QUANTUM MECHANICS: A RITZY PANORAMA

CHRISTOPHER ALEXANDER UDOFIA

ABSTRACT

Mechanics is a realm of Physics which studies the motion of bodies. Quantum mechanics entails the study of the motion of sub atomic realities. This work maintains the thesis that Quantum mechanics is the progeny of previous mechanics. To sustain this position the work traces the genesis of the study of mechanics remotely to Aristotle which was redefined and given a new orientation in the modern Newtonian mechanics. Using the philosophical mechanism of analysis, the work demonstrates that the breakdown of these two mechanics gave birth to Quantum mechanics. The research critically observes that a juxtaposition of Quantum mechanics with the former two showed that the objectivity, causality, determinism and certainty that defined the former mechanics are oblivionated in the framework of Quantum mechanics. The discourse concludes with the tenet that since the current status of research in science admits the unification of all the realms of knowledge, then the idea of the intermingling of Metaphysics and Science in the advancement of human knowledge should be a new dimension to knowledge acquisition.

Keywords: Mechanics, Quantum, Science, Metaphysics, unification.

Introduction

The objective of this work is to unravel the concept and idea designated as Quantum mechanics. The work proposes the thesis that quantum mechanics is a progeny of past mechanics hence a historical survey of mechanics from the ancient, through the classical, the contemporary and the latest trend is undertaken in the work. In this discourse; the work will lay bay the dynamics of the mechanics of each of the stated precusorial era, investigates their principles, assumptions and implications. Ultimately, the work shall attempt a philosophical scrutiny of quantum mechanics with the focus of unveiling the embedded unsavoury entailments.

*Correspondence:
CHRISTOPHER ALEXANDER UDOFIA

***Detailed author information and related declarations are provided in the final section of this article.*

Article Publication Details
This article is published in the **International Journal of Multidisciplinary Research and Bulletin**, ISSN XXXX-XXXX (Online).

The journal is published and managed by
IRPG International Research Publishing Group

Consequently, we shall conclude that the prevailing trend of compulsive unification of all realms of knowledge by the U theory, S-theory and M-theory; which has re-erupted the crisis of relevance between disciplines apart from it being portentous of the scriptural apocalyptic prelude to the universal eschatology is also significant as it inaugurates the replacement of the Einsteinian universe of space-time curvature by the prevailing insuperable African universe of Metaphysics –Science intermingling.

1. Ancient Aristotelian Mechanics

Aristotle's conception and explanation of motion in Ancient Western mechanics towers as the most comprehensive and sophisticated view that was ever to be articulated upon which subsequent physics and mechanics could be validly described as paraphrases or anecdotes of Aristotle.

In his Cosmology ("Aristotle's Physics," www.aristotle'sphysics.html), Aristotle dissected the universe into two parts; namely: the terrestrial region and the celestial. The moon was the boundary between the earthly (terrestrial) sublunary region and the (celestial) supralunary realm. Bodies in the sublunary realm are made up of the four elements of earth, water, fire and air which were impure, corruptible and imperfect. On the other hand, bodies in the celestial realm are made up of a fifth substance, *Quintessence*, which is incorruptible, perfect, pure, immutable and changeless. Aristotle conceived that motion was primarily determined in the two realms by the nature of substances prevailing in them. In his *De Caelo* (279^b, 17-20), he argues that the natural motion of the four elements of the sublunary realm is basically rectilinear or towards the centre of the universe, which was conceived by the medieval to be the earth and explains that motion in any other direction on earth was violent motion.

Motion in the supralunar realm was perfect (non-violent) and circular (non-rectilinear) because of the perfect nature of the substance in this realm. Whereas objects in the terrestrial realm are sustained in motion through the application of a local force and come to rest immediately the force is withdrawn, objects in the heavenly realm are in uniform perpetual motion because the *primus mobile* continually moves the spheres in heaven.

The implication of this position, viewing it via the Newtonian binoculars is strange, because it entails that "the laws governing the motion of the heavens were a different set of laws than those that governed motion on the earth" ("The Physics of Aristotle versus the Physics of Galileo", online.) The point to note however is that these assumptions of Aristotle on motion were mainly philosophical speculations mostly devoid of experimental justifications.

Aristotle assumed that the earth was at the centre of the universe. This geocentric assumption was later developed by the Egyptian Scholar, Ptolemy who improved it with new astronomical data and mathematical calculations. Herbert Butterfield (*The Origins of Modern*

Science 915) observes that Aristotle's geocentricism and mechanics had a magnetic grasp on the minds of the medieval thinkers and persisted to provide "the presiding issue", until the time of Galileo. Roy T. Matthews and F. De Witt Patt (*The Western Humanities* 405) record that medieval Christian thinkers replaced Aristotle's unmoved mover with God and the place beyond the spheres as heaven and upheld the geocentric view because it appears to justify the doctrine of the original sin which implied that the corrupt earth – the sublunar realm of imperfection, was inhabited by fallen mortals. Medieval theologians christened Aristotle and validated his geocentricism with a literal interpretation of some portions of the Bible such as Joshua 10:10-15, Psalm 104:1, 5 & 19, Ecclesiastes 1: 5-6, Job 38:1-3, etc.

At this juncture, it is pertinent to correlate some of the axiomatic postulates of the Aristotelian system into perspective, thus:

1. Motion on earth is different from motion in heaven. This means that the laws governing motion on earth is different from those governing motion in heaven. The implication here is that there is no universal law of motion.

2. The earth is the centre of the universe because it contains heavier substance than other planetary bodies. This implies geocentricism.

3. Bodies in the supralunar realm move in perfect orbs (circular movements) and are made up of an incorruptible element called aether.

4. The *Primum Mobile* is the first mover that necessarily gives rise to motion both in the supra and sublunar realms. The *Primum Mobile* became the invisible spirit that controlled the motion of the universe. Butterfield observes on this note that "a universe constructed on the mechanics of Aristotle had the door half-way open for spirits already; it was a universe in which unseen hands had to be in constant operation, and sublime intelligences had to roll the planetary spheres around" (19).

5. In the terrestrial realm, objects with more earth or weight fall twice as fast than objects with less weight. Also, objects fall immediately to the ground immediately the force propelling them is removed, since the natural state of the earth is rest or stationary. Hence, to explain the motion of a projectile after the force is removed, they attribute it to air compression.

In the course of time, these axiomatic pillars of the Aristotelian system of mechanics have been given technical knockout based on the incremental evidence garnered from evolving empirical observations and experimentations. In another consideration, a head on assault on the pillars of the Aristotelian system and by extension, the Church, was a kind of prevailing spirit or fashionable fad that characterized the philosophies of the renaissance and the early modern period after the dark ages of the stifling of the spirit of enterprise and free-thinking by the Church. Thus in what follows, it shall be gesticulate how such affrontal assaults on the Aristotelian system led to the debunking of the pillars of the system, the eventual waning of Aristotelianism and the ultimate demise of Aristotelian mechanics.

