



Impact of the Gravitational Attractive Force (GAF) and the Buoyancy Force of the Gravitational Field

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ABSTRACT

In this study, we explore the interaction between two hypothesized fundamental forces in nature: the traditional Gravitational Attractive Force (GAF), as described by Newtonian mechanics, and a proposed Buoyancy Force of the Gravitational Field (BFGF). We suggest that the balance between these two forces governs various phenomena, including orbital motion, rotational dynamics, free-fall trajectories, and even evaporation processes. Using orbital velocity data of planets and their natural satellites, we propose a revised technique to reassess the masses of the Sun and planets. Our analysis suggests that these celestial bodies may possess significantly larger masses than previously estimated. Additionally, we argue that the interplay between GAF and BFGF could provide an alternative interpretation of redshift phenomena and support a steady-state model of the universe. The proposed model also links tidal forces to life processes on Earth, highlighting a novel perspective on planetary evolution and biological cycles. While this framework presents intriguing possibilities, further theoretical and observational validation is essential to confirm these ideas.

Keywords: gravitational attractive force; gravitational buoyancy; orbital dynamics; planetary mass reassessment; steady-state cosmology

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INTRODUCTION

In nature, two fundamental forces influence the motion and behavior of matter within a gravitational field: 1. Gravitational Attractive Force (GAF), as described by Newtonian mechanics. 2-Buoyancy Force in the Gravitational Field

(BFGF), as proposed in this study. These two forces collectively impact a wide range of phenomena, including orbital motion, rotational dynamics, free-fall trajectories, and evaporation processes. The tidal power due to the rotational motion of the Earth is the key cause of the life cycle on Earth.

Recognizing and integrating the buoyancy effect into gravitational models provides an innovative approach to understanding celestial mechanics and may lead to significant theoretical advancements. I reveal the mass of the sun and the earth are heavier than previously estimated (Palchoudhury, 2025).

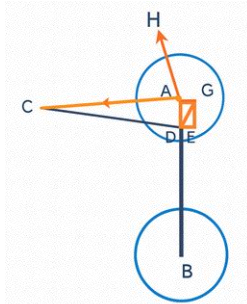


Figure 1: Orbital motion of two celestial bodies, A and B. Body B is more massive than body A. yet the gravitational force between them is mutual.

I like to repeat the text below with the diagram, collected from the article titled ‘Is the mass of the celestial bodies, the Sun and the Earth, heavier than previously estimated?’

(Palchoudhury, 2025) with some additional data for improvement. Presently, I discuss the activity of the Sun and almost all planets with many more natural satellites.

Diagram illustrating orbital motion between two celestial bodies, A and B. Here B is more massive while body A orbits it under the influence of gravitational attraction and a resultant force vector AC. The $\angle CAD = \theta$ determines orbital stability. However, as observed in nature, such as the Moon orbiting the Earth, smaller bodies tend to revolve around larger ones. The angle $\angle CAD$, denoted as θ , represents the trajectory-related parameter that influences the stability of the orbit. If θ exceeds 90° , the smaller body may escape the gravitational domain of the larger body.

Conversely, if θ is significantly less than 90° , the smaller body may fall towards the larger one. The resultant force vector is labeled as AC, while the component AD corresponds to the gravitational attraction. Comparative analysis using orbital parameters and data shown in Table 1 and Table 2 suggests that both the planets and the Sun may possess greater actual mass than currently estimated. This discrepancy prompts further investigation into the forces involved in orbital motion, potentially including additional effects not accounted for in classical Newtonian mechanics.

Table 1. Orbital parameters of planets and natural satellites with reassessed planetary masses

