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Quantum Ripple Theory (QRT)

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Abstract

Aim/Purpose: The aim of this paper is to outline a new theory; Quantum Ripple Theory (QRT).

Design/Methodology: The Quantum Ripple Theory (QRT) and its conceptual model are described, and simulations designed for the evaluation of the validity of the QRT theory and model, are discussed.

Findings: QRT conceptual model and simulation design.

Conclusion: The simulations described here will be implemented. The results and findings of the simulations will be given in a subsequent paper.

Limitation: Taking an engineering approach first means that a conceptual model is established, and a framework built and assessed, before being constrained by the application of detailed mathematical notation from the outset.

Implication: Implications for reaching definitive conclusions and the mathematics are based on a strong foundation.

Originality: Entirely new theory and model proposed.

Keywords: Quantum Ripple Theory (QRT), quantum mechanics, classical physics, unifying theories

Introduction

The current view of the universe is that it must be composed of more than the electrons, neutrons, protons, or photons, etc, of the visible (classical) universe, to explain how different forces work or the composition of fundamental elements. This has led to the discussion of ideas such as: Quantum Mechanics and the Standard Model, String Theory, Quantum Field Theory (QFT), or Loop Quantum Gravity (LQG), to better describe and postulate the universe.

Quantum Theory or Quantum Mechanics is essentially a theory of the microscopic world of atoms and their constituents. Among its main principles are the dual wave-like and particle-like behaviour of matter and radiation (wave-particle duality), as well as the prediction of probabilities in situations where classical physics foresees certainties (Heger, 2022).

The Standard Model is based on quantum mechanics and Einstein's theory of General Relativity; in brief, it describes the creation of our visible universe. Beginning with the “Big Bang”, more accurately, a period of Cosmic Inflation which led to particles, including protons and electrons to combine, thus resulting in Cosmic Background

Radiation (CBR) and the release of light. This was followed by the "Dark Ages", prior to the condensation of matter into stars, etc (the visible universe).

In String Theory, the fundamental constituents of the Universe are one-dimensional strings rather than point like particles. String theory not only embraces gravity but necessitates it and is based on ten dimensions (more dimensions are evaluated as potential theories as well) (Heger, 2022).

Work in Quantum Electro Dynamics (QED) led to the theory of Quantum Field Theory (QFT). QFT depicts one of the best theories available today, as most of the predictions made by QFT turned out to be accurate. Further, QFT excels when it comes to describing most of the physical phenomena and the (strange) behaviour of the universe. Research focuses on the potential gravitation-graviton interaction that, in the future, may aid in further describing and understanding quantum gravity, dark matter and the universe in general.

In Quantum Field Theory (Heger, 2023), all the particles present in the universe are mainly divided into two categories: Bosons and Fermions. Fermions are accountable for constructing matter. Bosons on the other hand are force carriers. The Fermionic family is further decomposed into quarks and leptons. Presently, there are six different types of quarks known as up, down, charm, strange, top, and bottom, which form protons and neutrons inside the nucleus of an atom.

Quarks are not considered as stable particles, and hence they unite into a cluster to form hadrons. Hadrons can be broken down into mesons and baryons. Baryonic particles (protons and neutrons) are established by combining 3 quarks. Protons are compiled of 2 up and 1 down quark, whereas neutrons are constructed via 2 down and 1 up quark. The remaining 4 types of quark entities cluster together to provide new particles. Leptons describe particles that are not comprised of quarks, such as the muon, electron, tau, or the neutrino. These entities portray stable particles and so they do not join with one another to form other particles and therefore they can exist autonomously.

Heisenberg's uncertainty principle predicts the existence of those particles that exist without any cause, and their presence is probabilistic. Such particles are labelled as virtual particles (that are experimentally discovered). Irrespective of how odd these particles may seem to be, they always tend to follow a certain (specific) pattern; they always come in pairs where one element portrays a regular matter particle while the other one represents an antimatter particle. Antimatter particles are particles that have the same mass as the matter particles but are opposite in charge. When an electron is created, an antimatter particle is also produced alongside, that particle is labelled a positron, a positive electron. When matter-antimatter particles collide, they annihilate to produce pure energy. Like electrons, all the other leptons also have an antimatter pair.