One of the stunning issues that Aristotelian mechanics could not satisfactorily address was the phenomenon of a projectile continuing in motion after the mover must has withdrawn force. This was sequel to Aristotelian position that a body drops immediately to the ground once the force is removed. Aristotelians argue that the continuous movement was due to air compression and movement. Unsatisfied with this explanation, Jean Buridan at the University of Paris in the 1300s and other Parisian scholars asserted that the projectile remained in motion because it acquired “impetus”, a propulsive force which bodies are capable of acquiring once in motion.

The emergence of the theory of impetus initiated the decline of the Aristotelian-Ptolemaic mechanics but not the influence of the Aristotelian sophisticated system and ideas had on the minds of later scientists. However, the patrician attempt to question the Aristotelian system which was sanctified as impeccable by the church fathers since it is in correspondence with biblical teachings, was an audacious attempt that triggered some suppressed skeptical minds into deeper rigorosity and even heretical assumptions.

One off the offshoots of such anti-Aristotle and heretical skepticism was actualized in the Copernican reversal of Aristotelian-Ptolemaic Geocentrism.

It was Nicolas Copernicus that advanced this free-spirit of inquiry initiated by the Parisian. Instead of imbibing the geocentrism of Aristotle as an infallible astronomical model; the way medieval theologians projected it, he made recourse to the Greek thinker, Aristarchus; who earlier conceived the universe as sun-centered, and inverted Aristotle’s earth centered astronomy into a sun centered, heliocentric view of the universe.

Remarkably, the switch of Copernicus from Geocentrism to heliocentrism was not based on some profound observations and grandiose mathematical calculations that were superior to the Aristotelian-Ptolemaic system, but on revolutionary imagination associated with paradigm change which Thomas Kuhn describes as “picking up the other end of the stick… a process that involves handling the same bundle of data as before, but placing them in a new system of relations with one another” (*The Structure of Scientific Revolutions* 85). An evidential corroboration from Copernicus himself should suffice. In his *On the Revolutions of the Heavenly Spheres*, which was dedicated, suspiciously, to His Holiness, Pope Paul III; may be with the surreptitious intent to avert being called a heretic, he argues thus:

But you are waiting to hear from me how it occurred to me to venture to conceive any motion of the earth, against the traditional opinion… and common sense…. I was impelled to consider a different system of deducing the motions of the universe's spheres for no other reason than the realization that (Mathematicians) do not agree among themselves in their investigations of this subject…. For this reason I undertook the task of rereading the works of all the philosophers which I could obtain to learn whether anyone had ever proposed other motions of the universe's spheres…. And in fact I found… Some think that the earth remains at rest. But Philolaus the Pythagorean believes that, like the sun and moon, it revolves around the fire in an oblique circle. Heraclitus of Pontus and Ecphantus the Pythagorean make the earth move,… like a wheel in a rotation from west to east about its center. Therefore, having obtained the opportunity from these sources, I too began to consider the mobility of the earth (Copernicus Nicolaus. "On the Revolutions of the Heavenly Spheres" 96-97).

Despite the display of exceptional brilliance and intellectual profundity in this transposing scheme of Copernicus, he could not provide satisfactory answers to the question of the cause of the motion of the earth and other spheres. This was left for succeeding scientists. However, one salient point becomes apparent in both the Aristotelian stationary earth with mobile spheres and the Copernican mobile earth with stationary sun. It is the fact of the relativity of motion. This unveils that even the ancients were aware of the phenomenon of the relativity of motion to a frame of reference prior to Einstein's relativity.

The compulsive grip that the Aristotelian system and ideas had on the church made Catholics, Protestants, Lutherans and Calvinists to forbid the teaching of Copernicus in his revolutionary *Revolutions of the Heavenly Bodies* as unbiblical. The free-thinking spirit launched by these feats of revolt against the Aristotelian dogmatic intellectual dictatorship unleashed the freedom and liberty of thinking and enterprise that characterized the intellectual rebirth in the Renaissance period and the scientific and technological revolution in the modern classical Newtonian era.

CLASSICAL MECHANICS

Classical mechanics is the branch of physics that describes the motion of macroscopic objects using the framework of ideas and laws developed by Isaac Newton and his 17th century contemporaries like Tycho Brahe, Johannes Kepler, Galileo Galilei, Descartes, Leibnitz etc. ("Classical Mechanics" en.m.wikipedia.org/wiki/Classical-mechanics).

Tycho Brahe played a leading role in collecting monumental observational data of the planetary courses. Based on the reservoir of data available to him he proposed an anti-Copernican system, thus:

I am of the opinion, beyond all possible doubt, that the earth, which we inhabit, occupies the centre of the universe, according to the accepted opinions of the ancient astronomers and natural philosophers as witnessed by Holy writ, and is not whirled about with an annual motion, as Copernicus wished. Yet, to speak the truth, I do not agree that the centre of motion of all the orbs of the secundum mobile is near the earth, as Ptolemy and the ancients believed. (Brahe, Tycho "Reform of Copernicus and Ptolemy" 99) .

This anti-Copernicanism of Brahe has not been celebrated, since Brahe, unlike Copernicus, did not sustain his position on elaborate mathematical calculations. It was Johannes Kepler(Owen Gingerich, "Kepler Breaks the Spell of Circulatory…"102-106) who subjected the mountains of momentous observational data of Brahe to mathematical elaborations. Through his research, he was able to demonstrate a non-deistic mechanical explanation of the motion of the planets which Aristotle attributed to the *primum mobile*. He also decisively broke away from the ancient axiom that all celestial motions are both uniform and circular. Kepler's findings had expression in three scientific laws. The first law of planetary motion of Kepler is the law of elliptical path which states planets' orbit or path around the sun is an ellipse and not a circle. So, the first law substituted the ellipse for the circle as the descriptive motion of planets. This shattered the ancient Aristotelian concept that planets orbit in perfect circles. The second law states that the speed of a planet is not uniform but varies in accordance with its distance from the sun. The farther a planet is from the sun, the slower it is and vice-versa. He also demonstrated mathematically that the force of the sun kept the planets in orbit around the sun. This pre-empted the law of universal gravitation by Galileo and Newton. The third law created a nexus between the average distance of a planet from the sun and the time it takes to complete a single orbit. Kepler is famous for his new attitude to observe d data which is evident in his attempt to formulate physical laws using mathematical equations as the models of scientific laws. The mathematization of science was a symbolic index of modern science.

Kepler also incepted the idea of conceiving the universe as a mechanical clockwork controlled by a universal physical force rather than the divine force proposed Aristotle and the Scholastics. The evidence of this momentous idea is couched by him thus:

I am much occupied by the investigation of the physical causes. My aim in this is to show that the celestial machine is to be likened not to a divine organism but rather to a clock work…, insofar nearly all the manifold movements are carried out by means of a single quite simple magnetic force, as in the case of a clock work….(Holton, Gerald and H.D.Roller, Duane. *Foundations of Modern Physical Science, 150)*

Galileo Galilei (1564-1642) (Gerald Holton and Duane H.D.Roller, *Foundations of Modern Physical Science* 153-162) achieved enormous breakthroughs and made indelible contributions to Astronomy and profound impact on mechanics. He constructed and made the first use of telescope for planetary sightings. His discoveries through these sightings that the sun had dark spots, the moon - depressions and elevations, Jupiter - moons orbiting it etc led to the displacement of the Aristotelian position that the celestial spheres are spherical and quintessential. His most profound achievement was in the area of mechanics (motion). Presenting his major argument to support Copernicus' motion of the earth, he asserts thus:

First if we consider only the immense magnitude of the starry sphere compared to the smallness of the terrestrial globe and weigh the velocity of the motions which must in a day and a night make an entire revolution, I cannot persuade myself that there is any man who believes it more reasonable and credible that it is the celestial sphere that turns round while the terrestrial globe stands still (Qtd by Gerald Holton and Duane H.D.Roller…,156).

