

From the solar system to the cosmos

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Introductory lecture

Cosmic Address

- Our sun is in a galaxy called the milky way – named after the band of stars we can see
- Types of galaxy – spirals and elliptical. Spirals are flat (this is what we are in)
- There are 10^{11} stars in our galaxy – 100 thousand million
- Our galaxy sits in a structure – gravitationally bound to one other large galaxy, and 40 smaller ones. This is called a local group.
- The local group is also part of the local supercluster. These are both gravitationally bound structures too.

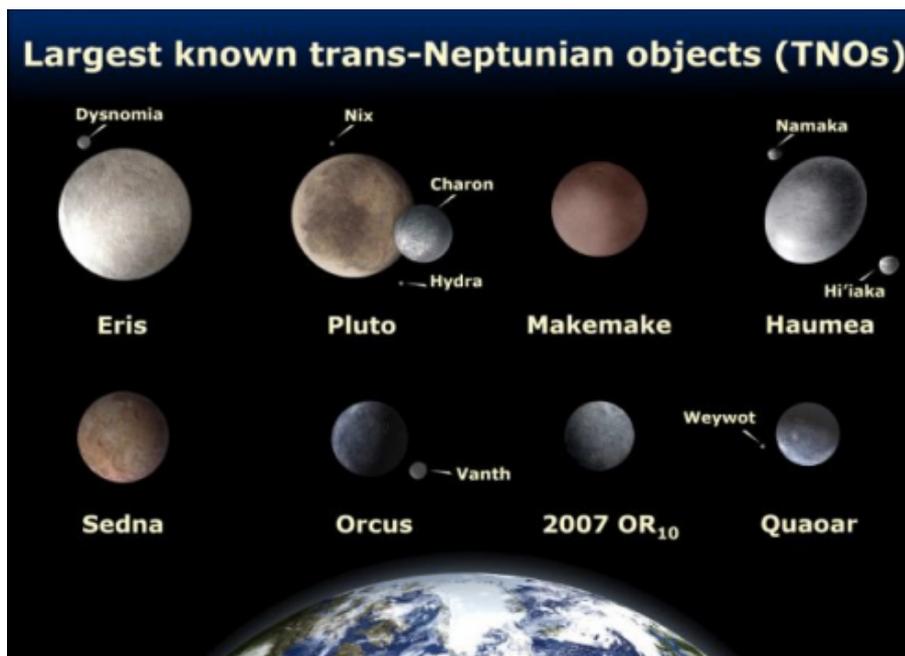
Planets and moons

- There are 8 planets in our solar system and 182 moons
- Definition of planets: *orbits the Sun. Has enough mass to be 'round'. Has cleared the neighbourhood around its orbit*
- This definition was formed due to the discovery of many new celestial bodies – created another set: *Dwarf Planets*.

