A PRECISE STUDY OF GRAVITATIONL FORCE

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Abstract: The various planets are orbiting around sun just because of the gravitational force of sun. The force of gravitational is that attracts any two objects with mass. The gravitational force is attractive because it always tries to pull masses together, it never pushes them apart.
The gravitational phenomenon as described by Einstein is radically different from the image painted by the Newton's universal law of gravitation since it is the consequence of geometric space-time distortions.

Keywords: Gravity, Law, Phenomenon, Image, Geometric, Universe, Distance, Force, Quantum, Relativity.

There are so many existing forces in the universe, myriad pushes and pulls. We're always pushing or pulling something, even if we are not in the motion only on the ground. But in the terms of physics, there are really only four fundamental forces which are the reasons for the origin of everything else: the strong force, the weak force, the electromagnetic force, and the gravitational force. The force of gravitational is that attracts any two objects with mass. The gravitational force is attractive because it always tries to pull masses together, it never pushes them apart. In fact, every object, including you, is pulling on every other object in the entire universe! This is the crux of Newton's Universal Law of Gravitation. Undoubtedly, you need to have a very large mass and so, you're not pulling on those other objects much. And objects that are really far apart from each other don't pull on each other noticeably either. But the force remains always there and it can be calculated.

This equation describes the force between any two objects in the universe:

In the equation:

F is the force of gravity (measured in Newtons, N)

G is the gravitational constant of the universe and is always the same number

M is the mass of one object (measured in kilograms, kg)

m is the mass of the other object (measured in kilograms, kg)

r is the distance those objects are apart (measured in meters, m)

So if you know about the massiveness of two objects and the distance of them from each other, the force between them is easily calculated.

Inverse Square Law

It is to notice that the distance (r) on the bottom of the equation is squared. This makes it an inverse square law. Because of this, if you doubles the distance between two objects, you reduce the gravitational force between them to a quarter of what it was. If you triple the distance between them, you reduce the force to a ninth of what it was. If we go the other way, halving the distance between two objects multiplies the force by a factor of four. This can be used to make rough comparisons between situations. This force moves between any two objects. It is known as the universal force, every object in the universe experience this force due to other object. For example when a stone to be thrown upwards from earth it do falls down to the earth owing to the gravitational force of earth. In the same manner moon is orbiting around earth owing to the gravitational force of the earth. The various planets are orbiting around sun just because of the gravitational force of sun. As per the Newton's law of gravitation, the gravitational force is directly proportional to product of the two masses and inversely proportional to square of the distance between them. The gravitational force is directly proportional to product of the two masses and inversely proportional to square of the

Where,

F= Gravitational force between two objects
m1 = Mass of object 1
m2 = Mass of object 2
d = Distance separating the objects centers
G = gravitational constant

This gravitational force was discovered by Sir Isaac Newton in 1687. Gravitational force is the weakest force among the four fundamental forces of nature. Einstein's general relativity [I] is widely considered as the standard theory of gravity, at least at the classical level. It is because of the theory has an elegant and well understood structure and it is in good accordance with all the standard experimental tests of gravity till now. However, gravitation tests are conducted till date only probe mainly p to the first order (post-Newtonian) effects of the theory. Since the most exciting predictions of the theory, such as existence of black hole etc., are strong field, it is very essential to examine and test the higher order effects of the theory. General relativity's some features are not even without difficulties. Particularly a major problem of the theory is the occurrence of unavoidable space-time singularities. It is generally suspected that the classical description, provided by the general relativity, breaks down in a domain where the curvature is large. Hence, the question of quantization of gravity arises. But sustained failure of reconciling general relativity with quantum mechanics indicates that the general relativity may need some modifications. Several alternative theories to general relativity have been proposed which are modifications of general relativity in the sense that they have the same post-Newtonian limit as general relativity while are different theories in other regimes. Among them Scalar-tensor theories of gravity, in which. Gravity is mediated by one or several long range scalar fields together with the usual tensor field, are considered as best motivated class of viable non-Einsteinian theories of gravity till date. They arise naturally as the low energy limit in several modern theoretical attempts to quantizing gravity, such as the Superstring theory or the Kaluza-Klein theory. Since all viable alternative theories coincide with general relativity in the post Newtonian limit, it is important to study higher order effects in which general relativity may give different predictions than those of alternative theories. At present technology has advanced to the point that the present on board gravitational experiments or near future experiments are expected to improve the accuracy of the measurement by at least two orders. For instance the Stanford Gyroscope experiment (the Gravity Probe-B mission) is expected to measure the post-Newtonian' parameter y with accuracy of 5 x 1 o·5 against the current limit of accuracy 3 x 10·3 whereas the Laser Astrometric Test of Relativity mission is expected to test relativistic gravity at the accuracy better than second order in gravitational field strength. Thus there is genuine possibility of measuring small deviations from the predictions of general relativity. Different authors obtained few theoretical predictions of gravitational theories with accuracy up to second order (or even higher accuracy) in gravitational strength during the last two decades. For instances bending of light and radar echo delay in standard and scalar tensor theories have been estimated with such accuracies. Considering the recent progress in experimental front it is now important to explore other second and higher order physical effects those can be used to test Einstein theory at higher order level and also to discriminate it from the alternative theories.