He also explained the dilemma of why the earth will not spin off its axis and why objects thrusted upward on earth do not fall before or after the spot they were thrown since according to Copernicus the earth was moving from West to East. He used the idea of universal attraction towards the sun to explain why the earth and other planets do not spin off during rotation and revolution. His attribution of the force of universal gravitation to both terrestrial cum celestial motion knocked out the Aristotelian claim that motion on earth is violent while celestial motion is perfect. He ushered the principle of inertia to explain the motion of projectiles to replace the notion of impetus of the Parisian. Galileo employed the experimental method to debunk Aristotle's claim that "heavier objects will fall faster than lighter ones". Beyond the myth and controversy surrounding the authorship of the Tower at Pisa experiment, Galileo who was a Professor at Pisa, is said to have used the experiment to demonstrate that a feather and a canon ball in a vacuum, thrown from a height, will land together since according to him, freely accelerated body do not gain weight. He showed that the acceleration of a falling body is proportional to time and independent of its weight and density. He explained that heavier objects seem to fall more speedily not because of weight but because of air resistance. Though some people view this experiment to be a thought/mind experiment rather than an actual one, but it is established that Galileo ensconced his experiments on elaborate mathematical pedestal. Butterfield affirms that Galileo said “the book of the universe was written in mathematical language, and its alphabet consisted of triangles, circles and geometrical figures” (102). An instance of his mathematical explanation of the universe came in the form of a law which posits that the force of gravity experienced by a body is inversely proportional to the distance of the body from the sun. So, it was Galileo that bequeathed the experimental mathematical method to the modern world.

The experimental mathematical method of Galileo would not have succeeded without the complementation of ideas and works of his predecessors, like Kepler’s copious mathematical laws of the universe derived from Brahe’s observation data, and his contemporaries and successors like Marin Mersenne; a scientific collector, Pierre Gassendi; a philosopher who also possessed encyclopedic scientific knowledge, Rene Descartes; a philosopher, mathematician and physicist, Thomas Hobbes etc. The historian Butterfield, describes Galileo as the father of modern mechanics and of experimental science and notes that:

Galileo gives the impression of having experimented so constantly as to gain an intimacy with movement and structures, he has watched the ways of projectiles, the operation of levers and the behavior of balls on inclined planes, until he seems to know them... the way that some know their dogs (105).

Sadly, since Galileo’s mechanics and astronomy validated the heliocentrism of Copernicus, and thus constituted an assault on Aristotelianism and Scholasticism, like Copernicus who was branded a fool and a heretic by Luther the reformer and the Church, the works of Copernicus, Kepler and Galileo were later proscribed under the *Index Librorum Prohibitorum* as false teachings and opposed to Holy scriptures and Galileo was made to recant and renounce his Copernican thesis. Though he submitted to the coercion of the Church in recanting his scientific thesis, it has to be stated that he only submitted his body to the pressure of the Church while his mind remained irrepressible. The submission of the mind entails the submission of the intellect. That can only be secured through the power of superior reasoning. Intellectual submission cannot be accomplished through physical force just like mundane force cannot be used to make a person understand the principles of science.this is why it is said that even when Galileo was tortured to recant, he bent to the ground and wrote "Galileo's repentance will not make the earth stand still".

Despite the status and fame of Galileo as the founder of classical mechanics, it was Isaac Newton who propelled it to its summit and pinnacle and it was based on the monumental synthesis of Copernicus, Kepler and Galileo in Newton's *Principia* that the works of the trio were acknowledged as non-contrary to the Bible and the inhibited triumph of those early pioneers of science was accomplished. (Tarcisio Agostoni, *Every Citizen's Handbook* 93).

Isaac Newton was the young Physicist who synthesized the researches of Copernicus, Kepler and Galileo into an organic formidable whole in his *Mathematical Principles of Natural Philosophy (Philosophia Naturalis Principia Mathematica)*.

Recognizing his debt to early scientist, Newton remarks that he was able to see beyond others because he was "standing upon the shoulders of giants" (Gerald Holton and Duane H.D.Roller *Foundation…*, 185)

Newton is famous in the world of science for his numerous legacies, one of which is the popular three laws which describe terrestrial motion.

Newton's Three Laws of Motion

The first law, which is also called the law of inertia, states that a body at rest continues to be at rest and a body in motion continues to be in motion, unless acted upon by an external force. It explains that all bodies are either at rest or in motion until acted upon by an external force which causes them to change from rest to motion or vice versa. This law is tenable at a certain macroscopic level where one seem to observe motion and cessation of motion. However, at the microscopic level, the fundamental units from which the macro world is constituted, is said to be at perpetual motion. Consequently, since the micro units of reality are perpetually in motion, the macro world which is made up of micro elements cannot be said to be capable of being at rest. Moreover, the idea of rest at the macro level is untenable considering the fact of constant rotation and revolution of planetary bodies. This law also presumes erroneously that it is possible for a body to exist without being acted upon by some natural forces. Such a state is nonexistent and mythical. There is no time that a body is not influenced by one external force or the other. Even when bodies appear to be in a seeming state of rest or motion, there are forces acting upon them.

The second law states that a force acting on a body causes a change in momentum proportional to the applied force and in the same direction as that of the force. Alternatively, this law says that the acceleration of a body is directly proportional to the net force acting on it and inversely proportional to the mass of the body. The formular is F(Force)=m(mass) × a(acceleration). This law says that acceleration increases or decreases proportionally and in accordance with the magnitude of the applied force. This law might have high degree of utility at the macro level, but at the micro level where we cannot determine the momentum and the position of micro-particles with certainty, this law crumbles.

The third law states that there is always an equal and opposite reaction to every action. In explanation, the law says that when you stand on the ground pressing it; exerting a downward force on it, there is an upward force exerted by the ground on you. This is why objects maintain equilibrium where the net force is zero and each force cancels out the other. This law is also beset by the problem of uncertainty at the micro level. Apart from Newton's achievement in Dynamics as revealed in his laws of motion, he also made groundbreaking achievements in astronomy which include his law of universal gravitation and the invention of the reflecting telescope. His law of universal gravitation is discussed below.

