphere and conducts extended observations of Jupiter, its moons and rings
- 2000 : Cassini spacecraft (launched 15/10/1997) makes its closest approach ~ 6.2 million miles, taking highly detailed true colour mosaic photos

# The Fifth Planet from the Sun

## Recent Times

- 2007 : New Horizons spacecraft (launched 19/01/2006 on way to Pluto) shows new perspectives on atmospheric storms, rings, volcanic Io and icy Europa
- 2009 : on 20/07/2009 a comet or asteroid crashes into southern hemisphere
- 2011 : Juno is launched on 05/08/2011 to examine chemistry, atmosphere, interior structure and magnetosphere
- 2016 : Juno arrived on 04/07/2016

# Some basic facts about Jupiter



- Largest planet in the solar system
- Gas Giant (along with Saturn)
- Mass is 2.5x greater than all other planets combined
- May have been formed from fragments of other planets, 4.5 billion years ago
- Settled into current position about 4 billion years ago

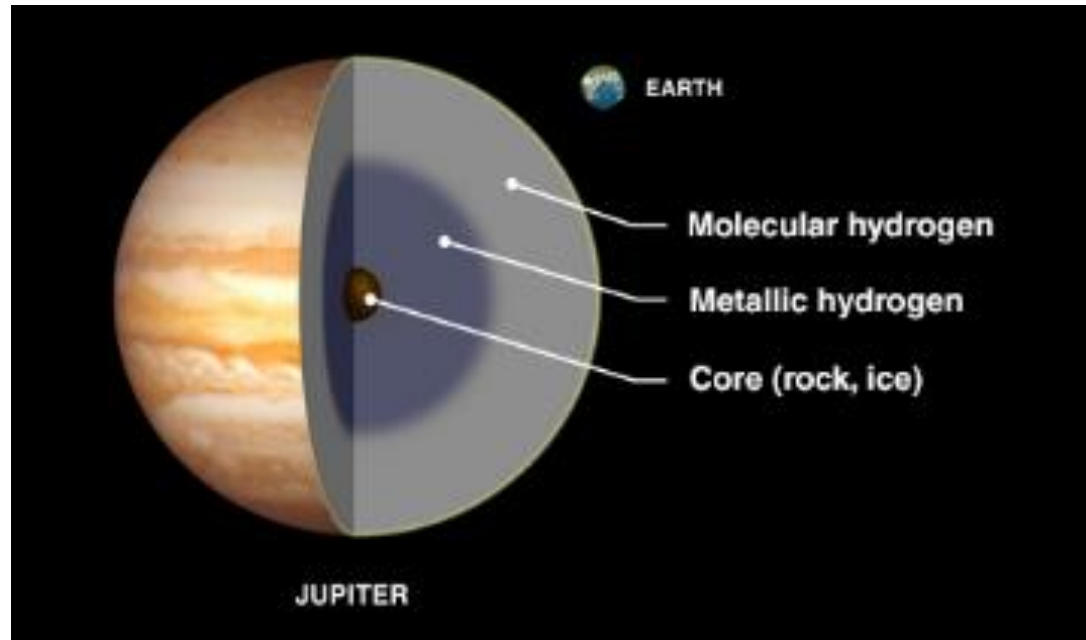
# Some basic facts about Jupiter



- Radius of 43,440.7 miles
- 778 million miles from Sun
- Shortest day in Solar System
- 10 hours to rotate once
- Jupiter orbits the Sun in 12 Earth years
- Equator tilted by 3 degrees
- Does not have extreme seasons



# Some basic facts about Jupiter



- Primarily composed of hydrogen
- May have a core of rock & ice
- Lacks well-defined surface
- Rapid rotation causes slight but noticeable bulge at equator

# Some basic facts about Jupiter



- Jupiter likely has three distinct cloud layers
  - Top = ammonia ice
  - Middle = ammonium hydrosulphide crystals
  - Inner = water ice & vapour
- Colours may be plumes of sulphur and phosphorus containing gases from the warmer interior