Bosons (force carrier particles) can be described via four categories; photons, W/Z bosons, gluons, and (theoretically) the gravitons. Until the early 19th century, scientists assumed that electricity and magnetism represent two distinct forces. Today, these two forces are described as just distinct forms of the same force known as the electromagnetic force. Electricity or visible light are examples of that electromagnetic force (operated by photons). The weak nuclear force is known as the second weakest force and is responsible for beta decay (this occurs when in a nucleus with too many protons or too many neutrons, one of the protons or neutrons is transformed into the other). W/Z bosons are accountable for carrying the force. The strong nuclear force (the strongest force) is responsible for binding the nucleons (protons and neutrons) together in the nucleus of an atom. Gluons are the particles in charge of carrying the strong nuclear force. The gravitational force (the weakest force) may potentially be controlled by the gravitons (if they exist).

Then there is the famous Higgs boson; this particle was found by scientists at CERN in 2012, which matched the expected properties of a Higgs boson. This particle signifies the physical proof of an invisible, universe-wide field that gave mass to all matter right after the Big Bang, forcing particles to coalesce into stars, planets, etc.

Quantum field theory (QFT) can be described as the blend of quantum mechanics and field theory. Classical mechanics is more affiliated with determinism, implying that based on past information, it is possible to make predictions about the future. Quantum mechanics as a science is all about probabilities. With quantum mechanics, the act of taking a measurement, results in altering the reality of physical phenomena. The combination of all possible outcomes of a particle is described via a wave function that defines the intrinsic properties of the quantum particle such as position or momentum. In general, humans normally observe the materialistic world while most scientists examine a world based on matter and fields.

In physics, empty space is not necessarily empty. While pointing two magnets with the same pole towards each other, a repulsive force is encountered. The area between the magnets seems empty but the experiment shows that there is some sort of force acting in-between the magnets. The space that is perceived to be empty contains a magnetic field. Similarly, empty spaces in the universe are not empty as they hold fields (such as the Higgs field). That notion reflects the basic concept of quantum field theory.

Quantum field theory states that; everywhere in the universe and at every instant of time, there are various types of fields that humans cannot observe, such as magnetic fields, electric fields, or gravitational fields. Taking this concept even further, it can be stated that every elementary particle has its own field (such as the Higgs field or the quark field). Physicists represent these fields via numbers. One or more of these numbers exist in every point of space. The fields are decomposed into various types depending upon how many numbers a field requires. To illustrate, the Higgs field represents a scalar field as at every point of space it requires a single number to describe the field. Electric and magnetic fields depict vector fields as they necessitate a magnitude and a direction to describe them. It is important to point out that according to Newton, the gravitational field is a vector field whereas Einstein described it as a tensor field.

A tensor field portrays a function that inputs coordinates (x, y, z) and returns a tensor. In a nutshell, tensors are multi-dimensional arrays of numbers in a rectangular shape. They can represent a lot more information than simple scalars or matrices. When these fields are provided with energy, they switch to higher energy states, a process that results in ripples. These ripples are now labelled as particles. To clarify, when ripples are fashioned in the electron field, electrons are formed. Or when ripples are moulded in quark fields, quarks are formed. When these ripples turn silent, the corresponding particles disappear. The point where the energy is injected into these fields basically depicts where the particles are formed, and as the energy starts to spread across the field, the particles are moving. Depending on the field, various amounts of energy are needed to produce the particles. The primary factor that determines how much energy a field demands (to generate a particle) depends on the mass of the corresponding particle associated with that field.

Higgs bosons are much heavier than electrons, therefore the Higgs field requires a large amount of energy to generate Higgs particles. Higgs particles can only be generated inside particle accelerators like the Large Hadron Collider at CERN. According to quantum field theory, the fields exist at the same place in space and time and so the observation that is being made depicts an exchange of energy among various fields. That is how the forces work and based on this phenomenon, it is possible that sometimes one particle gets converted into another. Presently, QFT is not able to explain the existence of dark matter and/or dark energy, however, many scientists though believe that dark matter may also be the result of energy in some unknown fields.

Loop Quantum Gravity (LQG) theory (Rovelli, 2016) has its roots in lattice Quantum Chromodynamics (QCD), loops, knots (rings), weaves and Penrose Spin Networks. In LQG, LQGs equate to space and space is said to be quantum in nature. Nodes relate to quanta of space (volume), links relate to the area of space, and time disappears from the equation (frozen time). Fluctuations in the quantum state of space give the appearance of time. In LQG, gravitons are pseudo particles, not force particles. LQG can be used to calculate the entropy of Black Holes. There is no such thing as infinity in nature, so no singularity, Big Bang, or Black Holes for LQG. Loop Quantum Cosmology suggests that there is no singularity, so the universe didn't begin with a (big) bang, but a bounce.