Newton was still struggling to make sense of how his terrestrial laws relate to celestial motion, when in a contemplative leap occasioned by his observation of the falling of some fruit from a tree, he deduced:

From whatever height in our hemisphere these bodies might fall, their fall would certainly be in the progression discovered by Galileo, and the spaces transverse by them would be equal to the square of time taken. This force which makes heavy bodies descend is the same, with no appreciable diminution, at whatever depth one may be in the earth and on the highest mountain. Why shouldn't this force stretch right up to the moon? And if it is true that it reaches as far as that, is it not highly probable that this force keeps the moon in its orbit and determines its movement? But if the moon obeys this principle, whatever it may be, is it not also reasonable to think that the other planets are similarly influenced? (Qtd by Voltaire, "On Mr. Locke and On the System of Gravitation", 145**)**

Utilizing his laws of terrestrial mechanics, Kepler's three laws of celestial mechanics, and Galileo's law of inertia, and his contemplative leap, Newton demonstrated and broached the principle of universal laws of motion which hold that the laws of physics that operate on earth also operate in heaven and the principle of universal gravitation which holds that all bodies in the universe are acted upon by the force of gravitational attraction and in reaction exert the same force of attraction on one another and as such are kept in uniform motion.

These postulates of Newton dealt the final blow to Aristotelian cum scholastic dichotomy between terrestrial and celestial mechanics and explain the puzzle of what kept planetary bodies in motion. Newton's mechanical reductionistic explanation of the universal phenomena in natural laws earned him the pride of place as the synthesizer of classical mechanics whose prominence is captured in Alexander pope's famous couplet:

"Nature and nature's laws lay hid in night: God said let Newton be! And all was light (qtd by Alexandre Koyre, "The Significance of the Newtonian Synthesis," 136)

Philosophical Assumptions of Classical Mechanics

According to Classical physics, which is mostly based on the theories of Newton, the following philosophical assumptions could be deduced:

1. Mechanistic view of the universe: The universe is viewed like a clock or giant machine whose parts function in perfect harmony and regularity.

2. Determinism, Certainty and Prediction: Explaining these assumption as it pertains to Newtonian mechanics, Gary Zukav (*The Dancing Wuli Masters* 50 – 51) observes that through the laws of motion of Newton, we can predict or retrodict (predict backward in time) with precision. Thus if we know the position and velocity of an object any where, we can predict where it will be at a certain time in the future or where it was at a certain time in the past. This implies that nature is determined and that every effect has a cause and hence that scientists can describe nature with certainty. Both Newtonian and Quantum mechanics are alike in being predictive. The difference is that prediction in Newton is certain while it is uncertain and probable in Quantum mechanics

3. Absolutism: The determinism of Newton mechanics implied the necessity of the existence of some absolute measurement systems, quantities or dimensions. In his "Scholium on Absolute space and time" (136 – 137) Newton discusses the existence of Absolute Time, Absolute Space and Absolute Motion as extrinsic reference frames that are unchanging and immovable. Newtonian reality is objective while the Quantum reality is relative or observer created.

4. Dualistic Conception of reality as particle or wave.

Albert Einstein and the Transition from Classical to Quantum Mechanics

Granted that the old Aristotelian mechanics reached its anticlimax in Newtonian mechanics, Newtonian mechanics which was the pinnacle of classical mechanics met its anti-climax in Einsteinian mechanics and mechanics finally transited to the Quantum. Relating this point, Heinz R. Pagels observes that:

Like Isaac Newton two centuries before him, Albert Einstein is a major transitional figure in the history of physics. Newton accomplished the transition begun by Galileo, from medieval scholastic physics to classical physics; Einstein pioneered the transition from Newtonian physics to the Quantum theory of atoms and radiation, a new non-Newtonian physics. (*The Cosmic Code* 5)

The accomplishment of Einstein in the area of physics is gargantuan. Here, we can only sketch an outline of his transitional feats from classical to quantum mechanics which are contained in his *Annus Mirabilis* (Miracle or Wonderful Year) papers published in 1905 in the journal, *Annalen der Physik*. The four papers were on Special Theory of Relativity, Photoelectric effect, Brownian Motion and Mass Energy Equivalence. The essential ideas and submissions of those papers will be discussed in the accompanying discourse.

1. **Special Theory of Relativity (STR)**:

The STR of Einstein is predicated on two postulates namely, the **relativity of motion postulate** and the **constancy or absoluteness of light velocity postulate.**

i. **The relativity of motion postulate**

Prior to Einstein, Isaac Newton had introduced three absolute quantities in his mechanics, namely, absolute motion, absolute time and absolute space. The term 'absolute' is employed to qualify these quantities to portray their non-contingency, independence and unconditional existence.

Motion is said to be a displacement or change in position. Galileo had earlier observed that for motion of a body to be established, it has to be done by relating it to the motion of another body. This means that how fast or how slow an object moves depends on how slow or how fast another object moves. Galileo ruled out the possibility of motion that can occur without being related to another motion. In essence, Galileo supported the principle of relativity of motion and opposed the idea of absolute motion; a kind of motion that is independent of other motions. Galileo's principle of relativity is documented in his "Dialogue Concerning the Two Chief World Systems". In this dialogue, he recorded that it will be impossible to decide whether an object is moving or at rest without relating or comparing it to another object.

Galileo advanced this idea of relativity of motion to a law of physics and noted that this law does not change in all inertial reference frames. This means that motion is universally a relative and not an absolute quantity. The relativity of motion postulate can further be illustrated using the observation of two persons; one in the train and one on the platform. The person on the platform sees himself to be standing still while the person in the train and the train are moving. In the reverse, the person in the train sees himself to be standing still while the person on the platform seems to be moving past him. A deeper reflection reveals that everything, including the train, the person in the train and the one on the platform are all moving because the earth itself on which they are is moving. The earth, the sun and the galaxy are constantly in motion relative to each other. Though everything in the universe is in motion, there is no way of determining that motion is occurring except we compare or relate the motion of one entity to the other. This proves that motion is not an absolute independent quantity but relative.

Under this framework of the relativity of motion, it should be noted that the speed of entities from one reference frame to the other changes or varies depending on the reference frame. For instance, your speed while in a car moving at 100km/h is different from speed you have while walking on the road. This describes Einstein's first postulate of relativity which avers that motion is relative and varies from reference frame to reference frame. However, Einstein in his second postulate, pointed out that though the relativity of motion makes everything to change speed depending on reference frame, there is an entity whose speed is not affected by the relativity of motion. This entity is light. The speed of light remains constant or absolute from reference frame to reference frame. This will be explained in the discussion on the second postulate.

Newton appreciated the idea of relativity of motion, however, he reasoned that for an object to be able to come to rest or be in motion; as contained in his first law of motion, there must be an underlying perpetual absolute motion which provides the framework for things to be at rest or in motion. Evidently, it is plausible to assert that Newton's conception of absolute motion was to provide a justification for his first law of motion.

