STARS & THE SOLAR SYSTEM

CONTENTS

ASTRONOMY

The universe is the vast expanse of space which includes everything that exists- all the stars, planets, satellites and clouds of dust and gases. The branch of science which deals with the study of universe is called **astronomy.**

The study of astronomy involves the methods and instruments used for the study of universe.

ASTRONOMICAL DISTANCES

For measuring these extremely large distances, we use two astronomical units, the ***light year*** and the ***parsec***.

A light year is defined as the distance travelled by light in one year.

1 light year = 300000 × 365 × 24 × 60 × 60 km

1 light year = 9.46×10^{12} km

Another unit commonly used for measuring astronomical distances is the parsec.

1 parsec is equal to 3.26 light years.

CELESTIAL OBJECTS

The stars, planets, moon and many other objects in the sky are called celestial objects.

GALAXIES

An enormous cluster of star held together by gravitational forces is called galaxy.

A galaxy is the building block of the universe. There are about 100 billion galaxies (10^{11} galaxies) in the universe and each galaxy has on an average 100 billion stars (10^{11} stars). So, the total number of stars in the universe are about $\mathbf{10^{22}}$.

The two important galaxies in the universe are :

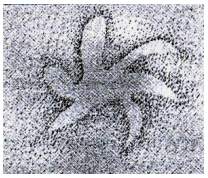
(i) Milky Way galaxy

(ii) Andromeda galaxy

Hubble (American astronomer), made important contribution in the study of galaxies. He divided galaxies into three categories spiral, elliptical and irregular.

(a) Spiral

(b) Elliptical



(c) irregular

(a) Spiral Galaxies :

Spiral galaxies are spiral in shape as shown in figure (a). Milky way galaxy is an example of spiral galaxy. Approximately 80 % of the total galaxies are of this kind.

(b) Elliptical galaxies :

They account for 18 % of all the observed galaxies. However, it is estimated that their number is far larger than the observed percentage.

(c) Irregular galaxies :

The small galaxies which lack clear symmetrical form are called irregular galaxies. They comprise 2 % of the observed galaxies. In these galaxies, we find lot of dust and large number of blue stars.

◆ **The milky-way galaxy :**

The name milky way comes from a greek word "gala" which means milk. Milky-way is the hazy luminous band of white light seen stretched across the sky at night. Its Indian name is Akash Ganga. Our solar system is the part of the milky-way. The milky way contains more than 100 billion (10^{11}) stars.

STARS

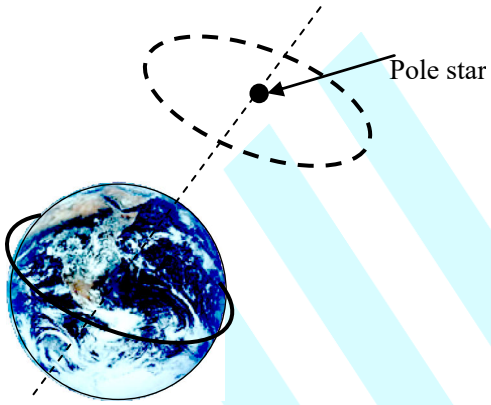
Stars are heavenly bodies that are extremely hot and give out light of their own. Stars are mainly made up of hydrogen. Inside the stars hydrogen is continuously being converted into helium by fusion reaction and this releases a tremendous amount of energy which is given out as heat and light. Stars vary in colour depending on their temperatures.

(a) Stars twinkle because we look up at the stars through air that is constantly blowing about, so we receive their light as unsteady and thus they seem to twinkle.

(b) The stars appear to us like points, because they are very far away from the earth.

(c) Stars appear to move from east to west because the earth rotates about its north-south axis from west to east. Thus, due to relative motion, all heavenly bodies (stars, planets, moon) appear to move from east to west.

(d) The pole star (polaris or Dhruva Tara) not change its position in the sky because it is situated in the direction which is directly above the geographic north-pole of the earth's axis. Thus, its position relative to the earth does not change and hence, it appears stationary.



(e) The start nearest to the earth is the sun itself & light from sun reaches to us in 8.3 light minutes. The next nearest star is the Alpha Centaury or Proxima Centaury & it is at a distance of 4.3 light years.