Planet	Satellite	Previous Mass (kg)	Position	Distance (d) (m)	Velocity (v) (m/s)	θ (deg)	$\cos \theta$	New Mass (kg)
Earth	Moon	5.97×10^{24}	Apogee	4.07×10^8	990.20	88.34	0.0289	7.10×10^{28}
Earth	Moon	5.97×10^{24}	Perigee	3.59×10^8	1053.92	88.00	0.0349	7.10×10^{28}
Mars	Phobos	6.43×10^{23}	Apogee	9.52×10^6	2123.02	88.00	0.0349	1.01×10^{26}
Mars	Phobos	6.43×10^{23}	Perigee	9.23×10^6	1351.92	88.00	0.0349	9.61×10^{25}
Mars	Deimos	6.43×10^{23}	Apogee	2.35×10^7	1352.36	88.00	0.0349	3.89×10^{26}
Mars	Deimos	6.43×10^{23}	Perigee	2.35×10^7	1352.37	88.00	0.0349	3.89×10^{26}
Jupiter	Ganymede	1.90×10^{27}	Apogee	1.07×10^9	10880.21	88.00	0.0349	6.52×10^{30}
Jupiter	Ganymede	1.90×10^{27}	Perigee	1.07×10^9	10886.32	88.00	0.0349	6.51×10^{30}
Jupiter	Io	1.90×10^{27}	Apogee	4.23×10^8	17299.56	88.00	0.0349	1.62×10^{30}
Jupiter	Io	1.90×10^{27}	Perigee	4.20×10^8	17369.44	88.00	0.0349	1.60×10^{30}
Saturn	Titan	5.68×10^{26}	Apogee	1.26×10^9	5493.82	88.00	0.0349	4.54×10^{30}
Saturn	Titan	5.68×10^{26}	Perigee	1.19×10^9	5654.39	88.00	0.0349	4.16×10^{30}
Saturn	Enceladus	5.68×10^{26}	Apogee	2.39×10^8	12595.41	88.00	0.0349	3.77×10^{29}
Saturn	Enceladus	5.68×10^{26}	Perigee	2.37×10^8	12654.76	88.00	0.0349	3.71×10^{29}
Uranus	Titania	8.68×10^{25}	Apogee	1.26×10^9	2147.00	88.00	0.0349	1.77×10^{30}
Uranus	Titania	8.68×10^{25}	Perigee	1.19×10^9	2209.75	88.00	0.0349	1.63×10^{30}
Uranus	Umbriel	8.68×10^{25}	Apogee	2.67×10^8	4655.44	88.00	0.0349	1.74×10^{29}
Uranus	Umbriel	8.68×10^{25}	Perigee	2.65×10^8	4676.42	88.00	0.0349	1.72×10^{29}
Neptune	Nereid	1.02×10^{26}	Apogee	9.63×10^9	842.72	88.00	0.0349	4.08×10^{31}
Neptune	Nereid	1.02×10^{26}	Perigee	1.38×10^9	2224.54	88.00	0.0349	2.22×10^{30}
Neptune	Proteus	1.02×10^{26}	Apogee	6.48×10^7	10271.38	88.00	0.0349	2.26×10^{28}
Neptune	Proteus	1.02×10^{26}	Perigee	6.40×10^7	10335.38	88.00	0.0349	2.21×10^{28}

Note: Gravitational constant $G = 6.67 \times 10^{-11} \text{ (m}^3 \text{ kg}^{-1} \text{ s}^{-2}\text{)}$.

Table 1 presents the relationship between the planets and natural satellites at apogee and perigee, using key orbital parameters to compute a revised estimate of the planet’s mass. The gravitational constant (G) is taken as $6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$.

The variable d represents the planets’–natural satellites’ distance at each position, while v denotes the natural satellite’s orbital velocity to the Satellites distance at each position, while v denotes the natural satellite’s orbital velocity relative to the planet. The angle θ , corresponding to $\angle CAD$ in the figure, is

used along with its cosine to resolve the force components relevant to the proposed model. The newly assessed mass of the planets remains consistent across both orbital positions, indicating that the model yields stable estimates despite changes in distance and velocity, thereby supporting the underlying theoretical framework.

The parameters used in Table 2 are defined as follows: G is the universal gravitational constant with a value of $6.67 \times 10^{-11} \text{ Nm}^2/\text{Kg}^2$. The variable d represents the distance between the planets and the Sun, measured at two key orbital points’

aphelion and perihelion, v refers to the planet's orbital velocity at these positions.

The product Mv denotes the planet's linear momentum, calculated as the multiplication of its mass and orbital velocity.

Finally, the angle θ corresponds to the orbital inclination as introduced in the theoretical model (see Figure), and its cosine value is used to resolve the velocity vector along the direction of the resultant force.