# Some basic facts about Jupiter



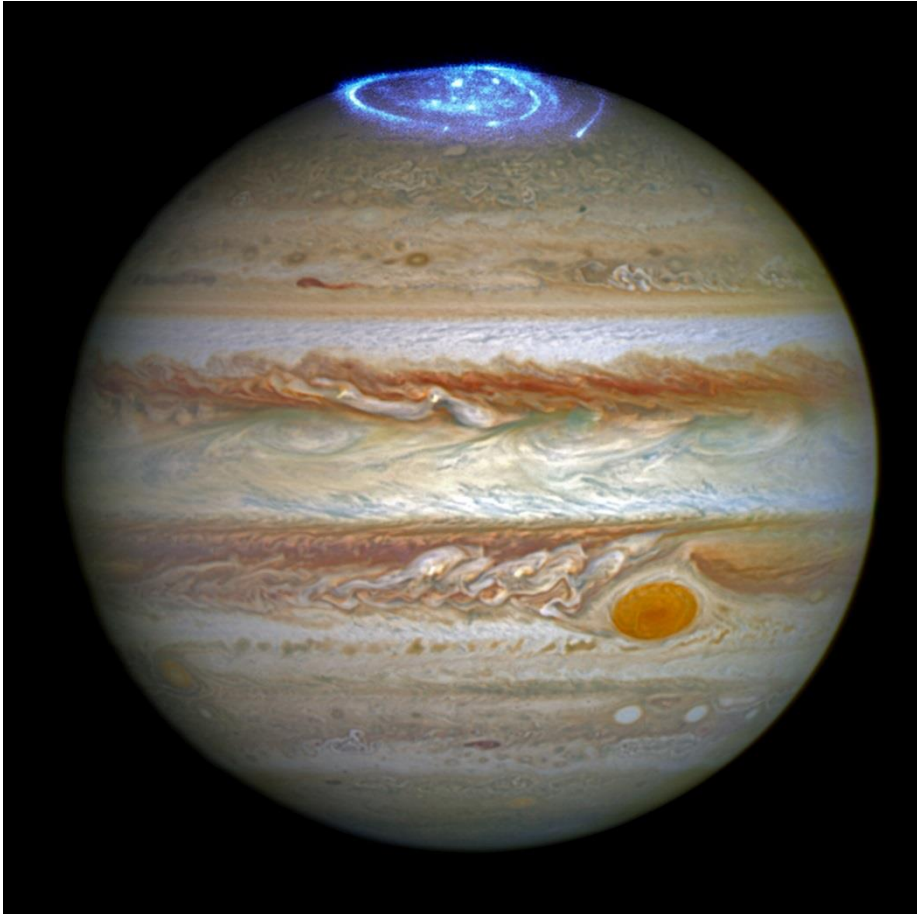
- Jupiter has fast rotation – spinning once every 10 hours
- Outer atmosphere separated into distinctive bands
- Results in turbulence & storms at boundaries
- Great Red Spot (approx. same diameter as Earth)