CONSTELLATIONS

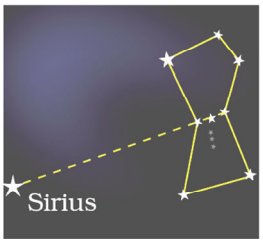
The stars forming a group that has a recognisable shape is called a constellation.

We can easily identify some constellations in the night sky.

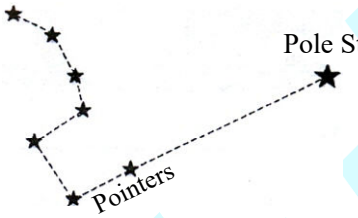
(a) Orion is a well-known constellation that can be seen during winter in the late evenings. It is one of the most magnificent constellations in the sky. It also has seven or eight bright stars(figure) Orion is also called the Hunter. The three middle stars represent the belt of the hunter. The four bright stars appear to be arranged in the form of a quadrilateral.

The star sirius, which is the brightest star in the sky, is located close to Orion. To locate sirius.

imagine a straight line passing through the three middle stars of Orion. look along this line towards the east. This line will lead you to very bright star. It is Sirius.

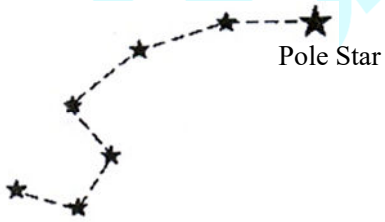


(b) Ursa major : It is also known as the Great Bear, the Big Dipper or Saptarishi. Ursa major contains seven stars making the pattern of a plough. A line drawn through the pointers of he plough leads us to the pole star or Polaris (**Dhruv Tara**). The Pole star always appears in the same position in the sky as it is directly above the north pole. This constellating is visible during the summers.



Ursa Major

(c) Ursa minor : It is known as the Little Bear or Little Dipper. Ursa minor also consists of seven stars arranged in a similar manner to those to Ursa Major, but the stars in this constellation are closer together and less brighter than in the Ursa major.



Ursa Minor

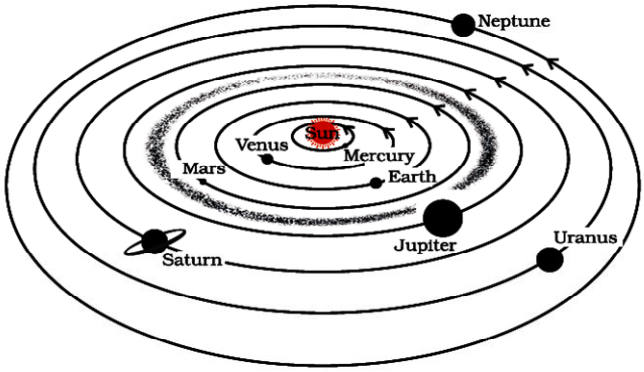
(d) Cassiopeia : Cassiopeia is another prominent constellation in the northen sky. It is visible during winter in the early part of the night. It looks like a distorted letter W or M.

Cassiopeia

SOLAR SYSTEM

The Sun and the celestial bodies which revolve around it form the solar system. It consists of large number of bodies such as planets, comets, asteroids and meteors. The gravitational attraction between the Sun and these objects keeps them revolving around it.

Eight planets revolve around the Sun in their order of distance from the Sun are : Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.



The solar system (not to scale)

◈ **The Sun :** It is the nearest star from us. It is continuously emitting huge amount of heat & light. It is the main source of heat & light for all the planets.

◈ **Planets :**

The planets look like stars, but they do not have light of their own. They merely reflect the sunlight that falls on them. The simplest method of identifying planets from stars is that stars twinkle, whereas planets do not. Also the planets keep changing their positions with respect to the stars. A planet has a definite path in which it revolves around the Sun. This path is called an **orbit**. The time taken by a planet to complete one revolution is called its period of revolution. The

period of revolution increases as the distance of the planet increases from the sun.

Besides revolving around the Sun, a planet also rotates on its own axis like a top. The time taken by a planet to complete one rotation is called its period of rotation.

Some planets are known to have moons/satellites revolving round them. Any celestial body revolving around another celestial body is called its satellite.

The Earth can be said to be a satellite of the Sun, though generally we call it a planet of the Sun. Moon is a satellite of the Earth. There are many man-made satellites revolving round the Earth. These are called artificial satellites.

