Comets And Their Origin

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Introduction

The word comet is derived from *cometa*. Outer space is filled with a great number of surprises and mysteries. The comets are also one of the great mysteries. Uncountable comets are rotating around the sun and are part of the solar system. The most successful comet discoverer of all time is Jean-Louis Pons. He claims that he discovered almost thirty-seven comets. The second most prolific was William Robert Brooks. The discovery of a comet dates back to the 1680s, when Gottfried Kirch made one. Comets were initially explained as solid rock particles floating in space, but after in-depth substance analysis, it has been confirmed that they are small icy solar system parts. When a comet passes close to the sun, it releases gases. The process of releasing the gases is known as outgassing. This gives the comet a tail, and a bright coma is shown behind a fast-moving comet in the sky. Scientists have discussed comets a lot and have predicted their behaviour. The life expectancy is also elaborated, which results in an understanding of the origin of the earth as a planet. The structure of comets is completely different from that of stars, asteroids, and other planets in outer space. There are many planets revolving around the sun and other stars. Comets are numerous, and they also revolve around heavy objects as well as the sun and stars. The paper discusses the comets and the human discoveries about them.

Discussion

A comet is composed of solid rock and has a long, bright tail. The rock is said to be the nucleus of the comet, and the tail is the gas released by the comet, which is bright. The overall mass of the comet is composed of rocky particles, ice, and dust. The size of the rock (nucleus) varies from a few meters to tens of kilometres. The tail is found to be stretched to almost fifteen times more than that of the earth’s diameter. Every particle, planet, moon, star, and galaxy has an orbit to follow. Similarly, the comets also have eccentric elliptical orbits. Their orbital periods, measured in years, can be longer than Earth’s (Masoumzadeh et al.). The assumed rotation of a comet can reach millions of Earth years (Shustov, 64). The orbits of the comets are classified into two categories. There are comets that follow shorter orbits and are beyond Neptune’s orbit in the scattered disk area. The long-orbited comets rotate outside the Oort cloud and before the nearest star. Their orbits are usually calculated as millions and millions of years long.

Some comets mostly pass outside the solar system and, once in millions of years, rotate around a big

star that is thousands of light-years away from us. These comets are usually called hyperbolic comets. Some comets also pass through the solar system, and they can be observed. Sometimes, when a comet passes very closely to the sun, it loses most of the ice and dust. It becomes smaller and looks like an asteroid. Comets are differentiated from asteroids because they have completely different behaviour and lifespans. The comets have a gravitationally unbound atmosphere. It surrounds the central nucleus. There is a tail known as the coma. It is composed of the dust and ice blown out of the comet (Masoumzadeh et al.). Sunlight pressure and solar wind plasma tend to form the tail and light it up. There is a discovery of the central belt comets, which resemble asteroids, and the prominent difference between the asteroids and comets is heavily blurred.

At the end of 2014, there were almost 5253 known comets. This number is currently increasing because of discoveries by astronomers and scientists. This observed number of five thousand comets is much smaller than the estimated total, and it would not be wrong to say that it is a fraction of the overall number of comets available in the outer universe. The estimated number of bodies which are available in the solar system is one trillion. It would be hard to say whether scientists will be able to find all or a good number in this decade because, according to scientists, only one or two comets can be viewed by the naked eye. Others are mostly unspectacular, even with highly powerful telescopes. The bright examples that can be observed by the naked eye are known as the great comets. Random research is being done on the comets. The European Space Agency was the first to land a robotic spacecraft on a comet. NASA has blasted a comet to study its interior. Fig (1) is obtained from

international sources. Fig: 1 (Lamy)

A comet is composed of solid rock, dust, frozen carbon dioxide, water ice, carbon monoxide, methane, hydrogen cyanide, formaldehyde, ethanol, ethane, and some of the highly sophisticated long-chain hydrocarbons and amino acids. This discovery of the composition of a comet resulted in the expectation of DNA, RNA or any other biological structure which would be responsible for the life transfer from one area of space to another. The outer surface of the comet is normally covered with tar or crude oil.

There are comets whose radius is greater than thirty kilometres, which are also observed and classified as large comets (Faggi et al.). Their exact size, weight, and body shape were difficult to identify because of the high speed and limited technology. In the past, very rare comets were identified in outer space, but now, proper telescopes and satellites floating in the sky have resulted in the discovery of comets as small as 100-300 meters, which would pass beyond what the human eye could see.

