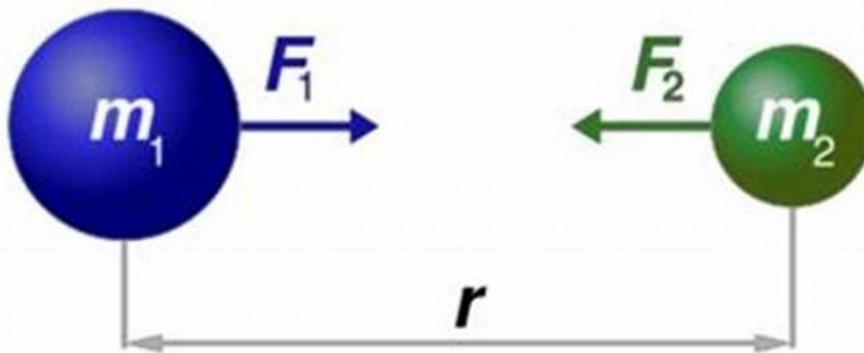


# The Amazing Journey to Quantum Gravity: What Led to the Derivation of Newton's Law of Gravitation

## Newton's Law of Universal Gravitation



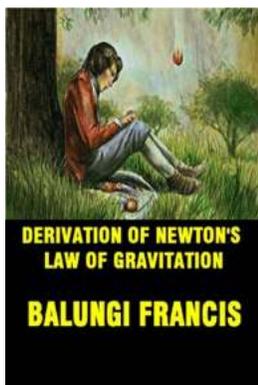
$$F_1 = F_2 = G \frac{m_1 \times m_2}{r^2}$$

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## The Incredible Story Behind Newton's Law of Gravitation

Newton's law of gravitation is one of the most fundamental concepts in physics, shaping our understanding of the universe and its workings. It describes the attractive force between any two objects with mass, enabling us to explain planetary motion, falling objects, and even the tides.

But have you ever wondered how this law was derived and the journey scientists undertook to reach this groundbreaking discovery? Join us on an incredible adventure through time as we dive into the fascinating world of gravitational theory and the quest for quantum gravity.



## Derivation of Newton's Law of Gravitation (The Journey to Quantum Gravity)

by Balungi Francis (Kindle Edition)

★★★★★ 5 out of 5

Language	: English
File size	: 551 KB
Text-to-Speech	: Enabled
Screen Reader	: Supported
Enhanced typesetting	: Enabled
Word Wise	: Enabled
Print length	: 46 pages
Lending	: Enabled



## The Birth of Gravitational Theory

The roots of gravitational theory can be traced back to ancient times when civilizations tried to make sense of the movements of celestial bodies. However, it wasn't until the 17th century that Sir Isaac Newton revolutionized our understanding with his law of universal gravitation.

Newton's law states that every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. This law provided an elegant explanation for the observed motions of objects in our everyday lives and the heavens above.

## **Newton's Derivation of Gravitational Law**

When Newton first proposed his law of gravitation, he faced the monumental task of mathematically deriving it from a solid foundation. His key breakthrough occurred when he combined his laws of motion with Johannes Kepler's laws of planetary motion.

By carefully observing the motion of planets, Kepler had derived three empirical laws that characterized their elliptical paths around the Sun. Newton realized that these laws could be explained by a single force, which we know today as the force of gravity.

Using his incredible mathematical skills, Newton developed a framework that would allow him to derive his law of gravitation. He introduced calculus into his mathematical toolbox, allowing him to express the relationship between the force, masses, and distances in a concise and elegant way.

## **Gravity and Quantum Mechanics**

While Newton's law of gravitation was a monumental achievement, it is important to note that it is not a complete description of gravity. The world of physics took a significant leap forward in the 20th century with the development of quantum mechanics.

Quantum mechanics revolutionized our understanding of the microscopic world, describing particles as both particles and waves and introducing the concept of uncertainty and probability. However, the theory of quantum mechanics and the principles it is built upon do not easily mesh with the classical theory of gravity.

This conflict sparked the quest for quantum gravity – a theory that unifies the principles of quantum mechanics and the general theory of relativity, which

describes gravity at large scales.

## **The Unresolved Quest for Quantum Gravity**

While tremendous progress has been made in the journey towards quantum gravity, scientists have yet to arrive at a complete and universally accepted theory. The current leading contenders for a theory of quantum gravity include string theory, loop quantum gravity, and others.

These theories propose novel ideas such as extra dimensions, vibrating strings, and discrete spacetime, challenging our intuitions and pushing the boundaries of our knowledge. The search for quantum gravity is not only an exploration of the fundamental forces of nature but also a philosophical and theoretical journey into the unknown.