PLANETS

Mercury *(Budh)*

The planet mercury is nearest to the Sun. It is the smallest planet of our solar system. Because Mercury is very close to the Sun, it is very difficult to observe it, as most of the time it is hidden in the glare of the Sun. However, it can be observed just before sunrise or just after sunset, near the horizon. So it is visible only at places where trees or buildings do not obstruct the view of the horizon. Mercury has no satellite of its own.

Venus *(Shukra)*

Venus is earth's nearest planetary neighbour. It is the brightest planet in the night sky. Sometimes Venus appears in the eastern sky before sunrise. Some times it appears in the western sky just after sunset. Therefore *it is often called a morning or an evening star, although it is not a star*.

Venus has no moon or satellite of its own. Rotation of Venus on its axis is somewhat unusual. It rotates from east to west while the Earth rotates from west to east.

The Earth (*Prithvi*)

The Earth is the only planet in the solar system on which life is known to exist. Some special environmental conditions are responsible for the existence and continuation of life on the Earth. These include just the right distance from the Sun, so that it has the right temperature range, the presence of water and suitable atmosphere and a blanket of ozone. From space, the Earth appears bluegreen due to the reflection of light from water and landmass on its surface. The axis of rotation of the Earth is not perpendicular to the plane of its orbit. The tilt is responsible for the change of seasons on the Earth. The Earth has only one moon.

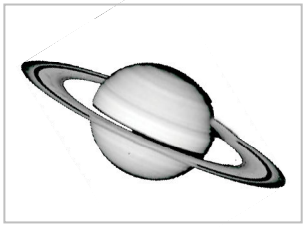
Mars *(Mangal)*

The next planet, the first outside the orbit of the Earth is Mars. It appears slightly reddish and, therefore, it is also called the red planet. Mars has two small natural satellites.

Jupiter *(Brihaspati)*

Jupiter is the largest planet of the solar system. It is so large that about 1300 earths can be placed inside this giant planet. However, the mass of Jupiter is about 318 times that of our Earth. It rotates very rapidly on its axis. Jupiter has a large number of satellites. It also has faint rings around it. You can easily recognise Jupiter as it appears quite bright in the sky.

Saturn *(Shani)*

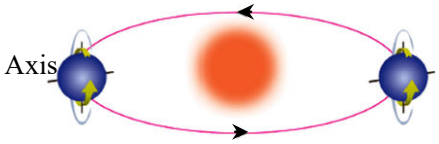


Beyond Jupiter is Saturn which appears yellowish in colour. What makes it unique in the solar system is its beautiful rings. These rings are not visible with the naked eye. You can observe them with a small telescope. Saturn also has a large

number of satellites. One interesting thing about Saturn is that it is the least dense among all the planets. Its density is less than that of water.

◈ Uranus and Neptune

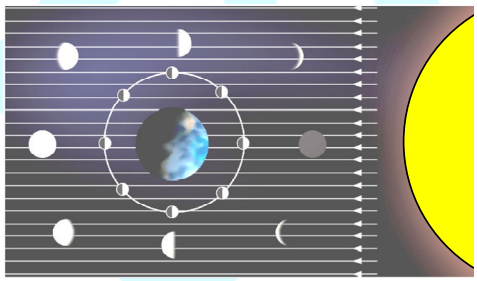
These are the outermost planets of the solar system. They can be seen only with the help of large telescopes. Like Venus, Uranus also rotates from east to west. The most remarkable feature of Uranus is that it has highly tilted rotational axis (Fig.). As a result, in its orbital motion it appears to roll on its side.



Uranus in its orbital path

➢ MOON

It is the natural satellite of earth. The day on which the whole disc of the moon is visible is known as the full moon day. Thereafter, every night the size of the bright part of the moon appears to become thinner and thinner. On the fifteenth day the moon is not visible. This day is known as the new moon day. The next day, only a small portion of the moon appears in the sky. This is known as the crescent moon. Then again the moon grows larger every day. On the fifteenth day once again we get a full view of the moon. The various shapes of the bright part of the moon as seen during a month are called **phases of the moon**

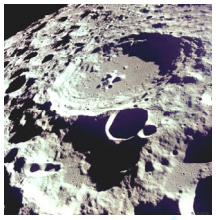


Positions of the moon in its orbit and its corresponding phases

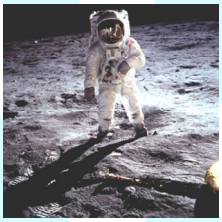
◈ Moon's Surface :

Moon's surface is dusty and barren. There are many craters of different sizes. It also has a large number of steep and high mountains (Fig.). Some of these are as high as the highest mountains on the Earth. The moon has no atmosphere. It has no water.