Quantum Ripple Theory (QRT)

Proposed in 2023 (Graham, 2023), Quantum Ripple Theory (QRT) is a new premise that was arrived at by looking at the problem of distance in measurement correlation for entanglement and identifying the potential implications of decoherence and interference.

Decoherence is the "process by which bodies and quantum systems lose some of their unusual quantum properties (superposition or the ability to appear in various places simultaneously) as they interact with their surroundings. When a particle decoheres, its probability wave collapses, any quantum superpositions disappear, and it settles into its observed state under classical physics" (Heger, 2022, p. 181).

"Interference is the ability of two waves passing through each other to mingle, reinforcing each other where peaks coincide and cancelling each other out where they correspond. This is like the way ripples in water interfere with each other" (Op. Cit., 2022, p. 187). This led to the following questions or hypotheses.

- Hypothesis 1: Does Decoherence provide the link (possibly theory) between Classical Physics and Quantum Mechanics?
- Hypothesis 2: Is decoherence the result of interference?

In addition:

- What criteria are required for decoherence to happen?

The latter question is the basis for any simulation of these hypotheses.

Furthermore, Entanglement is stated to be: "the property where two or more quantum objects in a system are correlated (or intrinsically linked). In such a scenario, the measurement of one, changes the probable measurement outcome of the other in a correlated manner (2-qubit quantum system), regardless of how far apart the two objects are" (Op. Cit., 2022, p. 208).

In Quantum Ripple Theory, quantum ripples (light fields) are the result of the release of energy, light. Light is suggested because of its wave-particle and self-interference properties (see justification for light for a fuller exposition). If we consider the notion that every quantum object is part of a single looped wave (a quantum ripple) detectable due to decoherence (interference), this leads to a further set of questions and hypotheses:

- Hypothesis 3: Is detection a form of interference leading to decoherence, and does detection equate to observation?

Therefore:

- Hypothesis 4: Is entanglement correlation due to quantum ripple interference, with measured objects (particles) being measurements of the same quantum ripple, therefore they correlate independent of distance and require no information passing of any sort?

If a ripple is measured (or detected), this would also represent interference and its value observed. The value should be the same, independent of where on the ripple the measurement is taken, this would represent a solution for the entanglement correlation problem. No information passing is required at any speed (or transmission of information faster than the speed of light) as the same ripple is being measured and ripples could be massive.

These hypotheses would additionally be a part of any simulation.

Methodology

Quantum Ripple Theory (QRT) Simulation Description (notes in *italics*). Considering QRT in a single plane:

- The simulation of Quantum Ripples in a single plane is *weakly analogous* to dropping a pebble into a pool of water.
- The pebble is equivalent to energy.
- The pebble *(energy)* is released at the origin, which will be at the centre of the ripples.
- The effect of the release of the pebble (the energy) is the forming of multiple ripples (quantum ripples).
- A ripple continues to spread outwards unless there is interference from another ripple (the result of another pebble of energy from the same point of origin, but of greater magnitude for a single plane).
- Both the size and frequency of the pebble (*energy*) would vary (*random probability*).

For each of the hypotheses above:

- *The simulation could determine if the interference results in different wave harmonics that would be akin to other phenomena.*
- *The model might identify a limited number of unique harmonic signatures, which might be associated with unique quantum phenomena.*
- *These may pose further questions for the model.*

QRT Simulation Extended

The simulation described previously acts in a single plane (a wavy disc). The second phase would have multiple planes. So, everything described above would need to be programmed for each plane (p), significantly adding to the complexity due to the increasing instances of interference.

A simpler, more abstract experiment is visualised in Figure 1, applying various angles and distances. A data collection and mathematical simulation application will be required to do this. This will require adjustment of the frequency of the sound sources to simulate various potential configurations and ripples.