## **The Future of Gravitational Theory**

As our understanding of the universe deepens, so does our desire to uncover the secrets of quantum gravity. The quest for a complete theory of gravity unifying the microcosm and macrocosm continues to drive scientific research and inspire the next generation of physicists.

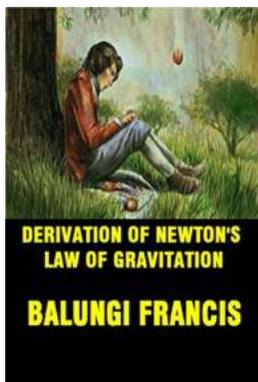
With advancements in technology, such as the Large Hadron Collider, and collaborations between brilliant minds around the world, we inch closer to potentially resolving the enigma of quantum gravity. The future may hold revolutionary discoveries that will reshape our understanding of the cosmos.

## **The Beauty of Gravitational Theory**

The derivation of Newton's law of gravitation and the journey to quantum gravity exemplify the beauty of scientific progress. From ancient civilizations looking up

at the stars to the brilliant minds of Newton, Kepler, and Einstein, humankind has continuously expanded its horizons to unravel the mysteries of the universe.

So next time you gaze at the night sky or observe an apple fall from a tree, remember the incredible journey that led to the derivation of Newton's law of gravitation and the limitless quest for a more complete understanding of gravity.



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In Newton's view, all objects exert a force that attracts other objects. That universal law of gravitation worked pretty well for predicting the motion of planets as well as objects on Earth and it's still used, for example, when making the calculations for a rocket launch. But unfortunately it cannot be derived from first principles.

While Newton was able to formulate his law of gravity in his monumental work, he was deeply uncomfortable with the notion of "action at a distance" that his equations implied. In 1692, in his third letter to Bentley, he wrote:

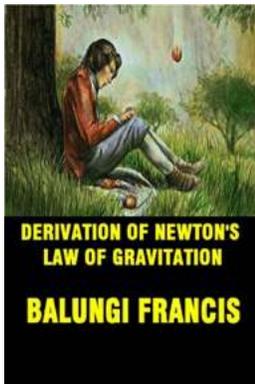
"That one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it."

He never, in his words, "assigned the cause of this power". In all other cases, he used the phenomenon of motion to explain the origin of various forces acting on bodies, but in the case of gravity, he was unable to experimentally identify the motion that produces the force of gravity. Moreover, he refused to even offer a hypothesis as to the cause of this force on grounds that to do so was contrary to sound science. He lamented that "philosophers have hitherto attempted the search of nature in vain" for the source of the gravitational force, as he was convinced "by many reasons" that there were "causes hitherto unknown" that were fundamental to all the "phenomena of nature". These fundamental phenomena are still under investigation and, though hypotheses abound, the definitive answer has yet to be found.

"I have not yet been able to discover the cause of these properties of gravity from phenomena and I feign no hypotheses.... It is enough that gravity does really exist and acts according to the laws I have explained, and that it abundantly serves to account for all the motions of celestial bodies." Newton

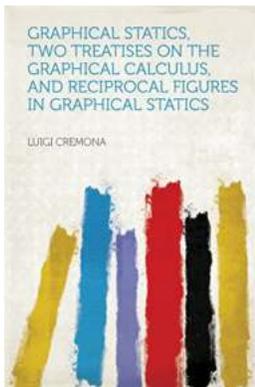
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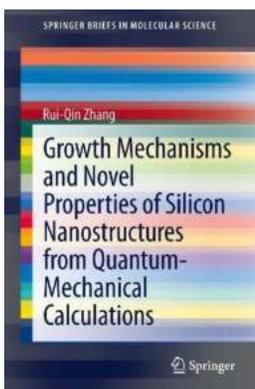
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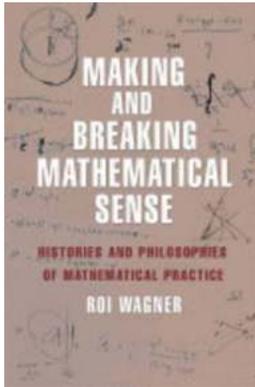
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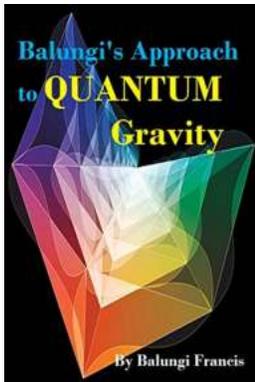
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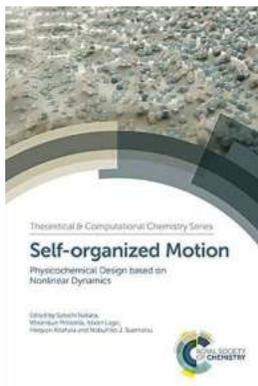
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