

Survey on Application of Physics' Laws in Space Studies

Kavya Gupta

B. Tech Student, Department of Electronics and Communication Engineering, ABES Engineering College,
Ghaziabad, India

ABSTRACT: Everything in this universe is bound to follow the laws of physics. There is nothing that happens in this world without a scientific reason behind it. It is same for celestial activities too. The movement of celestial bodies, their behavior towards any change, everything can be related to the already laid out laws and ideologies by our scientists. The recent advancements that give rise to technology incorporating inventions like satellites, rockets, spacecrafts or execution of any mission to space, everything obeys the principle laws.

KEYWORDS: celestial, elliptical, laws, force, flight

I. INTRODUCTION

Space and the outer world has always been a peculiar subject of research and study for everyone. Do the basic laws of physics, particularly, the laws of motion which apply to the entire world, apply to the celestial bodies too? It is important to understand that the way celestial bodies travel in space is based on the principles laid down by classical physics. Newton, Galileo, Kepler, Einstein give us a major insight into the celestial movements. The laws given by Kepler on planetary motion were proved by Newton using his laws of motion. The prolonged misconception that everything on earth has to come down without the existence of any force and that everything in space is bound to travel in a straight path was clarified by Newton. Ideologies of Newton incorporated some major theories. First, the existence of space is entirely independent of all other bodies. Second, the matter is responsible for the motion of any body. Third, the actual motion of any arbitrary body can never be explained on the basis of its' relative motion with other bodies.

II. SURVEY AND DISCUSSION

Going into a clearer view

Newton's first law of motion states that an object at rest stays at rest and an object in **motion** stays in **motion** with the same speed and in the same direction unless acted upon by an unbalanced force. It is popularly known as the **Law of Inertia**. This law can be related to the movement of planets in elliptical orbits. For planets to be traveling continuously in elliptical orbits, there has to be some force that helps it travel that way. It would have traveled in a straight path if there was no force holding it to travel in orbits. This law gives an insight that there exists some force that makes the planet stay in motion. This is what gave rise to **the centripetal force**. Centripetal deflection is the reason for the circular motion of planets around the sun. He gave the practical application of **Kepler's second law**. It states that a line between the sun and the planet sweeps equal areas in equal times. With this, we come to know that a body moving in an elliptical path with one focus at center is drawn by some force that varies as the inverse square of the distance. According to this law of inertia, an object will continue to move in a straight path unless an external force is acting upon it. But, the fact that celestial objects travel in the elliptical path made him think about gravitation. **Newton's universal law of gravitation** states that the force acting upon an object toward Earth should be inversely proportional to the square of its distance from the center of Earth. It is because of this **gravitational force** that the planets revolve around the sun and the moon revolves around the earth. With this, we conclude that for the revolving planets in fixed orbits, the gravitational force acts as centripetal force.



$$F = G [M*m / (r^2)]$$

G: universal gravitational constant

M,m: two arbitrary masses

r: the distance between the two masses m and M

III. RELATING TO PRACTICALITY

Now, how can comets just enter the solar system and leave on their own even after the presence of such high gravitational force? Newton in his times proposed that **under a sufficient amount of energy**, the objects under the gravitational pull may follow any path ranging from parabolic to hyperbolic or any arbitrary motion. They need not always follow the elliptical path unlike the idea behind Kepler's first law. This idea can be well proved by the absurd movement of comets. Comet is a collection of material that was leftover during the formation of the solar system. These comets are seen to travel in space and they even land on earth absurdly even after they are under constant gravitational force. It is because of the following reasons. First, the comets are very small as compared to other celestial bodies. Second, when their inner energy changes i.e. when the gases inside these comets expand under the action of sun, they shoot through the solar systems and appear to us as shining stars in the sky. Their flight is arbitrary. This **fact of flight of comets goes well in sync with the proposed ideology of Newton.**

Now, we know from **Newton's Third law** that every action has an equal and opposite reaction. This law gives us an insight on rocket propulsion. Rockets leave their launch pads when the enormous amount of gas inside it, leaves the rocket. The thrust produced by the rocket must be greater than the weight of the rocket in order to move it out from the launch pad. Here, the action is the expulsion of gas out of the rocket and the rocket leaving the launchpad acts as the reaction to the produced action. The fact that the rocket can travel even in the absence of atmosphere i.e. in space (no air for the rocket to push against) can be explained on the basis of the known ideology that **air plays a role of adding friction to the motion.** Here, at earth's surface, the atmospheric air plays the role of impeding the action. The gas expelled out of the rocket has to push away the air of the atmosphere in order to fly high. But, in space, the exhaust gas need not experience any friction of atmospheric air and flight of the rocket is better. Also, the comparatively fast propelling of rockets into space can be explained on the basis of **Newton's second law.** It states that the acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object.

$$F = ma$$

F: force on the object

m: the mass of the object

a: acceleration on an object

This relation can be used to describe the faster flight of rockets in space. The propellants of the rocket contribute towards the quantity of mass of the rocket. As the propellants burn during the course of a flight, the mass of the rocket decreases. This increases the acceleration of the rocket to keep the equation balanced. This is why as the flight increases its distance, there is a gradual increase in its speed too.

IV. THEORETICAL OUTLOOK

Newton proposed several ideologies to critique the vortex theory proposed by Descartes. He proposed that all the planets are at rest with respect to a matter of celestial vortex of the sun. This clearly meant that planets had no motion. But, Newton critiqued it by saying that no object can ever be at rest. Even if we are standing at a place without any motion, we won't be said to be at rest due to the continuous movement of the earth (where we reside). Similarly, for planets, they can't ever be at rest. It is because every other body remains in some motion with respect to other bodies.



V. CONCLUSION

Everything that happens in the universe has a logical and scientific approach to it. Even the celestial actions are based on some very important principles of physics. The advancements brought about in research and study, all lie behind some basic conceptual understanding of ideologies and laws of physics.

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