ISSN: 3067-0144

Iris Journal of Astronomy and Satellite Communications

DOI: 10.33552/IJASC.2026.02.000528

Iris Publishers

Research Article

Universal Constants and Modified Gravitational Equations of Celestial Objects

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Received Date: January 06, 2026

Published Date: January 20, 2026

Abstract

We present new equations of celestial objects (new equation of gravitational force, constant connecting area, acceleration and mass of any celestial object and another constant connecting number of stars and circumference of any galaxy) with new concepts and results identical with known determined calculations. Celestial objects are specific masses with specific diameters at specific distances with two motions with specific velocities and bound together by gravitational force. The main equations of celestial objects are controlled by these physical parameters (mass, diameter, distance, force, velocity). The distribution of celestial objects in the universe is uniform in terms of their masses and areas. Calculations confirmed that the mass, area and acceleration of all objects of the solar system and many stars give constant value. This result leads to conclude that all celestial objects have the same constant confirming that the content of the universe is homogeneous and isotropic. The new equation of gravitational force can be determined by three main physical parameters (mass, distance, velocity). The new equations of calculating masses, distances, rotational and orbital velocities of celestial objects can be deduced from the new equation of gravitational force with results identical with known determined values.

Keywords: Mass; area; acceleration; constant; stars; galaxies; gravity

Introduction

According to the cosmological principle and all models that use the Friedman-Lamaitre-Robertson-Walker metric (FLRW), including the current version of the Lambda Cold Dark Matter (ΛCDM) model, the distribution of matter in the universe is homogeneous and isotropic [1,2]. This means that the universe is the same in all locations and all directions respectively. The universe consists of mass and energy in the form of objects and systems (Planets, Stars, galaxies). The force of gravity is a fundamental interaction that causes mutual attraction between all objects with mass and energy and determines the motion of planets, stars and galaxies. Therefore, any object with mass exerts a gravitational force on all other objects with mass [3]. According to Newton's law of universal gravitation, the attractive force between two masses is directly proportional to the product of their masses and inversely proportional to the square of the distance along their centre of masses [4-9].

$$F = G\frac{m_1 m_2}{r^2} \qquad (1)$$

Newton suggests the existence of gravitational constant G but its value is determined by Henry Cavendish in 1798 and subsequent works [10-12] to be $6.674\times10^{-11} m^3 kg^{-1} s^{-2}$. Gravitational

acceleration is the acceleration of an object in free fall within a vacuum represents constant gain in velocity caused by the force of gravitational attraction and the centrifugal force from the rotation of the celestial object. Gravitational acceleration is represented by symbol g and its unit is m/s^2. Gravitational acceleration is a vector quantity. This means it has both magnitude and direction. Galaxies consist of stars, planets and vast clouds of gas and dust bound together by gravitational force. Large galaxies contain trillions of stars with diameters more than million light years, while small galaxies contain a few thousand stars with diameters of a few hundred light years. Galaxies have different shapes spiral, elliptical and irregular galaxies.

Physical Foundations

The homogeneity and isotropy of the universe indicate that all its contents and systems from smallest (nuclei & atoms & molecules) to the largest (stars & galaxies) are balanced in terms of their masses and areas with certain constant [13]. The Physical relations and laws can be expressed in terms of the main physical parameters responsible for their origin. The physical parameters (mass & area & acceleration) for (moons & planets & stars) give the same value which represent constant for all celestial bodies. The gravitational force between celestial bodies is essential for maintaining them in their orbits. Creation of gravitational force between any two celestial bodies leads to two motions for both of them (rotational motion & orbital motion). Gravitational force depends on three main physical parameters (mass of celestial objects & distance between them & rotational and orbital velocity). Specific distances between celestial objects (planets, stars) with particular distribution producing large specific systems (galaxies) with specific constant of all galaxies.