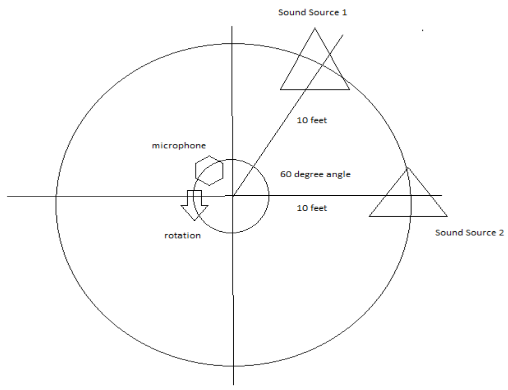

Figure 1: Quantum Ripple Theory (QRT) Extended Simulation/Experiment Diagram

Discussion

If the point of origin of energy is constant, Quantum Ripple Theory (QRT) may lead to a spherical, not flat, universe. The spherical case could be true in the first instance/ energy release. The initial energy leads to the creation and spread of ripples in all directions from the origin. The implication for a full simulation is that there is significant interference and complexity from the outset, sufficient to lead to the creation of matter through QRT Harmonics (expanded upon later) and the classical universe. The (planes of) ripples radiate in all directions, with the origin at the centre, interference would occur at points/planes perpendicular (90 degrees) to one another, potentially leading to tensor fields with x, y, z coordinates.

If interference results in decoherence from the quantum to the classical universe, it could suggest that our reality; the classical universe, sits on top of this expanding sphere at the points of decoherence. Time equates to expansion and there is no real or separate concept of space.

Justification for Light as the Primary Energy

All conjectures appear to agree that the starting point for any theory, including the Standard Model, begins with energy. It is suggested that any candidate for the "original energy" must exhibit wave-particle duality, self-interference, and be capable of metamorphosing into other phenomena. Interference enabling the creation and binding of particles to other particles and matter. Potential candidates for which wave-particle duality and self-interference extends are electrons and fields. In the case of Electrons:

- "Pair production (Blackett, 1933) closely shows that we must describe light not only as being made of photons, but also in the context that *photons can transform into other material particles, like electrons*" (Heger, 2022, pp. 60-61).

In relation to Fields:

- "What makes Compton scattering so important and motivating is that all this seems to suggest that we can again describe electromagnetic waves not as waves but rather as the light particles (photons) that bounce off other particles". And "pair production (opposite to annihilation) ... mysteriously, particles can appear from nowhere. Pair production and annihilation are examples of Einstein's mass-energy equivalence: E=mc2, where c = speed of light, m = rest mass of a particle" (Op. Cit., 2022, pp. 60-61).

- In addition, "an atom can spontaneously emit light" (Op. Cit., 2022, p. 49).
- In consideration of the above, as well as its wave-particle duality and self-interference properties, light is therefore proposed as the primary or original energy.
- A constant release of energy (dropping of pebbles) could also account for the continuous and increasing speed of the expansion of the universe. Newer, more powerful ripples push out "older" ripples. Such new ripples result in more interference.

QRT Harmonics

It is postulated that the result of numerous iterations of this simulation may result in an entangled spherical mesh of tensor fields. Einstein's description of a gravitational field is a tensor field. Tensor fields could be vital in the evolution of ripples to particles and matter. To recap; a tensor field portrays a function that inputs coordinates (x, y, z) and returns a tensor. Tensors are multi-dimensional arrays of numbers in a rectangular shape, and they can represent a lot more information than simple scalars or matrices. When these fields are provided with energy, they switch to higher energy states, a process that results in ripples. Importantly, these ripples are now labelled as particles. For instance, when ripples are fashioned in the electron field, electrons are formed, or when ripples are moulded in quark fields, quarks are formed. When these ripples turn silent, the corresponding particles disappear.

The point where the energy is injected into these fields basically depicts where the particles are formed, and as the energy starts to spread across the field, the particles are moving. Depending on the field, various amounts of energy are needed to produce the particles. The primary factor that determines how much energy a field demands (to generate a particle) depends on the mass of the corresponding particle associated with that field.

In addition, waves have three characteristics: frequency, length, and amplitude. The product of the first two characteristics listed gives the speed. Wavelengths are also of interest to the harmonics of phenomena. Gamma rays have the shortest wavelengths of the electromagnetic spectrum, and the highest energies. Listing phenomena from the shortest to the longest wavelengths: gamma ray radiation, x-ray, ultraviolet, visible, infrared, microwave, radio.