Table 2. Reassessment of the Sun's mass using planetary orbital velocities and estimated planetary masses

Planet	Planet Mass (kg)	Position	Distance (d) (m)	Velocity (v) (m/s)	Mv (N·s)	θ (deg)	$\cos \theta$
Mercury	—	Aphelion	6.98×10^{10}	4.36×10^4	2.72×10^{35}	88.00	0.0349
Mercury	—	Perihelion	4.60×10^{10}	5.37×10^4	1.48×10^{34}	88.00	0.0349
Venus	—	Aphelion	1.00×10^{11}	3.49×10^4	4.26×10^{34}	88.00	0.0349
Venus	—	Perihelion	1.07×10^{11}	3.51×10^4	1.18×10^{34}	88.00	0.0349
Earth	5.97×10^{24}	Aphelion	4.07×10^8	990.20	2.10×10^{33}	88.34	0.0289
Earth	5.97×10^{24}	Perihelion	3.59×10^8	1053.92	2.13×10^{33}	88.00	0.0349
Mars	6.43×10^{23}	Aphelion	9.52×10^6	2123.02	8.99×10^{30}	88.00	0.0349
Mars	6.43×10^{23}	Perihelion	9.23×10^6	1351.92	9.86×10^{30}	88.00	0.0349
Jupiter	1.90×10^{27}	Aphelion	1.07×10^9	10880.21	4.26×10^{34}	88.00	0.0349
Jupiter	1.90×10^{27}	Perihelion	1.07×10^9	10886.32	1.18×10^{34}	88.00	0.0349
Saturn	5.68×10^{26}	Aphelion	1.26×10^9	5493.82	1.48×10^{34}	88.00	0.0349
Saturn	5.68×10^{26}	Perihelion	2.37×10^8	12654.76	4.12×10^{34}	88.00	0.0349
Uranus	8.68×10^{25}	Aphelion	2.67×10^8	4655.44	1.18×10^{34}	88.00	0.0349
Uranus	8.68×10^{25}	Perihelion	2.65×10^8	4676.42	1.24×10^{34}	88.00	0.0349
Neptune	1.02×10^{26}	Aphelion	9.63×10^9	842.72	2.72×10^{35}	88.00	0.0349
Neptune	1.02×10^{26}	Perihelion	1.38×10^9	2224.54	1.48×10^{34}	88.00	0.0349

Note: Gravitational constant $G = 6.67 \times 10^{-11} \text{ (m}^3 \text{ kg}^{-1} \text{ s}^{-2}\text{)}$. Previously assessed solar mass: $1.99 \times 10^{30} \text{ kg}$.

Table 3 summarizes the interaction between the planets and the Sun, incorporating both gravitational attraction and a proposed buoyancy-like force within the gravitational field. Here, GAF represents the gravitational attractive force between the two bodies, while $BFGF$ denotes the buoyancy force acting at a lever arm distance a , as illustrated in Figure.

The new assessed mass of the Sun is taken as $3.40 \times 10^{35} \text{ kg}$ based on the model's prediction. The consistent lever arm value suggests that the torque caused by the buoyancy force contributes to the observed rotational velocity of the planets. The inclusion of $BFGF$ provides a novel interpretation of Newtonian gravitational theory.

Table 3. Reassessment of the Sun's mass using planetary orbital velocities, including estimates of gravitational and buoyancy forces and rotational properties

Planet	GAF (N)	New Sun Mass (Kg)	BFGF (N)	Lever Arm (a) (m)	Rotational Velocity (m/s)
Mercury	1.11×10^{35}	—	—	—	—
Mercury	5.94×10^{34}	—	—	—	—
Venus	2.17×10^{35}	—	—	—	—
Venus	2.12×10^{35}	—	—	—	—
Earth	6.97×10^{31}	3.40×10^{35}	6.97×10^{31}	2.110	465.36
Earth	7.44×10^{31}	3.40×10^{35}	7.44×10^{31}	2.110	496.89
Mars	2.99×10^{29}	7.14×10^{35}	6.97×10^{31}	3.183	241.00
Mars	3.44×10^{29}	5.66×10^{35}	7.44×10^{31}	3.670	241.00
Jupiter	2.90×10^{33}	4.44×10^{36}	2.90×10^{33}	28.446	12661.94
Jupiter	3.05×10^{33}	3.84×10^{36}	3.05×10^{33}	27.101	12661.94
Saturn	1.40×10^{33}	1.11×10^{37}	1.49×10^{33}	31.236	10233.33
Saturn	1.44×10^{33}	9.53×10^{36}	1.44×10^{33}	29.652	10233.33
Uranus	4.12×10^{32}	3.13×10^{37}	4.12×10^{32}	17.705	4109.44
Uranus	4.32×10^{32}	2.72×10^{37}	4.32×10^{32}	15.495	4109.44
Neptune	9.48×10^{33}	3.13×10^{37}	9.48×10^{32}	11.631	2699.72
Neptune	5.15×10^{32}	3.13×10^{37}	5.15×10^{32}	11.630	2699.72