Mathematical Foundations

Constant of Celestial Objects (Moons, Planets, Stars)

As a result of the homogeneity and isotropy of the universe, the area of any celestial object and its acceleration is proportional to its mass.

$$a \times g \propto m \qquad (2)$$

$$a \times g = cons \times m \qquad (3)$$

$$4\pi \times r^2 \times g = cons \times m \qquad (4)$$

$$cons = \frac{4\pi \times r^2 \times g}{m} m^3 kg^{-1} s^{-2} \qquad (5)$$

$$m = \frac{4\pi \times r^2 \times g}{cons} \qquad (6)$$

$$g = \frac{m \times cons}{4\pi \times r^2} \qquad (7)$$

where:

a is the area of any celestial object

m is the mass of any celestial object

cons is the constant value for any celestial object

r is the radius of any celestial object

g is the acceleration of any celestial object

Confirming Constant of Celestial Objects ((Moons, Planets, Stars)

By using equation (5), the calculations confirmed that there is constant value for celestial objects (Moons, Planets, Stars) relating their area, acceleration and mass as indicated in Table 1.

Table 1 shows that all bodies of the solar system and another 22 stars have the same constant value ($8.5 \times 10^{-10} m^3 kg^{-1} s^{-2}$). This leads to conclude that all celestial objects have the same constant value relating the area, acceleration and mass of any celestial object.

Acceleration of Celestial Objects

Calculations confirmed that the gravitational acceleration of the solar system objects is identical with known determined values as indicated in Table 2 by using equation (7).

Table 1: lists the constant of 22 stars, planets and moons of the solar system.

Stars	Planets	Moons of planets of the solar system	Constant ($m^3 kg^{-1} s^{-2}$)
Sun	Mercury	IO (Jupiter I)	8.5×10^{-10}
Proxima Centauri	Venus	Europa (Jupiter II)	8.5×10^{-10}
Sirius	Earth	Ganymede (Jupiter III)	8.5×10^{-10}
Epsilon Eridani	Mars	Callisto (Jupiter IV)	8.5×10^{-10}
Tau Ceti	Jupiter	Phobos (Mars I)	8.5×10^{-10}
HR 7703 A	Saturn	Deimos (Mars II)	8.5×10^{-10}
GL Virginis	Uranus	Titan	8.5×10^{-10}

Beta Hydri	Neptune	Titania (Uranus III)	8.5×10^{-10}
Gliese 514	Pluto	Oberon (Uranus IV)	8.5×10^{-10}
Mu Cassiopeiae Aa		Ariel	8.5×10^{-10}
61 Virginis		Umbriel	8.5×10^{-10}
Alpha Mensae			8.5×10^{-10}
Iota Persi			8.5×10^{-10}
HIP 57050			8.5×10^{-10}
Gamma Serpentis			8.5×10^{-10}
Eta Boötis			8.5×10^{-10}
HD 125072			8.5×10^{-10}
TRAPPIST-1			8.5×10^{-10}
V538 Aurigae			8.5×10^{-10}
Barnard's Star			8.5×10^{-10}
YZ Ceti			8.5×10^{-10}
Sigma Draconis			8.5×10^{-10}

Table 2: lists the values of gravitational acceleration of the objects of solar system.

Object	Acceleration (m/s^2)
Sun	274
Mercury	3.7
Venus	8.8
Earth	9.8
Moon	1.6
Mars	3.7
Jupiter	25.9
Saturn	11.19
Uranus	9
Neptune	11.2
Pluto	0.62

Constant of Galaxies

Approximating galaxies to spherical shapes and as a result of the homogeneity and isotropy of the universe, the square root of the number of stars of any galaxy is proportional to its circumference.

$$\sqrt{n} \propto 2\times\pi\times r \qquad (8)$$

$$\sqrt{n} = cons\times 2\times\pi\times r \qquad (9)$$

$$cons = \frac{\sqrt{n}}{2\times\pi\times r} m^{-1} \qquad (10)$$

where n is the number of stars of any galaxy

cons is the constant value for any galaxy

r is the radius of any galaxy

Confirming Constant of Galaxies

By using equation (10), the calculations confirmed that there is constant value ($1.7\times10^{-16}m^{-1}$) for many galaxies relating their number of stars and circumference as indicated in Table 3. This leads to conclude that all galaxies have the same constant value.

