Geo 5

Monday, December 9th, 2024 10:00 AM

Mr. Lyons

GLGY 1005 -01 INTRODUCTION TO GEOLOGY

Fall 2024

Earth's place in the Universe and Solar System's components

The Milky Way Galaxy

- Our galaxy known as **Milky Way**
- It is a spiral barred-shape of spiral nebulae
- Diameter: approximately 100,000 light years
- Thickness: approximately 1,000 light years
- All of these gaseous masses, stars, and nebulae are held together by gravitational attraction

Stars → Black in place
Gases → Absorb
Dust → Gas

Nebulae

Interstellar Gas

All what we center of the galaxy

The Milky Way

- Diameter: 90,000 light years
- Mass: ~50 billion times the mass of our sun
- The sun is located approximately 26,000 light years from the center of the galaxy
- Half the mass is gas other than dust
- Mass of the galaxy is concentrated in the galactic plane
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- The mass of the galaxy is concentrated in the galactic plane

20K light years wide

Like the shape of a lense when to edge view

↑ mass

↳ Sun in Cygnus-Orion arm

Milky Way position in the known Universe

Milky Way is located within a small cluster called the ↳ Inside the ~~Local Group~~

↳ that 40 galaxies in the local group known right now

Galaxy red- and blue shift

- The American astronomer Edwin Hubble in 1929 found the "Doppler effect" in the galaxy light, observed (using the spectrum analysis) away from our Earth passed a lesser "red shift"
- Light from distant galaxies travelled to earth at a lower "blue shift"

Galaxies moving away from us "red" light that is ~~less energetic~~ than expected

Galaxies moving towards us "blue" light that is ~~more energetic~~ than expected.

↳ This leads to:

Expanding Universe

- It was the American astronomer Edwin Hubble who observed Doppler shift in the light from a galaxy, by Sun Sun in Doubtfully
- **Universe is expanding!**
- It was a two-dimensional or a paraboloid level.

↳ Expanding Universe

↳ The ~~farther~~ away a ~~galaxy~~ is, the ~~faster it is moving~~ (the more balloon the red-shift)

Big-Bang Theory

- Big-Bang theory explains the initiation of the universe and the **Big-Bang Theory**
- Experimental confirmation of the Big Bang theory came from two factors, with the Nobel Prize awarded to two scientists CMB and Hubble

Big Bang Theory

↳ We currently that the Universe was born from ~~expanding~~ from an ~~very hot dense~~ in empty space.

known Universe age

- The age of the Universe can be inferred by calculating the rate of expansion.
- Accordingly, it was calculated that the process of Universe's age was started approximately ~~13.7 billion years~~ ago.
- The mass of the Universe was concentrated in a very small part of space.

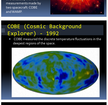
Using the Universe's rate of expansion, we can extrapolate its age.

↳ We think the Universe was born about ~~13.7 billion years~~ ago.

~~Big Bang theory~~

COBE (Cosmic Background Explorer) – 1992

- COBE measured the average temperature fluctuations in the cosmic background of the universe



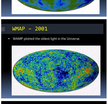
Calculated lots of data about the ~~Universe~~ ~~Universe~~ ~~Universe~~

↳ In particular, recorded temperature which plotted the ~~distribution~~ ~~temperature~~ of the ~~Universe~~ ~~Universe~~

↳ Used as evidence of the Big Bang

WMAP – 2001

- WMAP plotted the oldest light in the Universe.



Plotted the oldest (~~universe~~) radiation in the Universe very accurately

↳ More evidence to back up the Big Bang

↳ Discovery earned in Nobel Prize

Inside the galaxy: nebulae

- Nebulae are concentrations of interstellar gas and dust.
- The are formed through a variety of processes:
  - Concentration of small-sized material,
  - Explosions of a star or other celestial body,
  - Gravitational force or Cardiac mass stellar bodies.

Nebulae

Concentrated of Interstellar gas

↳ Remnants of Stars

Formation

- Coming together through gravity
- Cosmic explosions
- Cosmical collapse

Nebulosity around Gamma Cygni

Stars behind the Nebula let us see the Nebula more clearly, letting us see its shadow

The Eagle Nebula

- The Eagle Nebula is probably one of the most famous astronomical sky fotos.
- It consists of dust, gases (e.g., hydrogen, helium, and other gases), radiation, and other elements, known as "interstellar fog".
- This nebulae is regarded as a typical example for the **'brilliance of stars'**.

Dust
Gases
Vapors

} Interstellar Fog

↓

birth of stars

Stars – generalities

- The stars are massive gaseous bodies emitting in several ways
- Stars are made of:
  - **Hydrogen**,
  - **Helium**
- Their mass is so big, so they are permanently in danger of shrinking
  - **Gravitational**

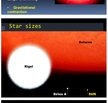
Stars ~~are~~ Mostly H and He

- Take together by a balance of outward radiation force and inward gravitational force

Stars are concentrated by:

- Force acting from them.