# Some basic facts about Jupiter



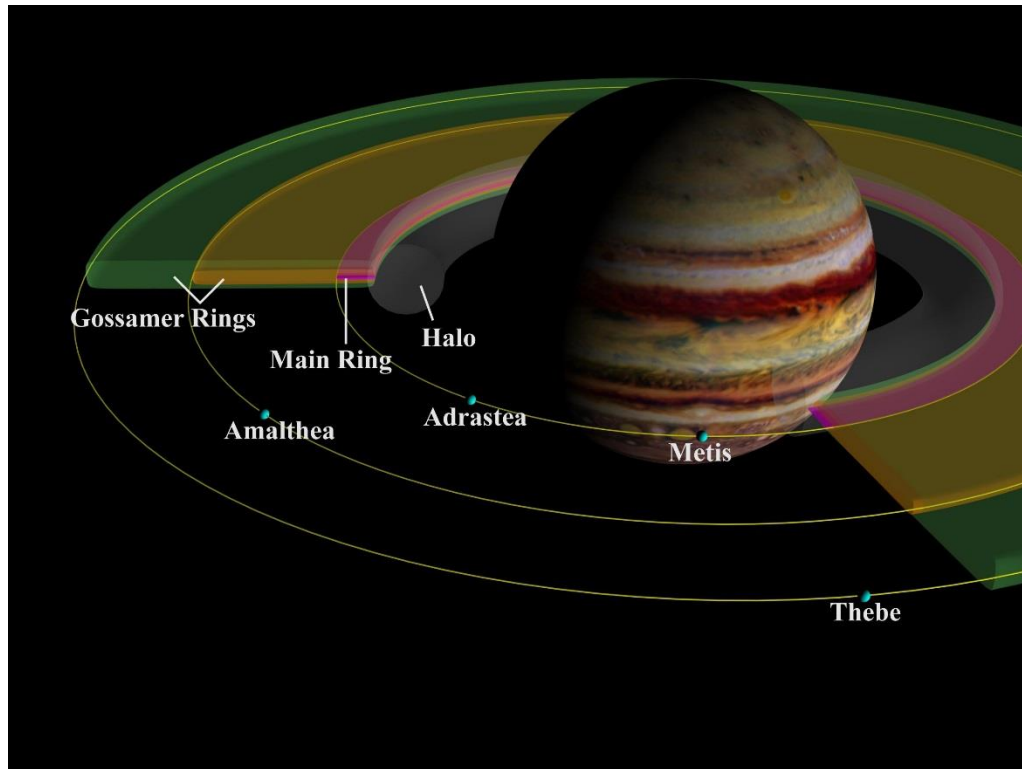
- Magnetic field is 16-54x Earth
- Strongest in Solar System
- Magnetosphere
- Generated by eddy currents in liquid metallic hydrogen core
- Magnetic field produces spectacular auroras at both poles