Gravitational Force of Celestial Objects

Any two celestial bodies or systems at specific distances leads to the creation of gravitational force between them with two motions for both of them (rotational motion & orbital motion). Gravitational force depends on three main physical parameters (mass of celestial objects & distance between them & rotational and orbital velocity). The new equation of gravitational force between two celestial objects or two galaxies with masses and at specific distance d with specific rotational velocities ($v_{r1}+v_{r2}$) and specific orbital velocities ($v_{o1}+v_{o2}$) can be determined by the following equations [14,15].

$$F=\frac{m\times v_{rot}\times v_{orb}}{d} \qquad (11)$$

$$F=\frac{(m_1+m_2)\times(v_{r1}+v_{r2})\times(v_{o1}+v_{o2})}{d} \qquad (12)$$

where:

m is the sum of two masses of celestial objects or galaxies m_1+m_2

v_{rot} is the sum of two rotational velocities $v_{r1}+v_{r2}$

v_{orb} is the sum of two orbital velocities $v_{o1}+v_{o2}$

m_1 is the mass of the first celestial object or first galaxy

m_2 is the mass of the second celestial object or second galaxy

v_{r1} is the rotational velocity of the first celestial object or first galaxy

v_{r2} is the rotational velocity of the second celestial object or second galaxy

v_{o1} is the orbital velocity of the first celestial object or first galaxy

v_{o2} is the orbital velocity of the second celestial object or second galaxy

d is the distance between two celestial objects or two galaxies

Mass, Distance, Rotational and Orbital Velocity of Celestial Objects

The mass, distance, rotational and orbital velocities of any two celestial objects can be determined by the following equations as deduced from equation (12).

$$m_1=\frac{F\times d}{(v_{r1}+v_{r2})\times(v_{o1}+v_{o2})}-m_2 \qquad (13)$$

$$m_2=\frac{F\times d}{(v_{r1}+v_{r2})\times(v_{o1}+v_{o2})}-m_1 \qquad (14)$$

$$d=\frac{(m_1+m_2)\times(v_{r1}+v_{r2})\times(v_{o1}+v_{o2})}{F} \qquad (15)$$

$$v_{r1}=\frac{F\times d}{(m_1+m_2)\times(v_{o1}+v_{o2})}-v_{r2} \qquad (16)$$

$$v_{r2}=\frac{F\times d}{(m_1+m_2)\times(v_{o1}+v_{o2})}-v_{r1} \qquad (17)$$

$$v_{o1}=\frac{F\times d}{(m_1+m_2)\times(v_{r1}+v_{r2})}-v_{o2} \qquad (18)$$

$$v_{o2}=\frac{F\times d}{(m_1+m_2)\times(v_{r1}+v_{r2})}-v_{o1} \qquad (19)$$

Calculations confirmed that the value of mass, distance, rotational velocity and orbital velocity of any object of the solar system by using equations (13-19) is identical with known determined values as indicated in Table 4.

Table 3: lists the physical parameters of 12 galaxies and their constant.

Galaxy	Number of Stars	Radius ly	Radius meter	Constant m^{-1}
Milky Way	2.5×10^{11}	5×10^{4}	4.7×10^{20}	1.7×10^{-16}
Andromeda	1×10^{12}	1×10^{5}	9.5×10^{20}	1.7×10^{-16}
Messier 101	9×10^{11}	92×10^{3}	8.7×10^{20}	1.7×10^{-16}
UGC 2885	2.1×10^{12}	14×10^{4}	1.3×10^{21}	1.7×10^{-16}
Large Magellanic Cloud	22×10^{9}	15×10^{3}	1.4×10^{20}	1.7×10^{-16}
Small Magellanic Cloud	4×10^{9}	6500	6.1×10^{19}	1.7×10^{-16}

Messier 33	6×10^{10}	24×10^{3}	2.3×10^{20}	1.7×10^{-16}
NGC 5128	7.5×10^{10}	28×10^{3}	2.6×10^{20}	1.7×10^{-16}
Messier 81	2.4×10^{11}	48×10^{3}	4.5×10^{20}	1.7×10^{-16}
Sculptor	3.2×10^{11}	57×10^{3}	5.4×10^{20}	1.7×10^{-16}
Messier 51a	1.5×10^{11}	38×10^{3}	3.6×10^{20}	1.7×10^{-16}
Messier 77	2.1×10^{11}	44×10^{3}	4.2×10^{20}	1.7×10^{-16}

Table 4: lists the values of mass, rotational and orbital velocity of the objects of the solar system.