First moon mission : On July 21, 1969 (Indian time) the American astronaut Neil Armstrong landed on the moon for the first time followed by Edwin Aldrin.



Surface of the moon

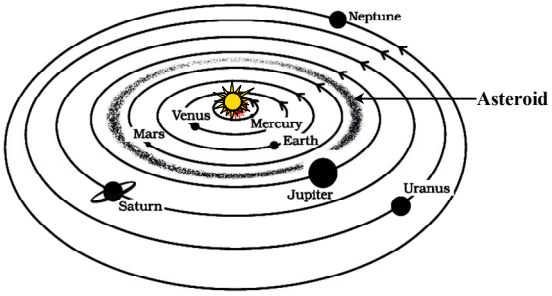


An astronaut on the moon

➢ SOME OTHER MEMBERS OF SOLAR SYSTEMS

◈ Asteroids

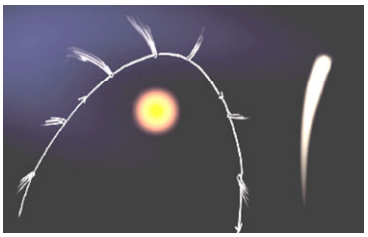
There is a large gap in between the orbits of Mars and Jupiter (Fig.). This gap is occupied by a large number of small objects that revolve around the Sun. These are called **asteroids**. Asteroids can only be seen through large telescopes.



The asteroid belt

◈ Comets :

Comets are also members of our solar system. They revolve around the Sun in highly elliptical orbits. However, their period of revolution round the Sun is usually very long. A Comet appears generally as a bright head with a long tail. The length of the tail grows in size as it approaches the sun. The tail of a comet is always directed away from the sun



Different position of a Comet

Many comets are known to appear periodically. One such comet is **Halley's comet**, which appears after nearly every 76 years. It was last seen in 1986.

◈ Meteors and Meteorites

At night, when the sky is clear and the moon is not there, We may sometimes see bright streaks of light in the sky (Fig.) These are commonly known as shooting stars, although they are not stars. They are called **meteors**. A meteor is usually a small object that occasionally enters the earth's atmosphere. At that time it has a very high speed. The friction due to the atmosphere heats it up. It glows and evaporates quickly. That is why the bright steak lasts for a very short time.

Some meteors are large so that they can reach the Earth before they evaporate completely. The body that reaches the Earth is called a **meteorite**. Meteorites help scientists in investigating the nature of the material from which the solar system was formed.

◈ Artificial Satellites

You must have heard that there are a number of artificial satellites which are orbiting the Earth. You might wonder how artificial satellites are different from the natural satellites. The artificial satellites are man-made & they are launched from the Earth. They revolve around the Earth much closer than earth's natural satellite, the moon.

India has built and launched several artificial satellites. Aryabhatta was the first Indian satellite. Some other Indian satellites are INSAT, IRS, Kalpana-1, EDUSAT, etc. Artificial satellites have many practical applications. They are used for forecasting weather, transmitting television and radio signals. They are also used for telecommunication and remote sensing.

◈ IMPORTANT POINTS TO BE REMEMBER

- The phases of the moon occur because we can see only that part of the moon which reflects the light of the Sun towards us.
- Stars are celestial bodies that emit light of their own. Our sun is also a star.
- It is convenient to express distances of stars in light years.
- Stars appear to move from east to west.
- The pole star appears to be stationary from the Earth, because it is situated close to the direction of the axis of rotation of the Earth.
- Constellations are groups of stars that appear to form recognisable shapes.
- The solar system consists of eight planets and host of asteroids, comets and meteors.
- A body revolving around another body is called a satellite.
- Moon is the natural satellite of the Earth. Some planets also have natural satellites.
- Venus is the brightest planet in the night sky.
- Jupiter is the largest planet of the solar system.
- The artificial satellites revolve around the Earth. They are much closer than the moon.
- Artificial satellites are used for weather forecasting, long distance communication and remote sensing.