Einstein's first postulate of relativity which is called the relativity of motion postulate, was simply a restatement or reaffirmation of the Galilean principle of relativity. It portrayed the meaninglessness of absolute motion by reiterating the Galilean relativity principle. Einstein did not stop at just repudiating the idea of absolute motion, he also extended the principle of relativity of motion to the electromagnetic realm. The principle of relativity which was propounded by Galileo in the 17th century was thought to only apply to the realm of mechanics and not that of electromagnetism. 19th Century Physicists reasoned that Galilean relativity will not apply in the electromagnetic reference frame since that reference frame falls outside of the laws of mechanics contemplated by Galileo and Newton. The laws of electromagnetism which consisted of a different set of equations formulated by James Clerk Maxwell were different from the laws of mechanics propounded by Galileo and Newton. Motion in the electromagnetic realm is said to be faster than any observable motion in the mechanical realm. Maxwell's calculated speed of electromagnetic waves gave the same result as the speed of light calculated by Ole Romer in 1676. This result corroborated the fact that light itself is an electromagnetic wave. The radical contribution of Einstein in this scheme was his revolutionary opinion that Galilean relativity principle should be applied to the electromagnetic realm. Elucidating the reason for his extension initiative, he notes that "the principle of relativity must therefore apply with great accuracy in the domain of mechanics. But that a principle of such broad generality should hold with such exactness in one domain of phenomena, and yet should be invalid for another, is a priori not very probable" (Albert Einstein, *Relativity: The Special and the General Theory*. Transl. Robert Lawson. New York: Crown. 1961. 18-19). It has to be remarked at this juncture that Einstein's pursuit to generalize the principle of relativity and unify the two domains turned out to be a mantra that pervaded his entire intellectual sojourn.

ii. **The constancy or absoluteness of the velocity or speed of light postulate**

This postulate asserts that the speed of light is constant or absolute in all inertial reference frames. Einstein's quest to extend the principle of relativity to the electromagnetic realm was an attempt to universalize the laws of physics across all reference frames. This encountered a seeming incompatibility because all speeds in the mechanical realm are supposed to be varied or relative. However, the speed of light appears to be inconsistent with this tenet of relativity because the speed of light does not vary or change in-spite of whether the reference frame is fast or slow. Light travels at an unsurpassable speed of 300million metres per second which is about 186,000 miles per second or 7½ times around the earth. This speed of light is absolute because no matter the medium that light passes through, it does not alter its motion by being slower or faster like the speed of other waves like sound or other bodies and objects who change their speed or motion relative to the medium in which they travel or their inertial reference frames. Exposing what appears to be incompatibility, David Eckstein explains thus:

Thus this beautiful theory of Maxwell, which was distilled out of a large body of experimental work and which itself was afterwards splendidly confirmed, demonstrates that the speed of light in a vacuum is a constant of nature. If we accept that the relativity principle not only applies to mechanics, then it must also be true that Maxwell's equations apply in any inertial frame, with the same values for the constant of nature. The speed of light would be a constant whose value would be the same in every inertial reference frame. The speed of the forward shining light of a forward moving locomotive must be exactly equal to that of one at rest or even one moving backwards! The speed of light is thus independent of the movements of its source. This however contradicts the vector addition of speeds which we have presented as a fact within Newtonian mechanics. (Eckstein, David. *Epstein Explains Einstein: An Introduction to both the Special and the General Theory of Relativity*. GmbH Berlin, www.epubli.de. 2013)

Contrary to the apparent incompatibility or irreconcilability between the absoluteness of the speed of light and the principle of relativity of motion, Einstein notes that " in reality there is not the least incompatibility between the principle of relativity and the law of propagation of light" (Albert Einstein, *Relativity: The Special and the General Theory 19-20).*

The most significant research of Einstein among others was in determining the nature and relationship between space and time. Classical mechanics held that space and time are absolute dimensions of measurement. Einstein in his "Special Theory of Relativity" (Online) holds to the contrary that time and space are relative dimensions dependent on inertial reference frame. An Inertial reference frame is the frame of reference that is in constant uniform motion. Since all the inertial frames are in relative motion, Einstein deduces that there is no motionless absolute fixed frame of reference anywhere in the universe. All motion is seen as relative to some other moving body. Therefore if two systems move relatively to each other, it implies two different spaces and two different times. Thus there is no simultaneity of occurrence based on simultaneous time and space but the seeming simultaneity of occurrence is relative to time, space and motion.

Einstein's position was based on his postulate that the speed of light is constant in all inertial reference frames contrary to the classical position that light changes in speed as it crosses from one frame to the other. Einstein demonstrates this absoluteness of light by showing that no object has been able to reach the speed of light in that if any object attempts approximating it, the object will be shredded into particles of energy which is transformed into light itself. This idea is implied in his equation $E = mc^2$, meaning that energy, E is equivalent to m(mass) x speed of light (c)squared.

The relativity of time and the contraction of space concepts and and other very crucial ideas were generated from Einstein's STR. Einstein was led to the proposition of these concepts from the insights he derived from the various thought experiments (Gedankenexperiments) he conducted. A thought experiment is an imaginary intellectual conception of event which is seemingly contrary to real life experience. This character of or element of being apparently opposed to experiential facts makes it to be otherwise called a counterfactual experiment. Some of the thought experiments associated with Einstein are:

a) **The Light Beam Chase: Special Relativity**

Einstein imagined himself chasing a light beam. He realized that if he were to catch up to the light, time would appear to stand still for him relative to outside observers. This led him to propose the special theory of relativity.

b) **The Elevator: Equivalence Principle**

Einstein envisioned an elevator in free fall. He realized that the effects of gravity are equivalent to the effects of acceleration. This thought experiment led to the development of the general theory of relativity.

c) **The Train and Platform: Relativity of Simultaneity**

Einstein imagined two observers, one on a train and the other on a platform. He demonstrated that two events simultaneous for one observer may not be simultaneous for the other, challenging traditional notions of time and space.

d) **The Twin Paradox: Time Dilation**

Einstein imagined that if we have a set of twin on earth and one is sent off to space on a speed approaching the speed of light, time for the twin going to space will be slower than time for the twin on earth. Thus, when the twin going to space returns, the twin on earth will be far older than the one that travelled due the fact of time dilation when an object approaches the speed of light.

e) **The Photon Box: Quantum Mechanics**

Einstein imagined a box containing photons. He demonstrated that the energy of the photons is quantized, laying the foundation for quantum mechanics.

f) **The Riverboat: Relativity of Length**

Einstein envisioned a riverboat moving downstream. He illustrated that the length of an object appears shorter to an observer in motion relative to a stationary observer.

g) **The Moving Rod: Relativity of Length**

Einstein pictured a rod moving relative to an observer. He demonstrated that the length of the rod appears shorter to the observer due to length contraction.

These thought experiments demonstrate Einstein's creative and intuitive approach to physics. By exploring complex concepts through simple, imaginative scenarios, he was able to challenge conventional wisdom and develop groundbreaking ideas. Some of the extraordinary spooky notions generated from these thought experiments include:

The Notions of Time Dilation or Time Relativity and Length Contraction: Prior to Einstein, they were various conceptions of time. Time was conceived variously as mystical, subjective, unknowable, divine etc. Isaac Newton, through the works of Galileo, was able to reduce time to a mechanical, measurable, predictable and absolute quantity. Time was an absolute for Newton because it was an objectively given phenomenon. Since Time was conceived by Newton as absolute and objective, it means Time does not depend on or relate with any other parameter for its determination. Time for Newton exists independently of motion and space. This absoluteness and independent existence of time devoid of the influence of other parameters was what Einstein overturned and overhauled using his light beam chase thought experiment. Time dilation implies that time goes slower if an object is moving at the speed of light and time gets faster if an object is moving slower than the speed of light. This proposition suggests that time is relative to reference frame. Hence the time dilation or the relativity of time proposition refutes Newton's assumption of time as an absolute. Einstein also used his thought experiments to demonstrate that length or space contracts or reduces if an object approaches the speed of light and increases when an object is slower than the speed of light.