The coma of the comet is the dust and the gas which is released and creates a thin and huge atmosphere around a comet. The pressure of sunrays and solar radiation causes an increase in the length of the tail, pointing it to the side opposite the sun. Water and gas are the most prominent substances. It is found that the comets release extreme quantities of X-rays. It was a surprise to the astronomers because the X-rays were associated only with higher-temperature bodies, but the comet consisted of dry ice, water ice, and low-temperature areas as well. The discovery of X-rays in comets was in 1996, and a great discussion about the formation of the comets was again officially started, and Russian, European, and NASA scientists discussed these concerns collectively. After a long time, it was confirmed that because of the interaction of the comets with the solar wind, the cometary atmosphere gets charged by the ions present in the solar wind. Both the atmosphere and the solar wind ions collide, and the transfer of electrons from atoms or molecules, a process known as charge exchange, results in the X-rays and the far ultraviolet photons.

The comets present in the outer area of the solar system are mostly cold and frozen. They are impossible to detect because of their inactive nature. Moreover, their sizes are too small, and the statistics obtained from the Hubble telescope data indicated that the comets of the Kuiper belt are mostly dormant and are more enormous in size, but because of their extreme distances from the earth and light sources like the sun and other stars, they are rarely seen (Shustov, 64). As a comet comes out of the Kuiper belt and enters the solar system, it is found to be in contact with the solar wind, which results in increased volatility, and the water starts vaporizing and streaming out of the nucleus along with the dust (Shanklin). The comet has two tails. The gas tail is separated from the dust tail. They are seen mostly to be completely distinct from one another.

These tails are named Tail I and Tail II. Tail I is composed of gases and ions and is on the side opposite the sun and the solar winds. On the other side, because of the orbital movement, the dust tail, Tail II, is a bit tilted. It is composed of dust particles. This is demonstrated in the picture obtained from the NASA website, Fig (2).

Fig: 2 (Lamy)

Sometimes, the comets have to face uneven heating. This heating results in holes in the comet nucleus, and the gases, along with the mixture of dust, start getting out. This emission of the streams of gases causes the nucleus to spin and sometimes even split apart. It is revealed that the dry ice, which is another name for the frozen carbon dioxide, is the only reason for the powerful jets of material, which come out in the form of dust from the nucleus of the comet. There are some infrared images that show such jets existing and carrying the dust out of the comet in the form of a coma.

Most of the comets are very small inside the solar system. Their orbits are long and elliptical. The path they follow usually makes them closer to the sun for some time and then takes them away to the distant areas of the solar system. The comets are classified according to their orbital lengths. The longer the orbital path is, the more elongated the ellipse will be observed.

Short-period comets are defined as those that have orbital periods of less than 200 years. Their orbital behaviour is mostly elliptical and in the same direction as the planets in the solar system. The

comets whose existence is found close to some more significant planet are usually known as its family. There are some comets named after the person who discovered them. For example, Encke's comet has an orbit that doesn't reach the orbit of Jupiter, and its complete name is an Encke-type comet (Dones). The comets whose orbital period is less than 20 years and have very low inclinations, which are up to 30 degrees, are known as Jupiter-family comets. The comets whose orbital periods are between 20 and 200 years have inclinations that extend from zero to even more than 90 degrees. Most of them are known as Halley-type comets. In total, 557 Jupiter-family comets have been discovered to date, and only 89 Halley-type comets have been discovered in 2017 statistics (Faggi et al.).

Within the asteroid belt, a new group of comets of entirely different classes is being discovered. They orbit in a circular path and are entirely within the asteroid belt. It is predicted that some comets will have to pass closer to the giant planets, which will result in their remaining on their paths. There are comets whose elliptical and circular paths only developed because of the sun and the other neighbouring planets' gravitational pulls. Astronomers' current statistics have concluded that the Jupiter family of comets is among the most prominent families known.

The long-period comets have highly eccentric orbits, and the period varies from 200 years to several thousand years. When the eccentricity of a comet is greater than 1, it doesn't mean that the comet will leave the solar system forever. There are many comets that are seen by the naked eye from the earth, and they will never be seen for the next thousand or several thousand years. There is a comet, McNaught, which has an eccentricity of 1.000019. It was seen in January 2007, and it is observed that its orbit will lead it away from the sun for the next 46,300 years.

The non-periodic or the single-apparition comets are the same as the long-period comets because of their hyperbolic as well as slight parabolic trajectories while they are near the perihelion in the inner solar system. Scientists have concluded that no comet with an eccentricity greater than one has been observed yet, but their existence is certain in many other galaxies and systems of the universe (Masoumzadeh et al.). The Comet C/1980 E1 has an orbital period of around 7.1 million years, and its eccentricity is observed as the highest one, which is 1.057. It was known as the hyperbolic comet. There are numerous comets that entered the solar system once, and there is no expectation that they will ever return to the solar system again. Their path is expected to be linear or have an infinite diameter of trillions of light-years.