Note: Gravitational constant $G = 6.67 \times 10^{-11} \text{ (m}^3 \text{ kg}^{-1} \text{ s}^{-2}\text{)}$. (Williams, 2024, 2025)

The interaction between the planets and the Sun involves not only gravitational attraction but also an additional force proposed in this study: gravitational buoyancy. At aphelion (1.521×10^{11} meters), the computed buoyancy force is approximately $6.96832 \times 10^{31} \text{ N}$. At perihelion ($1.470 \times 10^{11} \text{ m}$) it increases around $7.09 \times 10^{31} \text{ N}$. These estimates are based on orbital data, mass, velocity and distance sourced from NASA's Sun Fact Sheet and Planetary Fact Sheet

(Williams, 2024). Building on earlier calculations, this section introduces the concept of a buoyancy force that acts on bodies submerged in the gravitational field analogous to how objects experience buoyancy in a fluid like water. In fluid mechanics, the buoyancy force is equal to the weight of the displaced liquid, acting over the object's surface. Similarly, in a gravitational field it is proposed that matter experiences a distributed force over its surface area, influenced by its spatial

relationship with another body. This gravitational buoyancy force is modeled to vary directly with the product of the actual surface areas of two bodies and inversely with the square of the distance between them. The relationship is expressed mathematically as:

$$B = P \frac{S \cdot s}{d^2} \quad (1)$$

In this expression, B is the gravitational buoyancy force between the two bodies, P is a constant of proportionality, S and s are the actual surface area of the two interacting bodies, and d is the distance between them. The term “actual surface area” refers to the portion of a body’s outer boundary that directly interacts with external forces. It excludes internal voids and molecular free spaces, which are minimal in solids, greater in liquids, and even more pronounced in gases. Since these free spaces do not contribute to surface-level pressure or interaction, they are not included in the force calculation. This buoyancy force model complements the Newtonian gravitational framework. Based on the orbital motion of celestial bodies, the following relation can be derived:

$$Mv \cos \theta = F = G \left(\frac{Mm}{d^2} \right) \quad \text{or} \quad M = \frac{v \cos \theta \, d^2}{G} \quad (2)$$

The formulation enables a recalculation of a celestial body’s mass by incorporating the velocity component aligned with the resultant force direction, offering a novel method to reassess planetary mass within the gravitational buoyancy framework. Figure, illustrates the effect of gravitational buoyancy on a rotating celestial body. The force vector AC represents momentum (mv), while the gravitational attractive force (GAF) is projected along AD , which equals $AC \cos(\theta)$.

The buoyancy force acts at a distance a from the center of mass. Contributing to rotational motion. In Figure, the vector AC represents the linear momentum of a body, defined as mv , where m is the mass and v is velocity. The gravitational attractive force (GAF) is the projection of this momentum along the direction AD , given by $(AC \cos \theta)$. That is, $mv \cos \theta = F = G(Mm)/d^2$.

Here, the point G lies at a distance a from point A , indicating where the buoyancy force acts, on the side opposite the gravitational force vector. Since AD and FG are parallel and equal. The buoyancy force (FG) is conceptually equivalent to the gravitational attractive force (AD). However, the key difference lies in where the force acts. Because the buoyancy force acts at a distance from the center of gravity, it generates rotational torque.

Contributing to the celestial body’s spin. Thus, the rotational power is dependent on the product of the buoyancy force and moment arm a . This leads to a refinement in interpreting gravitational force. In Newtonian mechanics, the gravitational force does not account for the surface area of bodies. As a resultant, Newton’s model may underestimate the actual attractive force, especially when distributed surface-level effects are involved. To represent this difference, the following equations are proposed:

$$F_n = F_a - B \quad , \quad F_a = F_n + B \quad (3)$$

Where F_n is the Newtonian attractive force, F_a is the actual total attractive force and B is the buoyancy force in the gravitational field. This distinction explains natural phenomena such as why water, with $F_n < B$, tends to rise up or stay suspended. Such behavior supports the idea that the actual surface area of matters plays a measurable role in gravitational interactions, reinforcing the conception of gravitational buoyancy (Palchoudhury, 2016).