2. **General Theory of Relativity**: Einstein in 1915 proposed his general theory of relativity ("Einstein's Theory of General Relativity" www.space.com/theory-general-relativity.html) This theory extended his relativity concepts of space and time established in his Special Theory of Relativity to cover the Gravitational field and this resulted in a universal law or general theory that applies throughout the cosmos akin to Newton's universal Gravitational law. In his research, Einstein established the energy-mass equivalence and notes that everything that is massive contained an energy that attracts other massive bodies hence making the space near it to be curved. But every matter (object) is a conglomeration of space and time because matter cannot exist in oblivion but in a particular place and at a

particular time. Since matter is equivalent to energy, the curvature of space caused by the energy attraction between bodies is the curvature of space-time. Thus, the attractive force that Newton called 'gravity' is the curvature of space and time. This development decapitated Newton's universal law of gravitation and in its place emerged Einstein's General Theory of Relativity.

Einstein's General Theory of Relativity overturned the idea of an independent objective space presupposed in Newton's Universal Gravitation Theory. Einstein asserts thus:

I wish to show that space time is not necessarily something to which one can ascribe to a separate existence, independently of the actual objects of physical reality. Physical objects are not in space, but these objects are spatially extended. In this way the concept of empty space loses its meaning ("Quantum Physics…." Online)

3. **The Photoelectric Effect**: In his paper of 1905 Einstein asserts that electrically charged particles are emitted by a metal when a beam of light shines on its surface. This phenomenon is called "The Photoelectric Effect" (*Cosmic code* 14). Einstein was able to deduce the characteristic nature of light from this phenomenon. Based on his observation, Einstein asserts that light was made up of particles containing the light quanta (energy), photon or tiny packets of energy. This position contradicted the classical position which held that light is wavelike. The discovery of Einstein reveals that the explanatory power of classical mechanics is not adequate in explaining the behaviour of subatomic particles like photon. This discovery of Einstein inaugurated the search by physicists for the proper unveiling of the nature of subatomic particles which culminated in Quantum mechanics.

Also, Einstein's discovery of the paradoxical nature of light had a devastating effect on his General Theory of Relativity(GTR). The GTR involves the extension of the Special Theory of Relativity(STR) to planetary bodies and the whole universe. The extension of the STR to the entire universe was premised on the fact that the universe is a continuum like a field and not discontinuous like the Quanta photon. Now that the universe has been shown to be made of discrete (discontinuous) particles and also as wave-like, the GTR of Einstein which was based on the continuous conception of the universe collapses. Realizing the devastating effect this has on his theory, Einstein said, "I consider it quite possible that physics cannot be based on the field concept, i.e. on continuous structures. In that case, nothing remains of my entire castle in the air, gravitation theory inclusive (and of) the rest of modern physics" ("Quantum

Physics," online). Physicists like Heinz R. Pagels regard Einstein as the last classical Physicist. He notes that "Einstein, who opened the route to the new quantum theory that shattered the deterministic world-view rejected the new quantum theory. He could not intellectually accept that the foundation of reality was governed by chance and randomness" *The Cosmic Code: Quantum Physics as the Language of Nature 62)*

QUANTUM MECHANICS AND THE UNIFIED FIELD THEORY

This branch of physics is a derivative of two terms "Quantum" and "Mechanics". Gary Zukav (*The Dancing Wuli Masters: An Overview of the New Physics* 45) explains that "quantum" means quantity or specific amount of something whereas "mechanics" stands for motion. Thus, Quantum mechanics is the study of the motion of quantities. Quantum theory opines that nature comes in "Quanta" (bits and pieces or discrete quantities) which may appear as particles or waves in nature. Quantum mechanics is the study of this phenomenon of the particle–like and the wave-like nature of matter.

Quantum mechanics unlike Classical mechanics, studies the behaviour of matter at the subatomic or micro-level. The idea of the indivisibility of atoms was still prevalent in Newton's age (1600s) until the 1800's when physicists started investing efforts in the study of the atomic and subatomic phenomena.

Quantum mechanics (John O. Norton, "Origin of Quantum Theory", online) came to the fore and became prominent in the year 1900 when Max Planck experimented with the black body radiation. Radiation involves the dissemination of energy from a source. A body that absorbs all the radiation that falls on it before re-radiating it is called a black body. Planck discovered that excited atomic oscillators (black bodies) emit and absorb energy only in specific quantity (quanta) or (packets of energy). This remarkable position concerning the nature of subatomic particles contradicted the classical mechanics position that energy is released in a continuous form like the wave which was in consonance with the continuum conception of nature. Going by Planck's discovery, the subatomic world is discontinuous or discrete in nature as against the continuous nature of the macro-world. Albert Einstein keyed into this idea and made an audacious move by "stating that light consists of packets or discrete energy which he called photons" (Princewill Alozie, *Philosophy of Physics* 103) Unlike Planck who said that energy comes in quanta (packet forms), Einstein said that light itself is energy in quantized form. Bearing in mind his equation of the equivalence between energy and light, one will not be surprised by this description. The implication of this photoelectric effect is that light which was conceived by the classicals as a wave in allegiance to the wave theory of light of Thomas Young is now seen as possessing particle-like or corpuscular nature.

Strikingly, Quantum mechanics commenced on a paradoxical note. Prior to the discovery of Max Planck, the traditional notion about energy was that energy flows in a continuum like a smooth, unbroken stream of water. Planck's experiment with the radiation of black bodies which resulted in the finding that energy could be emitted or absorbed in discrete form was very odd as it implies that energy is not continuous but discontinuous against the traditional position. This result appears so incredible even to Planck, that he doubted it and only gave it credence when Einstein corroborated it in 1905 with his position that light (energy) is also emitted in discrete particles quanta or photons. Prior to this time, light had been viewed as a continuous electromagnetic wave ("Quantum physics: Quantum Theory/wave mechanic." Online). The position of Planck and Einstein led to the paradox that light behave both as a continuous e-m wave (conceived by Maxwell in his electromagnetic theory of light and Einstein) as well as a discrete particle/photon(as conceived by Planck and Einstein) All the attempts by Physicists to use the classical model to explain this behaviour of atoms were unsuccessful. This aroused the curiosity of scientists to begin to study the fundamental structure of matter more closely ("quantum theory".www.thebigview.com/spacetime/quantumtheory.html). Neils Borh was one of the radical band of scientists who attempted to explain this weird nature of the fundamental particles of reality. Borh solved the mystery by using the analogy of the solar system to explain the structure of an atom. Just like the solar system has many planetary bodies orbiting the sun, so does an atom with many tinier particles called electrons orbiting the nucleus. He said that electrons used to leap from one fixed orbit to the other in what is called Quantum Leap. This happens when an atom is heated and the electrons become agitated or excited. It is the leap of electrons that use to emit energy in the form of light. The most curious development about this leap is that the electron leaps from one orbit to another mysteriously without transversing the space in between the orbits. He argued that the leap occurred in such a weird manner because the energy of an electron is emitted in a discrete, noncontinuous manner such that it cannot be subdivided. Thus an electron is either in one orbit or the another and cannot be in between.

