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The Infinite nature of Quantum Mechanics and The Finite Nature of Classical Mechanics

Ardeshir Irani

Downey Research Corporation, 12343 Chavers Avenue, Downey, California 90242

ABSTRACT:

The contemporary comprehension of quantum mechanics and fundamental particles, such as bosons, offers an intriguing perspective to analyze its infinite nature, while the nature of fundamental particles, such as fermions, predicts the finite nature of classical mechanics. It is the act of observation or interaction that changes indeterministic infinite quantum mechanics to deterministic finite classical mechanics. This document explores these concepts by delving into the nature of photons, gravitons, and tachyons, the mathematics of infinities, and the profound implications these have on our understanding of the universe. Particle speed from zero to infinity is the regime of infinite quantum mechanics, while particle speed slower than light speed is the regime of finite classical mechanics. The wave nature of photons is used to create charge, while gravitons use their particle nature to create mass. Gravitons and photons exist together in void levels "n" of quantum mechanics by increasing energy and decreasing entropy as "n" increases. The wave particle duality gives a dual nature to photons and gravitons in the quantum region. The Quantum Field Theory of General Relativity should contain Tensor Fields for both photons and gravitons.

KEY WORDS: Quantum Mechanics, Bosons, Photons, Gravitons, Tachyons, Infinity, Classical Mechanics, Fermions, Wave particle duality.

MAIN TEXT:

The Nature of Photons:

Photons are elementary particles, the quantum of light and all other forms of electromagnetic radiation. Photons have zero mass, zero charge, and spin 1. As bosons, they are governed by Bose-Einstein statistics and exhibit unique properties that set them apart from fermions, the elementary particles that make up matter. One of the most striking characteristics of photons is that they travel at the speed of light, approximately 299,792,458 meters per second in vacuum, but their speed slows down in denser mediums such as air, water, and glass, because the nature of photons becomes classical when interacting as particles with the atoms of the denser objects.

Time and Space for Photons:

For a photon traveling at the speed of light, time effectively stands still. This concept arises from Einstein's theory of relativity, which posits that as an object approaches the speed of light, time dilation occurs, stretching time infinitely. Photons experience no time between their emission and absorption. The entire universe, through the photon's perspective, is condensed into a single point due to Lorentz length contraction. This idea has profound implications. It suggests that a photon can be present at an infinite number of locations simultaneously, as it does not experience time and space in the conventional sense.

Photon and Graviton Superposition:

The quantum mechanical principle of superposition allows particles like photons and gravitons to exist in mixed spin +1 and spin -1 states simultaneously until they are observed or are involved in an interaction. Photons have a wave nature based on E = hf and gravitons have a particle nature based on E = 2pc. The wave particle duality occurs for bosons and fermions. Hence quantum mechanics can extend its influence into the classical region, while classical mechanics cannot extend its influence into the quantum region. Since 2pc and hf are quantum effects of gravitons and photons respectively, they are not exactly equal at the quantum level. This is because gravitons have an intrinsic spin of 2 which is twice greater than the intrinsic spin 1 of photons,

and therefore gravitons carry twice as much quantum energy as photons do. The wave particle duality becomes 2pc = hf, quantum mechanically.

The photoelectric effect states that light has a particle nature, but the analysis that light has a wave nature is missing from the photoelectric effect. Only when light interacts with a substance light's particle nature shows up because light now enters the classical region from the quantum region. The same effect occurs when light moves through a denser medium which slows down its speed. We calculate 2pc – hf for electrons and photons for the photoelectric effect. Electrons are emitted from metals when light shines on the metal. If φ is the Work Function of the metal which is the amount of energy required to emit electrons from the metal, then 2pc + φ = hf. The first term corresponds to electrons emitted from the metal while the second term corresponds to photons incident on the metal, where φ has the magnitude of a few electron volts depending on the substance under consideration. We can write $\varphi = h f_0$ where f_0 is the frequency that corresponds to the stopping potential. It is the threshold frequency for a given material above which photoelectrons can be ejected from the material. Then, 2pc = h (f - f_0) for $f > f_0$. This formula equates the quantum energy between electrons and photons. Once the current reaches a certain constant value, increasing f (energy of photons) has no further effect on increasing the current, but increasing the intensity of the light source (amplitude of the light wave) will increase the constant value of the current, telling us that the photoelectric effect exemplifies both particles and waves, known currently as the wave-particle duality. When ejecting electrons from the metal the classical nature of light comes into play, but when increasing the intensity of the light source the quantum wave nature of photons is exhibited. This implies that the interaction with the metal to release electrons is a particle effect due to classical mechanics, but photons maintain their wave nature as quantum mechanical objects since the higher current in the photoelectric effect is proportional to the square of the amplitude of the wave.