Star sizes



Stars very massively in terms of

↳ Mass

↳ Size

↳ Luminosity

Star sizes

The Sun: characteristics

- The Sun radiates energy due to the continuous thermonuclear reactions at its interior
- The thermonuclear reactions combine atoms of hydrogen to form helium.
- The lifecycle of a star depends of how long its "hydrogen reserve" lasts.

Sun

- Fusion reactions continuously radiate energy

↳ $4H \rightarrow He$

The Sun: characteristics

The Sun is some forty-two million miles (67 million km) from Earth. Source: ~~LLNRNA~~

Atomic reactions: Hydrogen → He

Mass of the Sun: 1.99 x 10^{30} kg

Temperature at the center of the Sun: ~ 15 million degrees

The Sun radiates energy due to the continuous thermonuclear reactions at its interior

The lifecycle of a star depends of how long its "hydrogen reserve" lasts.

Source: Wikipedia

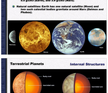
73% H
25% He
and 2% other elements

Planet Classification

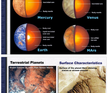
- Planets are classified based on their composition, leading to a distinction between terrestrial and gas planets. The order of planets from the Sun is:
  - Mercury
  - Venus
  - Earth
  - Mars
- Jovian planets (larger in size, possess a dense core surrounded by a thick atmosphere, consisting of H and Jupiter and Saturn):
  - Jupiter
  - Saturn
  - Uranus
  - Neptune
- In terrestrial classification, the most distant planet of Pluto, the dwarf planet, is classified as a dwarf planet of Kuiper Belt.
  - Pluto.

Terrestrial Planets

- Equatorial diameter: 4,879 km (Mercury) and 12,756 (Earth).
- Average density: 5.4 g/cm3 (Mercury), 5.5 g/cm3 (Venus), 5.5 g/cm3 (Earth), 3.9 g/cm3 (Mars).
- Terrestrial planets have the same general outline (Venus and Mars have similar broken geometry around Mars (Deimos and Phobos).



Terrestrial Planets



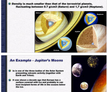
Terrestrial Planets

The Moon

- Mass: 1% of the mass of the earth.
- Its surface is a little approximately half as much as earth.
- Moon is one of the largest satellites in the solar system.
- The surface of the moon consists of:
  - Lunar mare (dark areas) and
  - Lunar highlands (lighter areas).
- Lunar mare (dark areas) are basaltic plains which formed the craters of ancient meteorites (underlined during Moon's history.

Jovian Planets

- Jupiter's diameter: approximately 143,000 km, being the largest in our solar system.
- The smallest one of the Jovian planets, Neptune, is approximately four times larger than the Earth, presenting a diameter of approximately 49,500 km.
- Density is much smaller than that of the terrestrial planets. Representing approximately 1.3 g/cm3 (Neptune) and 1.3 g/cm3 (Jupiter).



An Example – Jupiter's Moon

- It is one of the satellites of the Jovian Planet Jupiter, discovered by Galileo.
- It is Jupiter's closest to the Jovian Planet, and it is the fourth largest moon in the solar system. It is the largest moon of all the Jovian moons.

Photo from Galileo probe

Asteroids

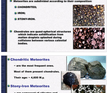
- Asteroids are small celestial bodies which orbit around the Sun. Most of them are located between Mars and Jupiter.
- The number of asteroids is approximately 1,000,000 (one million).
- Because of their irregular shape and lack of atmosphere, they are considered as minor planets.
- Their composition is similar to that of the Earth's crust, containing different kinds of minerals, such as silicates, nickel, iron, and magnesium.

Asteroids

- Asteroids are known as 'flying mountains' due to their irregular shapes.
- Ceres and Pholus, the two moons of Mars, are the largest asteroids. They are about 900 km and 200 km in diameter, respectively.

Meteorites

- Meteorites represent fragments of rocks from the interplanetary space, which have reached the surface of the Earth.
- They may be made such fragments can be the remnants collisions in the interplanetary space of the Solar System.
- Meteorites are classified according to their composition:
  - **Stony meteorites**
  - **Iron**
  - **Stony-iron**
- Meteorites are quasi-spherical stones with a diameter of 1 cm to 1 m, which have undergone melting during atmospheric passage and have a fusion crust or solidification crust.



Chondritic Meteorites

- are the most frequent ones.
- Most of them present chondrules.
- Their age: ~ 4.55 M.y.

Stony-Iron Meteorites

- are composed of silicates and metallic iron in approximately equal proportions.

Iron Meteorites

- are composed of metallic iron, mostly composed of nickel and iron-nickel alloy variation.
- Iron meteorites are considered as a major type of meteorites.

Space Dust

- Cosmic dust, also known as space dust, is a type of dust that exists in space.
- It consists of:
  - Fragments of small rock-forming minerals composed mainly of O, Mg, Fe, and Si.
  - Organic compounds.
- It is composed of dust grains that are in size plus.