The works of Planck and Einstein had a remarkable effect on Prince Louis De Broglie (Alozie, 104) which made him to postulate that particles of matter should similarly exhibit wave-like behavior since the light wave of Planck and Einstein exhibits particle-like behavior. Buttressing his radical position, De Broglie asserts thus:

On the one hand the quantum theory of light cannot be considered satisfactory since it defines the energy of a light particle(photon) by the equation E=hf containing the freguency f. Now a purely particle theory contains nothing that enables us to define a frequency: for this reason alone, therefore, we are compelled, in the case of light, to introduce the idea of a particle and that of frequency simultaneously. On the other hand, determination of the stable motion of electrons in the atom introduces integers, and up to this point the only phenomena involving integers in physics were those of interference and of normal modes of vibration. This fact suggested to me the idea that electrons too could not be considered simply as particles, but that frequency(wave properties) must be assigned to them also ("Quantum Physics," online)

Thus, De Broglie imputed the particle-wave duality to both light and wave.

Erwin Shrodinger, impelled by De Broglie's matter-wave hypothesized that electrons which are conceived as hard spherical particle revolving around a nucleus of an atom, according to Bohr's planetary model of an atom, are not spherical particles but patterns of quantized standing waves. This was in consonance with Planck, Einstein and De Broglie.

A detailed account of the contributions of different scientist to the Quantum phenomenon is monumental and variegated. However, the varied strains are encapsulated and synthesized in the different postulated principle and canons of interpretation postulated by the quantum scientists in their exposition of quantum theory. What follows is only an anecdote of the broader picture to the effect that it is simply a synopsis that highlights the most salient principles and interpretations of Quantum Mechanics.

Principles and Canons of Explanation of the Subatomic (Quantum Mechanics) reality

1. **Wolfgang Pauli's exclusion principle**

Prior to Shrodinger's discovery of electrons as "standing waves," Wolfgang Pauli' in 1925 discovered that no two electrons can exist in an atom with exactly the same properties. Pauli observed that the presence of an electron with one particular set of properties excluded the presence of an electron with a similar property. Pauli's finding came to be called the exclusion principle.

2. **Max Born's indeterminacy principle**.

Reflecting on Schrodinger's identification of electrons as standing waves, Born observed in 1926 that those waves are not real entities but are probability waves. Heinz Pagel (62) remarks that Born's interpretation marks the birth of the idea of the God who plays dice and the end of determinism in physics. Born's position explains that since subatomic phenomena possess this dual properties and there is no precise way of predicting the outcome of single measurement of those properties then all that quantum theory could predict is the probability that a quantum phenomena will possess this or that property. Thus it is the probability or statistical approach rather than the precise, deterministic approach that can be used in measuring quantum phenomena. This entails that quantum phenomena possess an indeterminable nature hence Born's principle was called the principle of indeterminacy.

3. Heisenberg's uncertainty principle

In 1927, Werner Heisenberg postulated the uncertainty principle guiding quantum phenomena. The mathematical background of this principle is traceable to Heseinberg's Matrix mechanics. In his matrix mechanics (Pagels 69-70) he showed that if two matrices, p and q are used to represent the physical properties of position and momentum of a particle and they have the property that p x q does not equal to q x p, then it is impossible to simultaneously measure the momentum and the position of the particle with precision or certainty. Heisenberg discovered that in the subatomic realm this kind of uncertainty prevails.

In his exposition of this notion of uncertainty, Karl Popper said "according to Heisenberg's uncertainty relations, every measurement of the position interferes with the corresponding measurement of the component of the momentum" (*The Logic of Scientific Discovery*, 219) Describing the uncertainty interpretation of quantum theory, Heisenberg said "the more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa" ("Uncertainty Principle" whatis.techarget.com/definition/uncertainty-principle). Heisenberg's uncertainty principle constitute the major theoretical framework for the Copenhagen interpretation of Quantum mechanics.

4. Bohr's Complementary Principle

Sequel to the indeterminacy and the uncertainty principles of Born and Heisenberg, the philosopher Bohr offered a philosophical interpretation to the wave-particle duality, position-momentum contradictory relationship of subatomic reality. Pagels (75-76) explains that according to Bohr, the wave-particle behaviour of an electron, though mutually exclusive or contradictory are never the less complementary properties of the same reality in the absence of which knowledge of the subatomic reality will be inadequate. This means that though the observation of one of these properties of the subatomic reality excludes or blurs the observation of the other, knowledge of the two is fundamental for the holistic understanding of the reality.

5. Copenhagen Canon of Interpretation

The uncertainty principle of Heisenberg and Bohr's complementary principle constitute what is called the "Copenhagen interpretation of quantum mechanics". It is called the Copenhagen interpretation because Bohr and his research assistant Heisenberg were working in the German town called Copenhagen. Pagels (76) remarks that the two vital points that emanated from the work of the duo, which constituted the Copenhagen canon of interpretation are:

i. Quantum reality is statistical and not certain.
ii. The physical properties of quantum objects are observer cum experiment created, thus, there is no objective world in which these properties existed independent of observation.

Summarizing the Copenhagen interpretation, Pagels says:

…the Copenhagen interpretation of the Quantum theory rejected determinism adopting instead the statistical nature of reality, and it rejected objectivity, accepting instead that material reality depended in part on how we choose to observe it. After hundreds of years the world view of classical physics fell (77)

Bohr presented the Copenhagen interpretation of quantum theory in 1927 in a conference where distinguished physicists and Einstein were in attendance. Einstein criticized this interpretation virulently because of the embedded indeterminism of reality presupposed in the interpretation. The substance of his reaction against the Copenhagen interpretation constituted what is called the ERP argument.

6. Einstein, Podolsky and Rosen (EPR) interpretation.

This disagreement between Einstein and Bohr over the Copenhagen interpretation led to Einstein coming out in 1935 with a position in the paper "Can Quantum-Mechanical Descriptions of Physical Reality be Considered Complete?" (Zukav 300) alongside Boris Podolsky and Nathan Rosen. Basically, their argument is that quantum theory, going by the Copenhagen interpretation, is incomplete since there are some aspects of reality that it cannot explain. In the "thought experiment" they proposed to debunk the uncertainty of the quantum theory, Pagels (140) explains that they argued that the position and the momentum q and p of two particles 1 and 2 who upon interacting at point p, fly away to London and New York respectively, can be measured simultaneously without uncertainty, that is, without the measurement of the position and momentum of particle 1 altering the momentum and the position of particle 2. Thus, if the sum of the momentum of the two particles is $p = p_1+p_2$ and the distance between the two particles is q $=q_1-q_2$, then the momentum of particle 2, is $p_2 = p1-p_2$ and the distance of particle 2 is, $q_2 = q_1-q$. Though the measuring of position q_1 may blur the previous measurement of its momentum p_1 of particle 1, but it will not alter the deductions for particle 2. Note that at the point of interaction of the particles, the two of them become alike in properties and as such the determination of the momentum and position of one implies same determination for the other. The EPR thought experiment assumes that the determination of the quantities of particle 1 cannot instantaneously influence and blur the determination of the quantities of particle 2 because they are far apart and there is no mediation or causative link between them. The EPR's position is based on the assumption of local causality principle. This principle, according to Pagels states that "distant events cannot instantaneously influence local objects without mediation" (139).

