

The Effect of the Buoyancy Force of the Gravitational Field in the Local Dominating Area of a Heavier Body

Sankar Palchoudhury 

Independent Researcher, Retired W. B. State Govt. Employee, 101/673/A, College Para, P.O. Kharia, Ward No. 21, Dist. Jalpaiguri, Pin Code – 735101, West Bengal, India

sankarpalchoudhury@gmail.com

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ABSTRACT

There are two fundamental forces in nature: (1) the Gravitational Attractive Force (GAF), as described by Newtonian mechanics, and (2) the Buoyancy Force in the Gravitational Field (BFGF), as proposed in this study. These two forces influence motion such as orbital dynamics, rotational behavior of celestial bodies, free-fall trajectories, and the evaporation of matter within a gravitational field. Local activities are affected by larger bodies through the acceleration due to gravitational attraction (g), the Newtonian gravitational attractive force (F_n), the actual gravitational attractive force (F_a), and the buoyancy force of the gravitational field (B).

Keywords: Buoyancy Force, Local dominating Area

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INTRODUCTION

In nature, two fundamental forces govern the motion and behavior of matter within a gravitational field: (1) the Gravitational Attractive Force (GAF), as described by Newtonian mechanics, and (2) the Buoyancy Force in the Gravitational Field (BFGF), as proposed in this study. Together, these forces influence a wide range of phenomena, including orbital motion, rotational dynamics, free-fall trajectories, and evaporation processes. Recognizing and integrating the buoyancy effect into gravitational models provides an innovative approach to understanding celestial mechanics and may lead to significant theoretical advancements (Palchoudhury, March 2025). According to Newton's law of universal gravitation, all masses attract each

other with a force proportional to the product of their masses and inversely proportional to the square of the distance between them. This interaction gives rise to what is commonly known as the gravitational field, which permeates all of space. The attractive force can be mathematically expressed as

$$F = G \left(\frac{Mm}{d^2} \right) \quad (1)$$

where F is the attractive force between two bodies, G is the gravitational constant, M is the mass of the heavier body, m is the mass of the lighter body, and d is the distance between them. In analogy with a substance immersed in water experiencing buoyancy, it is proposed that matter in a gravitational field experiences a distributed buoyancy-like force over its surface area, influenced by its spatial relationship

with another body. This gravitational buoyancy force is expressed as

$$B = P \left(\frac{S}{d^2} \right) \quad (2)$$

where B is the buoyancy force in the gravitational field, P is a constant of proportionality, S is the actual surface area of the larger body, s is the actual surface area of the smaller interacting body, and d is the distance between them. The term “actual surface area” refers to the portion of a body’s boundary that directly interacts with external forces. It excludes internal voids and molecular free spaces, which are minimal in solids, larger in liquids, and most significant in gases. Since these free spaces do not contribute to surface-level interaction, they are not included in the force calculation. This buoyant force model is therefore presented as a complement to the Newtonian gravitational framework. Based on orbital motion, the following relation can be derived ([Palchoudhury, March 2025](#)).

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

M is the mass of the heavier body, v is the orbital velocity of the lighter body, and the angle $\angle CAD = \theta$ in the figure. F is the gravitational attractive force. m is the mass of the lighter body, and d is the distance between two bodies.

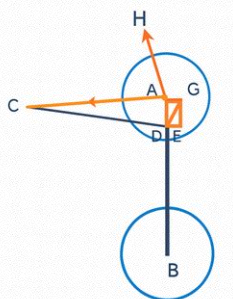


Figure 1: Orbital motion of two celestial bodies, A and B . Body B is more massive than body A , yet the gravitational force between them is mutual.

This 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. (Palchoudhury S, March 2025)

ORBITAL MOTION AND LOCAL AREA ACTIVITIES

Previous studies have examined various aspects such as orbital motion, rotational velocity, and the mass of celestial bodies ([Palchoudhury, March 2025](#); [June 2025](#)). These works introduced the concept of the Buoyancy Force in the Gravitational Field (BFGF) alongside the Newtonian Gravitational Attractive Force (GAF).

The present discussion focuses on local area activities governed by the presence of a larger body. Specifically, three components are considered:

1. The acceleration due to gravitational attraction (g), i.e., the Newtonian gravitational attractive force (F_n);
2. The actual gravitational attractive force (F_a);
3. The buoyancy force in the gravitational field (B).

In classical Newtonian mechanics, the gravitational attractive force does not include any dependence on the surface area of interacting bodies. Consequently, Newton's model may underestimate the actual force when distributed surface-level effects are present. To account for this, the following relationship is proposed:

$$F_n = F_a - B \quad \text{or} \quad F_a = F_n + B \quad (3)$$

where F_n is the Newtonian gravitational attractive force, F_a is the actual total attractive force, and B is the buoyancy force in the gravitational field. This distinction helps to explain certain natural phenomena. For example, in cases where $F_a < B$ or $F_a > B$, water may rise or remain suspended. Such behavior supports the hypothesis that the effective surface area of matter plays a measurable role in gravitational interactions, reinforcing the proposed concept of gravitational buoyancy (Palchoudhury, March 2025).