Energy States and the Infinite Nature of Photons:

Photons, being bosons, can occupy the same quantum state as an indefinite number of other photons. The ability of photons to coexist in the same energy state without limit suggests an aspect of infiniteness, an attribute associated with quantum mechanics.

This contrasts with fermions, which obey the Pauli exclusion principle, preventing two fermions that are alike from sharing the same quantum state, implying the nature of classical mechanics is limited.

Rest Mass Energy and Nuclear Reactions:

The relationship between energy and matter is encapsulated in Einstein's famous rest mass equation E = mc², created classically by gravitons. Since E = γmc² + pc; E = $\sqrt{p^2c^2 + (mc^2)^2}$ + pc and for m = 0, E =2pc is the quantum mechanical part of energy created by massless gravitons. The rest mass energy of nucleons can be harnessed in nuclear reactions, such as fusion and fission. These reactions release tremendous amounts of energy, as seen in the destructive power of nuclear bombs. The conversion of mass into energy in such reactions exemplifies the vast but finite potential energy stored within classical matter.

Dark Energy and the Multiverse (Reference 1):

The concept of energy creating matter and antimatter leads to the intriguing idea of a matter or antimatter multiverse, a collection of multiple finite universes of varying finite dimensions, since classical mechanics has a finite nature. Since energy is lowest and entropy is highest in level "0" of the quantum mechanical void which creates1-D space, while energy is greatest and entropy is least in level "n" of the void which creates (n+1)-D space, the frequency and energy of photons and gravitons in the void will increase as f_n where $f_n > f_{n-1} > f_{n-2} > \ldots\ldots f_1 > f_0$ based on E = hf for photons, and $p_n > p_{n-1} > p_{n-2} > \ldots\ldots p_1 > p_0$ based on E = 2pc for gravitons. The "n" different levels of the void are isolated from one another or are adiabatic in nature.

Since the energy of a wave is proportional to the square of its amplitude, as "n" increases the amplitude of the photon's wave increases with f_n. The graviton's momentum p_n also increases because $p_n = h(\frac{f_n}{2c})$. Since there is an upper limit on f_n and p_n the number of higher dimensions "n" of the multiverse that can be created is limited, since creating the multiverse is a classical phenomenon. Only quantum mechanics can have infinite degrees of freedom ($n \rightarrow \infty$) while classical mechanics must have finite degrees of freedom.

Gravitons and photons as quantum mechanical particles:

Gravitons are elementary particles, the quantum of mass. Gravitons have zero mass, zero charge, and spin 2. Gravitons move at the speed of light and are classified as Bosons. Gravitons relate to