# Some basic facts about Jupiter



- Magnetic field produces spectacular aurorae at both poles

# Some basic facts about Jupiter

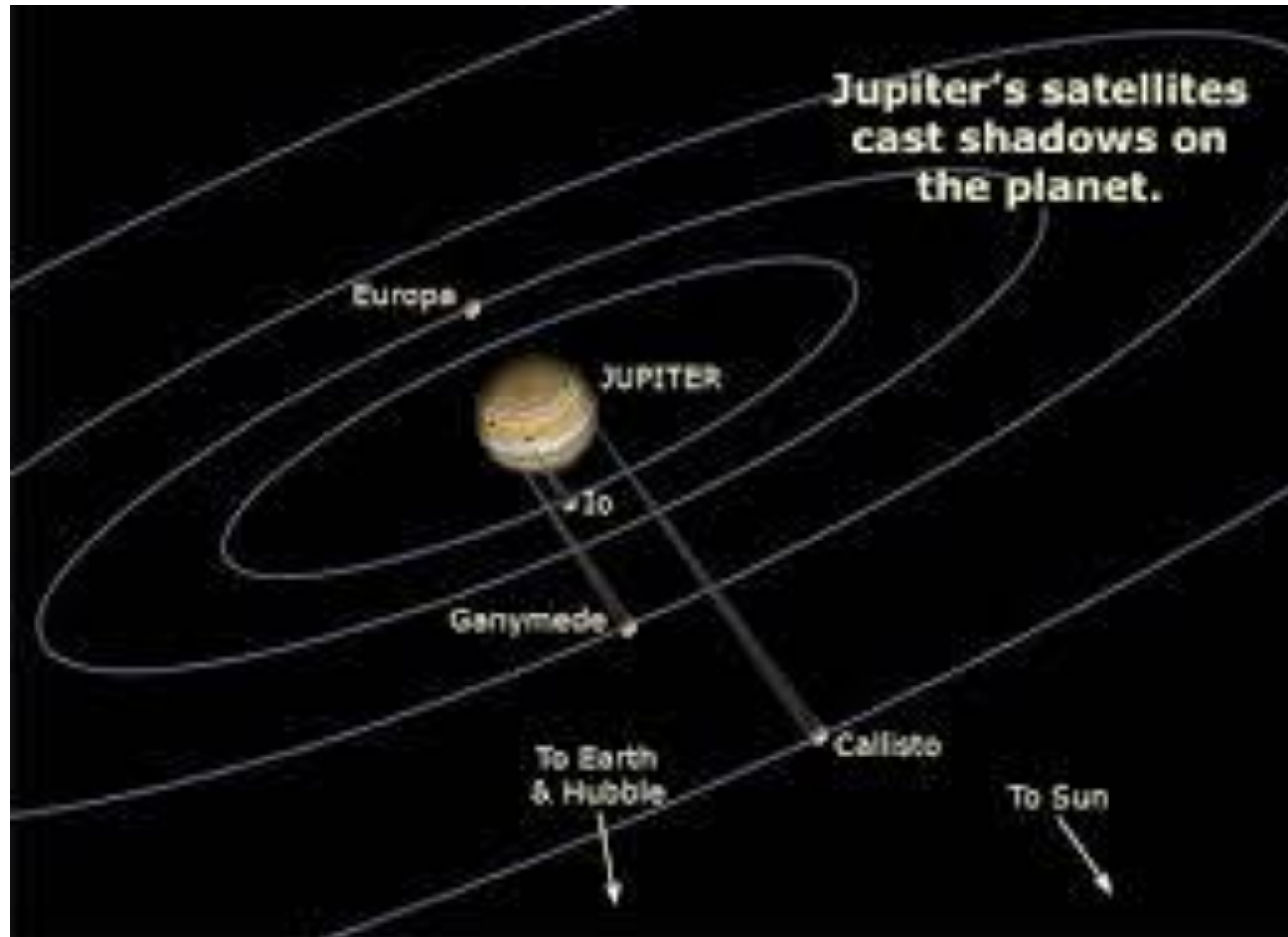


- Jupiter's rings discovered by Voyager 1 in 1979
- Rings are delicate, dusty structures created by dust thrown off by impacts on small moons
- Three main components
  - Pair of very faint outer rings (gossamer rings)
  - Wide, flat main ring
  - Thick inner ring (halo)

# Jupiter's Moons

- The four largest moons were discovered by Galileo in 1610 using an early version of the telescope
- Io, Europa, Ganymede & Callisto are known today as the Galilean satellites
- There are 53 confirmed, named moons and 14 provisional, un-named moons (67 in total)

# Jupiter's Galilean Moons





# Jupiter's Galilean Moons



# Jupiter's Galilean Moons

- **Io** is the most volcanically active body in the solar system
- Io's surface is covered by sulphur
- Jupiter's immense gravity causes "tides" in the solid surface that rise 300 feet high, driving off any water
- Io's volcanoes are driven by hot silicate magma



# Jupiter's Galilean Moons

- **Europa** has a frozen surface covering a liquid-water ocean
- 2x water of Earth
- Potential for having a “habitable zone”
- The Hubble telescope has imaged what may be water vapour plumes (26/09/2016)



# Jupiter's Galilean Moons

- **Ganymede** is the largest moon and is larger than Mercury
- Only moon known to have its own internally generated magnetic field



# Jupiter's Galilean Moons

- **Callisto** has a few small craters indicating a small degree of current surface activity
- Approximately the same size as Mercury



# Juno Mission Timeline

- The second spacecraft under NASA's New Frontiers Programme
- Launched on 5<sup>th</sup> August 2011
- Deep space manoeuvres during August & September 2012
- Earth flyby gravity assist in October 2013

# Juno Mission Timeline

- Jupiter arrival in July 2016
- Juno will orbit Jupiter for 20 months (37 orbits)
- End of mission (deorbit into Jupiter) in February 2018

# Juno Mission Objectives

- Determine how much water is in Jupiter's atmosphere, which helps determine which planet formation is correct
- Measure composition, temperature, cloud motions and other properties of the atmosphere



# Juno Mission Objectives

- Map Jupiter's magnetic and gravity fields, revealing the planet's deep structure
- Explore and study Jupiter's magnetosphere near the planet's poles, especially the auroras – providing new insights about how the planet's enormous magnetic force field affects its atmosphere