Table 1 Newtonian Gravitational Attractive Force

Body	Old Mass (M kg)	Distance/Radius (d, m)	$g = GM/d^2$	Test Mass (m, kg)	$F_n = mg$
Earth	5.97×10^{24}	6.37×10^6	9.82	5.00×10^3	49113.077
	5.97×10^{24}	$6.37E \times 10^8$	9.82×10^{-4}	5.00×10^3	4.9113077
Mars	6.43×10^{23}	3.73×10^6	3.08	5.00×10^3	15415.837
	6.43×10^{23}	3.73×10^8	3.08×10^{-4}	5.00×10^3	1.5415837
Jupiter	1.90×10^{27}	6.98×10^7	2.60×10^1	5.00×10^3	130035.08
	1.90×10^{27}	6.98×10^9	2.60×10^{-3}	5.00×10^3	13.003508
Saturn	5.68×10^{26}	5.83×10^7	1.12×10^1	5.00×10^3	55810.898
	5.68×10^{26}	5.83×10^9	1.12×10^{-3}	5.00×10^3	5.5810898
Uranus	8.68×10^{25}	2.54×10^7	8.98	5.00×10^3	44905.915
	8.68×10^{25}	2.54×10^9	8.98×10^{-4}	5.00×10^3	4.4905915
Neptune	1.02×10^{26}	2.46×10^7	1.13×10^1	5.00×10^3	56482.403
	1.02×10^{26}	2.46×10^9	1.13×10^{-3}	5.00×10^3	5.6482403
Sun	1.99×10^{30}	6.96×10^8	2.74×10^2	5.00×10^3	1371345.8
	1.99×10^{30}	6.96×10^{11}	2.74×10^{-4}	5.00×10^3	1.3713458
Single Water Molecule	5.97×10^{24}	6.37×10^6	9.82	5.00×10^3	49113.077
	5.97×10^{24}	6.37×10^8	9.82×10^{-4}	5.00×10^3	4.9113077
One Iron Molecule	9.19×10^{25}	6.37×10^6	9.82	9.36×10^{-26}	9.19×10^{-25}
	9.19×10^{29}	6.37×10^8	9.82×10^{-4}	9.36×10^{-26}	9.19×10^{-29}

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

Table 2 Buoyancy Force in the Local Dominating Area

Body	* $mg=F_n$	**New Heavy Mass (M, kg)	***Test Mass (m, kg)	Distance (d, m)	Actual GAF (F_a)	BFGF (B, N)
Earth	4.91×10^4 4.91	7.10×10^{28} 7.10×10^{28}	5×10^3 5×10^3	6.37×10^6 6.37×10^8	5.83×10^8 5.83×10^4	5.83×10^8 5.83×10^4
Mars	1.54×10^4 1.54	3.89×10^{26} 3.89×10^{26}	5×10^3 5×10^3	3.73×10^6 3.73×10^8	9.34×10^6 9.34×10^2	9.34×10^6 9.34×10^2
Jupiter	1.30×10^5 1.30×10^1	6.52×10^{30} 6.52×10^{30}	5×10^3 5×10^3	6.98×10^7 6.98×10^9	4.46×10^8 4.46×10^4	4.46×10^8 4.46×10^4
Saturn	5.58×10^4 5.58	4.54×10^{30} 4.54×10^{30}	5×10^3 5×10^3	5.83×10^7 5.83×10^9	4.45×10^8 4.45×10^4	4.45×10^8 4.45×10^4
Uranus	4.49×10^4 4.49	4.54×10^{30} 4.54×10^{30}	5×10^3 5×10^3	2.54×10^7 2.54×10^9	2.34×10^9 2.34×10^5	2.34×10^9 2.34×10^5
Neptune	5.65×10^4 5.65	4.08×10^{31} 4.08×10^{31}	5×10^3 5×10^3	2.46×10^7 2.46×10^9	2.25×10^{10} 2.25×10^6	2.25×10^{10} 2.25×10^6
Sun	1.37×10^6 1.37	3.40×10^{35} 3.40×10^{35}	5×10^3 5×10^3	6.96×10^8 6.96×10^{11}	2.34×10^{11} 2.34×10^5	2.34×10^{11} 2.34×10^5
Single Water Molecule	2.95×10^{-25} 2.95×10^{-29}	7.10×10^{28} 7.10×10^{28}	3×10^{-26} 3×10^{-26}	6.37×10^6 6.37×10^8	3.50×10^{-21} 3.50×10^{-25}	3.50×10^{-21} 3.50×10^{-25}
One Iron Molecule	9.19×10^{-25} 9.19×10^{-29}	7.10×10^{28} 7.10×10^{28}	9.36×10^{-26} 9.36×10^{-26}	6.37×10^6 6.37×10^8	1.09×10^{-20} 1.09×10^{-24}	1.09×10^{-20} 1.09×10^{-24}

*Data collected from Table 1, **Table 1 (Palchoudhury S, June 2025). ***NASA Old mass: [$Gravitational\ constant\ G = 6.67 \times 10^{-11} (m^3\ kg^{-1}\ s^{-2})$].

During fission, minute particles of uranium-235 and subatomic particles vibrate enough in the gravitational field and generate various wavelengths, including infrared waves, visible wavelengths, and other wavelengths (Palchoudhury S, Dec 2023). It is general knowledge that at the time of fission, uranium-235 splits into krypton-92 and barium-141. After the split, the actual surface area of Krypton-92 + Barium-141 is greater than Uranium-235. Krypton-92 + Barium-141 feels greater BFGF than Uranium-235, owing to greater actual surface area, and Krypton (92) + Barium (141) seems to be less weighty than Uranium (235). This difference in weight and surface area contributes to their varying behaviors in nuclear reactions. Consequently, Krypton-92 and Barium-141 may offer unique advantages in certain applications, such as energy generation or nuclear research. In nuclear fission, no mass is lost and converted.

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CONCLUSION

The influence of the Buoyancy Force of the Gravitational Field (BFGF) in the Local Dominating Area of a Heavier Body is found in the acceleration due to gravitational attraction force (g), the Newtonian gravitational attractive force (F_n), the actual gravitational attractive force (F_a), and the buoyancy force of the gravitational field (B).

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