gravity just as photons relate to electromagnetism. Hence mass is created by gravitons according to E = γ mc², while charge is created by photons according to E = (q^2/ 24 $\pi\epsilon_0$ r) x $\{(Sin^2\,\theta\,\mathrm{Cos}^2\,\emptyset + \gamma^2[\,Sin^2\,\theta\;\; Sin^2\,\emptyset + \mathrm{Cos}^2\,\theta]\,) + (\gamma^2 - 1)(\,\mathrm{Cos}^2\,\theta + Sin^2\,\theta\;\; Sin^2\,\emptyset\;\;)\}$ or E = $q^2/\,24\,\pi\epsilon_0$ r for charges at rest (Reference 2). The total formula, both classical and quantum mechanical, for gravitons is E_g = γ mc² + pc, while for photons it is E_{ph} = ($q^2/\,24\,\pi\epsilon_0$ r) x $\{\,(Sin^2\,\theta\,\mathrm{Cos}^2\,\emptyset + \gamma^2[\,Sin^2\,\theta\;\; Sin^2\,\emptyset + \mathrm{Cos}^2\,\theta]\,) + (\gamma^2 - 1)(\,\mathrm{Cos}^2\,\theta + Sin^2\,\theta\;\; Sin^2\,\emptyset\;\;)\,\}$ + hf. The total creative energy of the multiverse is given by the equation $E_T = E_g + E_{ph}$. The infinite vacuum energy popping in and out of the void that creates mass and charge, offers a unique perspective on the infinite nature of quantum mechanics.

Gravity waves moving at the speed of light have been detected by LIGO-Laser Interferometer Gravitational Wave Observatory in USA. While photons and gravitons maintain their wave and particle nature respectively in the quantum region, photons become particles in the classical region while gravity waves are created by matter consisting of gravitons. All accelerated particles with mass radiate away their energy in the form of electromagnetic and gravitational waves. Both electromagnetic and gravitational waves are radiated in electron and proton synchrotrons but while the electromagnetic waves can be detected easily, not so for the gravitational waves because it takes a lot more mass to detect gravitational waves as in the case of LIGO. This is because while electromagnetic waves created by the acceleration of electrical charges propagate in the framework of 4-D space-time, gravitational waves created by the acceleration of masses are waves of the spacetime fabric itself. The creation of electromagnetic waves by electrons and protons in circular particle accelerators is a consequence of the wave-particle duality since the charged particles are radiating waves.

Gravitons exist at the same quantum levels of the void as photons based on their energy and entropy. As level number “n” increases, the nature of gravitons becomes more structured and compacted to decrease its entropy. Solids have a lower entropy than liquids which have a lower entropy than gases. By compacting a substance, we are increasing its mass per unit volume, since for a given volume solids have more mass than liquids which have more mass than gases. Adding more mass and less randomness as in the case of solids increases momentum and energy due to the binding energy of solids and decreases entropy. The same rule applies to the wave nature of photons because by increasing its energy we are increasing its amplitude while decreasing its

wavelength, which adds more structure to the wave, thereby decreasing its entropy. As the energy of both hf and 2pc increases their entropy decreases, and vice versa.

Gravitons and tachyons cannot be detected directly in nature since photons can only detect particles with mass that move slower than the speed of light. It is the Higgs Field that gives energy to gravitons to form gravity in the form of classical gravitational matter. The Higgs Field also applies to photons for creating classical positive and negative charge. Referred to as the void earlier, the Higgs Field is infinite vacuum energy that exists everywhere since it has a quantum nature from which photons and gravitons draw energy in the form of E = hf for photons wave nature and E = 2pc for gravitons particle nature to create charge and mass classically, and from hf = 2pc, we get the wave particle duality λ = h/2p for massless bosons and λ = h/2mv for particles with mass. Since one cannot have a charge without mass, this implies photons and gravitons exist together in the different energy levels of the void. Photons and gravitons are indistinguishable quantum mechanically except for their intrinsic spin states. When matter and antimatter collide, we get pure energy in the form of two photons due to the extinction of the charges and two gravitons due to the extinction of the masses. Since photons and gravitons act together as per the wave particle duality, we would have to consider both their effects together to develop a complete quantum field theory for general relativity, which would be a unification of quantum mechanics with the classical field theory of gravitation (Reference 3).