The EPR experimenters then assert that there is a way of determining simultaneously the position and momentum of subatomic object without uncertainty. Hence, they conclude that the Copenhagen quantum interpretation is incomplete in its explanation of quantum phenomena.

Latest Trend in Quantum Mechanics: The Unified field theory et al.

Einstein was distressed by the emerging contradiction and incompatibility between macro and micro mechanics as brought out in the principle of determinacy presupposed by the former and indeterminacy implied in the later. Stephen Hawking (*A Brief History of Time* 163-164) explains that Einstein particularly objected against quantum mechanics introduction of unpredictability and randomness in science, despite the fundamental role he played in its emergence. He never accepted the quantum indeterminacy principle because according to him" God does not play dice" and accepting it will entail that the universe is governed by chance.

In his attempt to remedy science from this bleak outcome, he started working on the possibility of unifying his general theory of relativity - which explains all the phenomena on the macroscopic level, with electromagnetism - which describes the behaviour of subatomic properties. It is said that Einstein dedicated the rest of his life, unsuccessfully, to working out the unification of relativity and quantum theory ("Uncertain Principle," online). Inspired by Einstein's effort, other Physicists developed a new model called "string theory" during the 1960s and 1980s. Describing the meaning of string theory, Katrin Becker et al (20) observe that string theory rose because of the attempt to understand the strong unclear force that is responsible for holding protons and neutrons inside the nucleus of an atom as well quarks inside the protons and the nucleus. It is intended to be used for the ambitious purpose of constructing a theory that unifies general relativity or gravity which deals with the macro realities and quantum mechanics which deals with the micro realm of the non-observable or very small.

The goal behind the string theory is to present a unified theory that will explain all the fundamental laws of nature completely. The string theory will then assuage Einstein's fear that quantum mechanics is incomplete because it seems to contain the possibility of a causality violating action- at- a- distance.

However, the success of the string theory is limited because the theory has not been satisfactorily corroborated and because there are up to five competing string theories. To remedy the second limitation of the string theory, Physicists have designed what is called the M-theory which is intended to unite all existing string theories in 11 dimensions ("Uncertainty Principle", online).

A philosophical scrutiny of the trajectory of mechanics from the Ancient to the Contemporary era.

The gradual developmental evolution of mechanics from the ancient to the contemporary calls for an insightful philosophical scrutiny of the dynamics of such development. Here, we avail you of such scrutiny that will unravel the deeper implications of this trajectory.

1. **Metaphysics/Mysticism cum Science Curvature:** The development of mechanics projects a trajectory from the ancient Aristotelian supernaturally determined universe through the modern Newtonian mechanically determined (clock like) universe to a contemporary interlude of uncertainty and a final consummation in a notorious unification of the determinable and the indeterminable in the M-theory.

In this framework, the Germanic wall that separated the scientific realm of strict precision and determination breaks down to accommodate the metaphysical and mystical realm of unpredictability, imprecision and unobservability. The emerging and prevailing universe is no more that of demarcation between science and non-science but that of metaphysics/ mysticism cum science curvature where precision meets imprecision, determination folds into indetermination, certainty synchronizes with uncertainty, the physical is assimilated by the spiritual and the spiritual is penetrated by the physical. This universe is no more the Einsteinian universe of space-time curvature but that of metaphysics-science curvature and interpretation. This ultimately vindicates the African world-view of extra-ordinary interpretation between the physical and the spiritual which is demonized by western and allied thinkers.

2. **The demise of the Kantian phenomena/noumena dualism and the rejuvenation of the Berkeleyan subjective Idealism:** The Kantian world-view of demarcation between the experiential phenomenal world and the the ideal antinomial noumena, created an objective world independent of the mind, upon which man imposes his rational categories to comprehend. This Kantian objective realism diffuses with the emergence of the observation-created quantum reality. Thus the subjective idealism of Berkeley where the observed realities are essentially mind dependent devoid of any objective existence has re-emerged.

3. **Causality becomes a Quantum Causality and gives birth to the spurious action-at-a distance:** The indeterminacy, probability and uncertainty principles of quantum mechanics submit that we cannot simultaneously predict the position and momentum of the sub-atomic particles which constitute the irreducible elements with which the macro- world is constructed. By virtue of serving as the building blocks of macro phenomena, the macro world is ipso facto entrenched in the same attributes of indeterminacy, uncertainty and probability. Mechanical cause and effect relationship is not therefore absolutely tenable even in the macro world since it is an offshoot of the indeterminable micro-particles. This implies that the spurious action-at a distance- that is, unmediated action, which holds at the subatomic realm where space and time collapses, is possible in the macro-realm. Hence causality; action mediation between objects becomes the casualty of quantum mechanics since determinism between cause and effect no more holds.

4. **Possible manifestation of the Apocalyptic eschatology:** The present state of the breaking down of disciplinary boundaries with its resultant crisis of disciplinary relevance sequel to the inevitable compulsive unification of all realms of knowledge seem to bring the universe closer to the brink whereby in the fullness of time, as prophesied in the Scriptures, there will be an apocalyptic cataclysm preluding the grand eschatological end. At this juncture knowledge will reunite with its universal author and the universe will reurn to its author.

Conclusion

Our discourse of Quantum mechanics actuated a historical tour of the development of mechanics from the ancient through the modern to the contemporary. Among our discoveries is the fact that motion which was deterministic in both the ancient Aristotelian and the modern Newtonian mechanics becomes shrouded in probability, indeterminacy and uncertainty in Quantum mechanics. Quantum mechanics therefore deals a mortifying blow on the principles of the ancient and modern mechanics.

Scientists like Einstein, who abhorred the quantum outcome of indeterminacy, faced with the impossibility of exterminating the barefaced and potent quantum reality swung into action with the aim of devising a construct that will connect the quantum realm of the unobservable with the macro observable realm. This effort culminated in emergence of the unified field theory, the string theory and subsequently the M-theory.

A scrutiny of the trajectory of mechanics from the ancient to the contemporary gives birth to some very insightful and intriguing philosophical implications with one of the ramifications being the replacement of the Einsteinian universe of space–time curvature by the emerging universe of metaphysics-science interpretation and hence knowledge therefore seems to have transcended from the *terminus a quo privatio* (realm of disunification and incompletion) to the *terminus and quem perfectio* (realm of unification and completion).

Article History
Received: 24-August-2025
Accepted: 30-August-2025
Published: 07-September-2025

Article Publication Details *(rpt*)*
This article is published in the **International Journal of Multidisciplinary Research and Bulletin**, ISSN XXXX-XXXX (Online). In **Volume 1 Issue 1 (September-October) 2025**
The journal is published and managed by **IRPG**.

Acknowledgements
We sincerely thank the editors and the reviewers for their valuable suggestions on this paper.

Funding
The authors declare that no funding was received for this work.

Data availability

No datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate

The author(s) declare that it is not applicable.

Consent for publication

The author(s) declare that this is not applicable.

Competing interests

The author(s) declare that they have no competing interests.

Author details

CHRISTOPHER ALEXANDER UDOFIA

DEPARTMENT OF PHILOSOPHY, AKWA IBOM STATE UNIVERSITY, NIGERIA

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