General Theory of Relativity given by Newton is widely recognized as the standard theory of gravitation. The gravitational phenomenon as described by Einstein is radically different from the image painted by the Newton's universal law of gravitation since it is the consequence of geometric ·space-time distortions. General Relativity and gravitational theory of Newton, however, make essentially identical predictions as long as the strength of the gravitational field is weak. Nonetheless there are few crucial weak field predictions where the two theories diverge and thus can be tested with careful experiments. Einstein himself proposed three tests precession of the perihelion, gravitational bending of light and gravitational red shift. However, now it has been clear that the gravitational red shift is a test of the Einstein equivalence principle (or more correctly as a test of local position in variance principle) rather than that of general relativity. On the other hand Shapiro in the year 1964 proposed another crucial observational test of general relativity through measurement of relativistic time delay that was confirmed experimentally Jater.

Gravity is the word taken (from Latin gravitas, meaning 'weight'), or gravitation, is a natural phenomenon by which all things with mass or energy—including planets, stars, galaxies, and even light are brought toward (or gravitate toward) one another. On Earth, gravity gives weight to physical objects, and the Moon's gravity causes the ocean tides. The gravitational attraction of the original gaseous matter present in the Universe caused it to begin coalescing, forming stars and for the stars to group together into galaxies, so gravity is responsible for many of the large-scale structures in the Universe. Gravity has an infinite range, although its effects become increasingly weaker on farther objects. Gravity is most accurately described by the general theory of relativity (proposed by Albert Einstein in 1915) which describes gravity not as a force, but as a consequence of the curvature of space time caused by the uneven distribution of mass. The most extreme example of this curvature of space time is a black hole, from which nothing, not even light can escape once past the black hole's event horizon. However, for most applications, gravity is well approximated by Newton's law of universal gravitation, which describes gravity as a force which causes any two bodies to be attracted to each other, with the force proportional to the product of their masses and inversely proportional to the square of the distance between them. In physics, a gravitational field is a model used to explain the influence that a massive body extends into the space around itself, producing a force on another massive body. Thus, a gravitational field is used to explain gravitational phenomena, and is measured in Newton's per kilogram (N/kg). In its original concept, gravity was a force between point masses. Following Isaac Newton, Pierre-Simon Laplace attempted to model gravity as some kind of radiation field or fluid, and since the 19th century explanations for gravity have usually been taught in terms of a field model, rather than a point attraction. In a field model, rather than two particles attracting each other, the particles distort space time via their mass, and this distortion is what is perceived and measured as a "force". In such a model one states that matter moves in certain ways in response to the curvature of space time, and that there is either no gravitational force, or that gravity is a fictitious force. Gravity is the weakest of the four fundamental interactions of physics, approximately 1038 times weaker than the strong interaction, 1036 times weaker than the electromagnetic force and 1029 times weaker than the weak interaction. As a consequence, it has no significant influence at the level of subatomic particles. In contrast, it is the dominant interaction at the macroscopic scale, and is the cause of the formation, shape and trajectory (orbit) of astronomical bodies. The earliest instance of gravity in the Universe, possibly in the form of quantum gravity, supergravity or a gravitational singularity, along with ordinary space and time, developed during the Planck epoch (up to 10−43 seconds after the birth of the Universe), possibly from a primeval state, such as a false vacuum, quantum vacuum or virtual particle, in