Tachyons and their effect on Entangled Particles (Reference 4):

Tachyons are scalar bosons that exist in the next higher spatial dimension of our universe with the purpose of coming to our dimension to change the past. They have zero mass, zero charge, and zero spin. Based on the Lorentz Transformation for v > c, tachyons can travel backwards in time into the previous dimension, and can travel faster than light speed, to transmit information instantaneously between two entangled particles, to change their spin value states from a superposition mixed state of up (+1) and down (-1) to a definitive up or down state such as in the case of spin +½ and spin -½ electrons, spin +1 and spin -1 photons, spin +2 and spin -2 gravitons. For entangled particles, only the state of one of the two spin particles needs to be observed to change the state of both particles even if the two particles are separated by a very large distance. If the first particle was observed to have a spin up state, then the second particle instantaneously

gets a spin down state. Tachyons travel faster than light at infinite speed and can only be detected by their effect on changing particles from their quantum nature to their classical nature. The laws of quantum mechanics due to tachyons are retro-causal, meaning the future can change the past, while the laws of classical mechanics are causal, meaning the past is unchangeable once created.

Quantum Electrodynamics (QED) and Quantum Gravidynamics (QGD):

For QED, the principle of least action calculated using Special Relativity classically gives a straight line between two points because of the flat space time of Special Relativity and two Field vectors, the Electric Field and the Magnetic Field. For QGD, the principle of least action calculated using General Relativity should give classically a line along the Geodesic between two points because of the curved space-time of General Relativity and two tensors, due to the Field produced by photons and the Field produced by gravitons. Hence the Quantum Field Theory of General Relativity should contain both Tensor Fields from which we should be able to recover the Quantum Field Theory of Special Relativity or QED.

Understanding Infinity and its relation to Quantum Mechanics:

The infinite nature of mathematics has been depicted in the paper of infinite quantum cosmology (Reference 5). In mathematics, not all infinite quantities are equivalent; certain infinities exceed others in magnitude. As examples: the set of all infinite complex numbers in 4-D space would have all infinite real numbers in 3-D space as its subset; the set of infinite real numbers is greater than the set of infinite integers because there are infinite real numbers between integers 0 and 1, 1 and 2, and so on; the set of infinite negative and positive integers would have as its subset the infinite set of positive or negative integers.

This implies that the greater infinite quantum mechanics can be divided into many smaller infinite quantum mechanics which can then create finite classical mechanics or a finite number of multiverses. The greater the value of the infinite quantum mechanics the more finite number of multiverses with higher dimensions it would have the capacity to create. As an example, the quantum mechanics of infinite positive and negative numbers can create twice as many multiverses or twice as many dimensions as the quantum mechanics of infinite positive or infinite negative numbers. All multiverses being created by photons and gravitons draw their energy from the infinite field energy of the quantum mechanical void.

Classical mechanics exemplifies the ***limited*** physical nature of energy, atoms formed by fermions (electrons, protons & neutrons) as too all of matter which is a condensed form of energy.

Quantum mechanics exemplifies the ***limitless*** nature of energy made of massless bosons (photons, gravitons, and tachyons). Particles of quantum mechanics that have zero mass and zero charge are made of pure uncondensed energy.

CONCLUSION:

The void that creates matter, and positive and negative charges, contains photons and gravitons in it. Gravitons, particles mediating gravity, are emitted by accelerating masses such as in the case of a star being sucked in by a Black Hole or the merger of two Black Holes, much like photons are emitted by accelerating electric charge in circular particle accelerators. Gravitons are observed as gravitational waves by LIGO just as photons are observed as electromagnetic waves at the National Synchrotron Light Source II at BNL (Brookhaven National Lab.) because all accelerated particles radiate away their energy in the form of waves. Energy of gravitons and photons converted into mass and charge has limited potential as in the case of classical mechanics. When pure energy becomes impure condensed energy, it loses its infinite nature. A mathematical example would be condensing the infinite real numbers between integers 1 and 2 into the finite integers 1 and 2. Quantum mechanics, unlike classical mechanics, is valid in all regions that are faster or slower than the speed of light which is the reason photons, gravitons, and tachyons exist in our physical universe, while classical mechanics must contain mass and charge, and it is limited only to particles moving slower than the speed of light. A complete quantum field theory should contain the quantum effects of both photons and gravitons.

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