MASS OF THE SUN AND PLANETS

In reviewing the orbital motion of all planets, it is verified and observed in the column 3 of the Table No. 3, the mass 3.4×10^{35} of the Sun according to the current calculation is heavier than the previously estimated mass $1.99 \times 10^{30} \text{ Kg}$. In reviewing the orbital motion of natural satellites of planets, it is verified and observed in the column 10 of the Table No.1, the mass of planets according to the current calculation is heavier than the previously estimated mass in column No.4, Table No. 1

MASS OF THE UNIVERSE

The mass of the universe estimates at $1.5 \times 10^{53} \text{ Kg}$. The mass of the planets and Sun are heavier than before estimate. For the inter action between GAF and BFGF, all planets and the Sun of solar system moving and found their mass heavier than before estimated. Certainly, mass of the universe heavier than $1.5 \times 10^{53} \text{ Kg}$.

RED SHIFT

The motion (orbital) of celestial bodies is the resultant force of two forces (GAF & BFGF) and follows a curved path around a center. Please stand before a wall clock and watch the wall clock. When the hand is at 6, nearest to you, it is the blue shift. But when the hand is at 12, furthest from you, it is the red shift. It’s a continuous process. What is now near to you, blue shift, after a long time, it will be at the furthest to you, redshift. This is a continuous process. It is reality: there is no change in distance among celestial bodies. That is to say, the universe is neither at all expanding nor closing. It is a steady-state universe.

TIDAL EFFECT

The Earth rotates on its axis regularly. Tides are created on the Earth by the influence of the Sun and moon regularly. We see the water of the sea and rivers swell up during high tide because $mv > mg$ (column No. 4 & 7 of Table 4), both case m is same, but $v > g$ in the Earth, $v = 465.36 \text{ meter/s}$ but $g = 9.8 \text{ meter/s}^2$. During high tide, not only water but also plants and animals swell up, which we cannot see with the naked eye. During rotation, the Earth feels a force equal to $Mv \text{ N/s}$, or for equal to $Mv \text{ (N/s)}$ force the Earth rotates. During swelling, the relation among cells, compounds, atoms and molecules are disturbed. And some gap arises among nanoparticles. Due to tidal force i.e. swelling up force, trees suck fluid from connected soil, spread all over the tree as because plant has such as capacity. Photosynthetic process fluid forms into a food and spreads all over the tree, and the tree grows up. This process is a regular process. This process is a cycling process. This process is applicable for all of the Earth.

Table 4. Estimated effects of tidal power on planetary and molecular properties

Name	New Mass (kg)	Rotational Velocity (m/s)	Mv (N·s)	Kinetic Energy (J)	$m_{\oplus}g$ (N)
Earth	7.10×10^{28}	465.36	3.30×10^{31}	3.25×10^{-21}	6.95×10^{29}
Mars	3.89×10^{26}	241.00	9.38×10^{28}	7.68×10^{33}	—
Jupiter	6.52×10^{30}	12661.94	8.25×10^{34}	1.13×10^{31}	—
Saturn	6.52×10^{32}	10233.33	6.67×10^{34}	5.23×10^{38}	—
Uranus	1.80×10^{30}	4109.44	7.29×10^{33}	7.68×10^{33}	—
Neptune	4.10×10^{31}	2677.70	1.09×10^{35}	7.68×10^{33}	—
Sun	3.40×10^{35}	1997.0	6.80×10^{38}	7.68×10^{33}	—
Water (molecule)	3.00×10^{-26}	465.36	1.40×10^{-23}	3.25×10^{-21}	2.94×10^{-25}
Iron (molecule)	9.36×10^{-26}	465.36	4.36×10^{-23}	1.01×10^{-20}	9.17×10^{-25}

Note: Gravitational acceleration on Earth $g_{\oplus} = 9.8 \text{ m/s}^2$ and $m_{\oplus}$ here is the Earth mass.

Here new mass collects from column No. 10, Table No.1. Humans and other animals in the Earth are subject to the tidal effect every day. Like plants, they also have a need for food. They collect indirectly food from plants in a cyclical way. Tidal power is different in different part of the Earth as g (gravitational acceleration). The power of body mechanism is different in different part of the Earth.

CONCLUSION

In nature, two fundamental forces may influence the motion and behavior of matter within a gravitational field: 1- Gravitational Attractive Force (GAF), as described by Newtonian mechanics. 2- Buoyancy Force in the Gravitational Field (BFGF), as proposed in this study. These two forces

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collectively impact a wide range of phenomena, including orbital motion, rotational dynamics. Free-fall trajectories and even evaporation processes. Impact of tidal power effect on life cycle. Recognizing and integrating the buoyancy effect into gravitational models opens a new avenue for understanding celestial mechanics and may lead to significant theoretical advancements.

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