a currently unknown manner. Attempts to develop a theory of gravity consistent with quantum mechanics, a quantum gravity theory, which would allow gravity to be united in a common mathematical framework (a theory of everything) with the other three fundamental interactions of physics, are a current area of research. The ancient Greek philosopher Archimedes discovered the center of gravity of a triangle. He also postulated that if two equal weights did not have the same center of gravity, the center of gravity of the two weights together would be in the middle of the line that joins their centers of gravity. The Roman architect and engineer Vitruvius in De Architectura postulated that gravity of an object didn't depend on weight but its "nature". In ancient India, Aryabhata first identified the force to explain why objects are not thrown out when the earth rotates. Brahmagupta described gravity as an attractive force and used the term "gurutvaakarshan" for gravity. Modern work on gravitational theory began with the work of Galileo Galilei in the late 16th and early 17th centuries. In his famous experiment dropping balls from the Tower of Pisa, and later with careful measurements of balls rolling down inclines, Galileo showed that gravitational acceleration is the same for all objects. This was a major departure from Aristotle's belief that heavier objects have a higher gravitational acceleration. Galileo postulated air resistance as the reason that objects with less mass fall more slowly in an atmosphere. Galileo's work set the stage for the formulation of Newton's theory of gravity. In 1687, English mathematician Sir Isaac Newton published Principia, which hypothesizes the inverse-square law of universal gravitation. In his own words, "I deduced that the forces which keep the planets in their orbs must be reciprocally as the squares of their distances from the centers about which they revolve: and thereby compared the force requisite to keep the Moon in her Orb with the force of gravity at the surface of the Earth; and found them answer pretty nearly." The equation is the following:

{\displaystyle F=G{\frac {m_{1}m_{2}}{r^{2}}}\ }F=G{\frac {m_{1}m_{2}}{r^{2}}}\

Where F is the force, m1 and m2 are the masses of the objects interacting, r is the distance between the centers of the masses and G is the gravitational constant. Newton's theory enjoyed its greatest success when it was used to predict the existence of Neptune based on motions of Uranus that could not be accounted for by the actions of the other planets. Calculations by both John Couch Adams and Urbain Le Verrier predicted the general position of the planet, and Le Verrier’s calculations are what led Johann Gottfried Galle to the discovery of Neptune. A discrepancy in Mercury's orbit pointed out flaws in Newton's theory. By the end of the 19th century, it was known that its orbit showed slight perturbations that could not be accounted for entirely under Newton’s theory, but all searches for another perturbing body (such as a planet orbiting the Sun even closer than Mercury) had been fruitless. The issue was resolved in 1915 by Albert Einstein’s new theory of general relativity, which accounted for the small discrepancy in Mercury’s orbit. This discrepancy was the advance in the perihelion of Mercury of 42.98 seconds per century. Although Newton's theory has been superseded by Einstein's general relativity, most modern non-relativistic gravitational calculations are still made using Newton's theory because it is simpler to work with and it gives sufficiently accurate results for most applications involving sufficiently small masses, speeds and energies. In the decades after the publication of the theory of general relativity, it was realized that general relativity is incompatible with quantum mechanics. It is possible to describe gravity in the framework of quantum field theory like the other fundamental interactions, such that the “attractive force” of gravity arises due to exchange of virtual gravitons, in the same way as the electromagnetic force arises from exchange of virtual photons. This reproduces general relativity in the classical limit. However, this approach fails at short distances of the order of the Planck length, where a more complete theory of quantum gravity (or a new approach to quantum mechanics) is required.

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