Object	mass (kg)	distance from Sun (m)	rotational velocity (m/s)	orbital velocity m/s
Sun	1.9×10^{30}		2000	225000
Mercury	3.2×10^{23}	58×10^{9}	3	48000
Venus	4.8×10^{24}	109×10^{9}	1.8	35000
Earth	5.9×10^{24}	150×10^{9}	263	30000
Moon	7.3×10^{22}	150×10^{9}	4.5	1000
Mars	6.4×10^{23}	228×10^{9}	241	24000
Jupiter	1.8×10^{27}	779×10^{9}	12600	13000
Saturn	5.6×10^{26}	1434×10^{9}	9860	9000
Uranus	8.6×10^{25}	2873×10^{9}	2580	6900
Neptune	1.02×10^{26}	4495×10^{9}	2670	5000
Pluto	1.3×10^{22}	5995×10^{9}	13	4000

Results and Discussions

The universe consists of two main physical parameters energy and mass. Constant of energy for all electromagnetic radiation from gamma rays to radio waves connecting energy and frequency of all photons is confirmed by the measurements of Planck which is known as Planck's constant [16,17]. For mass, the distribution of celestial objects in the universe is uniform in terms of their masses and areas. Calculations for all objects of the solar system and twenty – two stars confirmed that the mass, area and gravitational acceleration give constant value ($8.5\times10^{-10}\,m^{3}kg^{-1}s^{-2}$). As a result of the homogeneity and isotropy of the universe, the distribution of galaxies in the universe is uniform for the number of stars of any galaxy and its circumference. By using equation (10), the calculations for twelve galaxies confirmed that the square root of the number of stars of any galaxy is proportional to its circumference with constant value ($1.7\times10^{-16}\,m^{-1}$).The gravitational acceleration of celestial object as free fall to the surface of the object depends on its mass and varies from object to another. Gravitational acceleration is the constant gain in velocity caused by the force of gravitational attraction and the centrifugal force from the rotation of the body. By using equation (7) we found that the gravitational accelerations of all objects of the solar system are identical with known calculated values as indicated in Table 2. According to the above values and results the gravitational acceleration of celestial object depends on the mass of the object, constant value of any celestial object ($8.5\times10^{-10}\,m^{3}kg^{-1}s^{-2}$) and its area.

Particular celestial objects as specific masses at specific distance leading to the formation of gravitational force which in turn leads to their two motions with specific rotational and orbital velocities. Gravitational force between the (Sun & Earth), (Earth & Moon) and (Earth & Venus) by using equation (12) are to be (F = $8.7\times10^{27}\,kg.m.s^{-2}$), (F = $2.85\times10^{23}\,kg.m.s^{-2}$) and (F =

$8.03\times10^{21}\,kg.m.s^{-2}$) respectively. According to the above values the gravitational force between celestial objects depends on the masses of two objects, two rotational velocities, two orbital velocities and the distance between them. Gravitational force between Earth and Moon is greater than the gravitational force between Earth and Venus because the distance between Earth and Moon is much smaller than the distance between Earth and Venus. Calculated value of mass, distance, rotational velocity and orbital velocity of any object of the solar system by using equations (13-19) is identical with known determined values.

Conclusions

As a result of the homogeneity and isotropy of the universe, the mass, area and acceleration of any celestial object (moon, planet, star) give constant value. The number of stars of any galaxy and its circumference gives another constant value. Constant of stars is greater than the constant of galaxies. Gravitational acceleration of celestial object depends on its mass, its area and constant value. Gravitational force between any two celestial objects is produced at specific distance and leads to both rotational and orbital velocity of celestial objects and expressed in terms of the physical parameters responsible for its formation (their masses, distance between them in addition to rotational and orbital velocities). New equations of calculating masses, distances, rotational and orbital velocities of celestial objects can be deduced from the latest form of gravitational force. Calculations confirmed that the results of new equations for all objects of the solar system are identical with all known determined calculations.

Conflicts of Interest

The author declares no conflict of interest.

Acknowledgment

The author would like to express his sincere appreciation and deepest gratitude to anonymous reviewers and all the staff of the Iris Journal of Astronomy and Satellite Communications whose insightful comments, contribution and support have greatly enhanced the quality, accuracy and publication of this research.

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