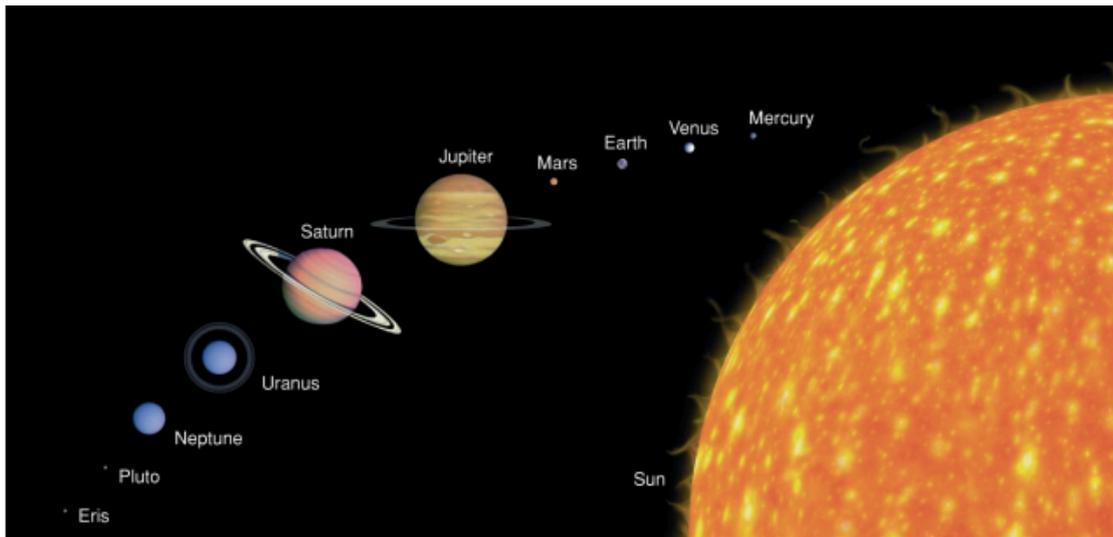
Story of Pluto

- Scientists work on a continuum – astronomers found new objects outside Pluto's orbit
- This meant that Pluto could not be a planet
- Pluto has a smooth surface – means it is young and has not been hit by objects

Trans-Neptunian objects



Solar system



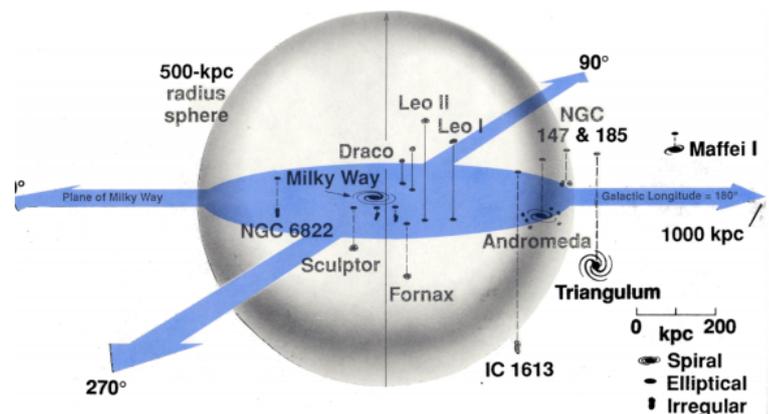
a The scaled sizes (but not distances) of the Sun, planets, and two largest known dwarf planets.

The Sun

- A ball of hot Hydrogen gas, that generates heat and light by nuclear fusion – a big nuclear reactor
- It has sunspots on it – slightly colder areas

The Milky Way

- Has a core (the bulge) and the edge.
- It is a spiral galaxy – about a 100 billion stars, orbiting a supermassive black hole. We are located far away from the black hole
- Andromeda is the other large galaxy, and the other ones are smaller. We are still finding smaller galaxies in our local group (“scraps” of galaxies)
- Smaller galaxies do not have a shape or form – they just looked like clouds. They still contain about 1 billion stars in them.
- Most dwarf galaxies are satellites of the two main galaxies



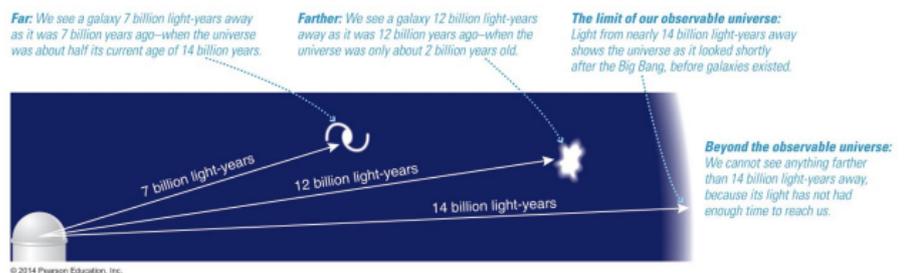
Virgo Cluster of Galaxies

- Thousands of galaxies gravitationally bound together with lots of dark matter
- On a bigger scale, there are ‘superclusters of clusters’

Describing the universe

- Quantitatively described
 - Distance
 - Time
 - Mass
- *Distance:*
 - Astronomical Unit: average distance between the Earth and the Sun
 - 150 million kms = 1.5×10^8 kms
 - Light-year: distance light travels in a year
 - (speed of light) x (1 year) = 9.46×10^{12}
 - Parsec: distance unit professional astronomers use (about 3 light years)

- The further away we look, the further back we look in time.
- Limit: the universe is 13.7 billion years old – can we see right back to the beginning



- We are trying to see the birth of the first stars. We can see a time when there are no stars, and when there are galaxies, but we cannot see the birth of the first stars.