It is hoped that the running of sufficient simulations may demonstrate the creation or evolution of new wave harmonics, and their metamorphosis into other phenomena. Interference (tensor fields) and increasing wavelengths being possible proponents enabling the creation and binding of particles to other particles and matter.

Consequently, there are many new questions to be asked, including:

- Does interference increase wavelength?
- Or do wavelengths increase due to expansion?
- Do increasing wavelengths impact the creation and binding of particles to other particles and matter?

Quantum Ripple Theory - Further Points for Discussion

In QRT, it is further suggested that light ripples are light fields possibly akin to gravitational fields. As described earlier, the classical physics universe may reside on the outermost "surface" at points of decoherence, the result of many interferences, so more complex. This classical universe is a small portion of the whole universe, the remainder is dark energy/matter. This is based on the notion that the initial "pool" is dark energy. This idea could be tested in the simulation. Looking at the projected ratio of light ("interference area") ripples, to dark energy (remaining "area"). The ratios should match those believed to exist for dark energy and dark matter, and energy and matter, the former estimated to be approximately 68% of the universe.

QRT starts with a spontaneous instance of light energy appearing within a dark energy universe. This primary energy is due to vacuum fluctuations of the electro -magnetic field which include the spontaneous emission of light. Strictly speaking, the term singularity is nonsensical. It has been suggested that dark energy may be a 5th force missing from the Standard Model (BBC, 2023). Yet more questions arise, such as those pertaining to black holes, white holes, as well as thermodynamics, the shape of the universe, etc. These questions will not be considered here but could be directed by simulation results.

Like Loop Quantum Gravity (LQG) theory (Rovelli, 2016), Quantum Ripple Theory (QRT) leads to the initial creation of the "Tensor Networks/Lattice" where time or space is an illusion, and there is no singularity. QRT also considers the current notion of a singularity to be wrong. However, unlike LQG, QRT implies the universe is an expanding spherical lattice of ripples (initially at least), where interference(s) lead to decoherence into the classical universe. This allows for quantum and classical to coexist, and space to be deemed an illusion. Importantly, unlike LQG, QRT is a more testable theory.

In theory, for QRT, time can be replaced by distance (the radial value of the ripple in the simulation). The practical reality is, however, that this distance (space) is not measurable; space can be replaced by time in the same fashion. Likewise, a way of determining something similar to a universe horizon to prove that the universe may not be flat but a sphere, is not immediately apparent.

Penrose's Spin Networks look very much like Artificial Neural Networks (ANNs) with nodes and links. This could provide another means of simulation, or the current simulation model may result in something resembling these networks.

A further anecdote: an international consortium of astronomers has recently presented evidence that the fabric of the cosmos itself is constantly vibrating with light -years-long gravitational waves. The main result of the findings of the Pulsar Timing Arrays (PTAs) collaboration, is that low-frequency gravitational waves exist in the Universe all around us (Mack, 2023). Finally, if QRT and hypotheses 1-4 are supported by the simulation data, a new look (from a different angle) at the Standard Model may be appropriate, assessing the possibility that QRT could be considered as a stage or precursor to the Standard Model and hence could be viewed as a prerequisite for it.

Conclusions

A new theory, Quantum Ripple Theory (QRT) has been described, and simulations and experiments to evaluate its validity have been discussed. These simulations and experiments will be executed, empirical data will be collected and analysed, and the findings and conclusions will be described. The results will be published in a subsequent paper.

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Authors' Brief Bios

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Eur. Ing. Dr. Deryn Graham FHEA, C. Eng, FBCS, CITP, PhD, MSc, MA has worked as a university academic in the United Kingdom (UK), Sweden, New Zealand, and Finland. Her background is in applied Computer Science and Artificial Intelligence (AI). Eur. Ing. Dr. Graham holds a PhD in Artificial Intelligence from Brunel University, UK, a master's degree (MSc) in Computing Science and a master's degree (MA) in Education. She is a European Engineer (Eur. Ing.), a Fellow of both the British Computer Society (FBCS) and the Higher Education Academy (FHEA), a Chartered Engineer (C. Eng.) and a Chartered Information Technology Professional (CITP). She has held significant grants in multi-disciplinary research, including a European FP5 project in Acoustic Emission applied to mechanically loaded Paper (AEP), and has published widely. Her most recent publications and research interests are in the areas of AI, Learning, Analytics, and Quantum Computing. She is currently collaborating with QuMatrix.

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