Comets have a significant impact on life. In an early period when the earth was at its initial stages, scientists discovered that the comets used to bombard the young earth and brought a great quantity of water that is now present and can be seen in the great oceans of the earth. Some scientists agree on this point, but some are still doubtful. The Comets have the majority of the organic molecules, which explains why they could be considered the ones that brought the precursors of life or directly brought life to the earth. Also, it is observed that since the comet has a rocky and icy surface, it has the potential to create the amino acids through which the proteins are made. In 2015, scientists found the majority of oxygen in molecular form.

Many hyperbolic comets have been discovered in the last ten years, the numbers of which are shown in Table (1) from 2007 to 2016.

Year	Number
2007	12
2008	7
2009	8
2010	4
2011	13
2012	10
2013	16
2014	10
2015	15
2016	4

Table (1)

From 1200 A.D. to the 1650s, comets were considered acts of God, and there was a great fear in society. Many scholars, including Gotthard Arthusius, have published discussions about comets and natural disasters (Mozhenkov and Vaisberg). There was an incident in 1680 when a great comet hit the Earth, and the great floods started, which poured water on the Earth. Poisonous gas was detected in the tail of the comet in 1910, which resulted in people buying gas masks, anti-comet pills, and anti-comet umbrellas.

Comets' orbits are not as sophisticated and properly managed due to the higher number of collisions and their complete destruction because of breakups. There was a comet that was found close to Jupiter, and six days after its discovery, it broke into pieces, and those pieces fell into Jupiter's atmosphere. Due to thermal stress, many comets split into two parts, and there are 42p/Neujmin and

53)/Van Biesbroeck, which are parts of a parent comet.

Similarly, because of lower pressures and movement issues, many comets fall into giant planets like Neptune and Jupiter. Also, some even fall into the sun and other planets, and eventually, their end happens. Sometimes a giant comet, while travelling opposite to the other comets and asteroids, collides on a regular basis and eventually breaks down into pieces over time (Dones). The collisions of the comets, according to the scientists, are spectacular, and the last one was seen in 1994 when a comet broke into pieces and fell into Jupiter's atmosphere. All of the collisions and falling into the sun date back thousands of years.

There are some unusual comets which exhibit entirely different and unusual properties. These comets don't exist in the asteroid belt but in some other regions, like between Saturn and Jupiter, Saturn and Uranus, and close to Mercury. Their orbits are unstable and continuously change. They were initially predicted as asteroids, but after faint tails and movements were observed, they were finally declared as comets.

Numerous comets were discovered in the early part of the century, but they were not found again. They changed their behaviour, and the predicted orbits were either wrong or, because of some unnecessary changes, they left their orbit. Currently, a new comet has been discovered, and according to the astronomers, it is concluded that it was one of the lost comets and was found again (Shanklin). There are eighteen comets that were rediscovered and fall in the category of rediscovered and lost comets.

The people associated comets, their appearances, and their disappearances with human birth and death. It has been observed by a number of people that when a bright comet appeared in the sky, it caused a large number of people to experience hysteria and panic. This caused these comets to be regarded as bad omens. In 1997, when the existence of poisonous gas in the comet was discussed again, a newspaper published that a comet seen right now could save poisonous millions. It triggered a massive number of people to commit suicide in the Heaven Gate cult. That's why philosophers discuss comets as the causes of threats and problems to the human population.

Conclusion

In a nutshell, it can be explained that comets are beautiful artistic pieces of the universe and are as bright as stars when viewed from Earth but are close to planets and asteroids. They are very rarely seen in the sky, with only one or two appearing per year. The comets are present inside the solar system, but their orbit decides if they will last inside or leave sooner. Comet composition is different, mostly made up of gases and dust, with an atmosphere and a solid nucleus. There are comets which have orbits lasting even thousands of years. There were many comets which were seen in the solar system, and it is expected that they will never be seen again. They have long tails that are multiple times bigger than their nucleus. Sun rays and solar winds affect their tail, and their overall behaviour

and movement are controlled by the sun's gravity and the neighbouring planets. They are considered pieces which initially collided with the earth and brought water, organic substances, and other life-related substances. Humans were affected by the comets in the past as well as in the present. The appearance of comets was terrible for some people.

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