Energy-space-time Plateau-Rayleigh instability , Quantum phenomenon & The Fundamental interactions

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In general, fluids in motion or at rest tend to minimize their surface area due to their surface tension. It is shown that kinetic energy flow through space-time experience the same Plateau-Rayleigh instability observed in fluid dynamics. Energy, space-time act like fluids, and the space-time reaction to the energy action is the equivalent of an interface tension between energy and space-time. Energy cannot continuously flow through space-time due to an energy-space-time Plateau-Rayleigh instability, space-time compression (contraction) on kinetic energy direction of motion induces an energy wave like motion (a space-time compression wave acting as kinetic energy waveguide), the particle or energy packet must follow when moving through space-time, the reason for the observed wave-particle duality. Quantum phenomenon is simply a consequence of the space-time compression on kinetic energy direction of motion. Kinetic energy and space-time are fluids and energy quanta can reach a critical point when energy quanta can change from linear to circular motion and assume a spherically symmetrical shape (the minimum surface area possible to minimize the tension at the space-time energy interface) and so it condensates as mass energy. It is shown that energy quanta to mass transformation occurs via Plateau–Rayleigh energy-space-time instability and it is governed by an energy-space-time Young-Laplace equation. Electric field lines are described as space contraction energy shock waves induced by a dynamic space-time phase transition at maximum kinetic energy-space-time interface tension which is the "charge". Space-time always reacts to the presence of energy and that reaction is the interface tension at the energy-space-time boundary : gravitational & electric energy fields are consequences of energy-space-time interface tension (at either rest or kinetic energy boundary) also governed by an energy-space-time instability Young-Laplace equation. Gravitational constant G and the fine structure constant ∝ are respectively, the energy interface fields interaction constants. The Strong force is a consequence of a direct contact between the nucleon's energy-space-time interface tension fields and has no interaction constant. The range and variation in the strength of the Strong force is due to Heisenberg's uncertainty principle.

1. Introduction

1a. A theory of everything must be a description of reality and not just a mathematical construct

Science is the process of developing *models* of things and phenomena, with the goal of understanding how they behave; however, models of things are not actually those things unless they describe reality. The bottom line is that these models are useful if we use them to make predictions, and those predictions are real, but we must remember that the models are not *real and that can have consequences*. Einstein's General Relativity model has not made an incorrect prediction in a hundred years, but that doesn't make it "real" in any sense beyond that ability to predict how the world behaves. Same can be said about Quantum Mechanics, so a unification of these theories does not seem possible because they are just models that don't describe reality and also happens to be incompatible. If these theories truly described reality unification will naturally be possible.

Quantum Mechanics and General Relativity are like two ships lost at sea (meaning they are not anchored to reality). In fact, they are multiple ships lost at sea with no way of knowing which one is real because they can be understood in multiple ways, however if we were successful in bringing one home (understand the actual description of reality) then all the remaining ships will vanish just like a wave function collapsing into a single measurement outcome.

Einstein tried to keep his General Relativity anchored to reality by extending Galileo's "weak equivalence principle" to an assumption that uniform acceleration is indistinguishable from a uniform gravitational field and therefore gravity was equivalent to acceleration because acceleration is real, however that leads to the "geometric interpretation" of gravity not as a traditional force but as the "curvature" of spacetime (spacetime is a a four-dimensional manifold mathematical abstract but these dimensions should not be considered fundamental because space can warp or contract and time can slow down when approaching light speed velocities), caused by mass and energy and yet we experience a force. A gravitational field has a physical existence in the sense that it can carry energy and momentum and the "geometric interpretation" only exists because the gravitational field **can** be represented mathematically by the spacetime metric. The "geometric interpretation" is the easier way to visualize the gravitational field, however we must understand that "Einstein's equivalence principle" is not a universal law of physics that cannot be challenged like for example the conservation of momentum (conservation of momentum is a natural consequence of translation symmetry and according to Noether's theorem if physics remains unchanged in different regions of space, then momentum will be conserved) and only holds because accelerated motion and motion in a gravitational field have the same space-time curved trajectories, the first because an accelerated object has a force applied and the second because the space is distorted at its boundary with the mass energy and time as a property of space runs at different rates inside the space distortion. There is no force or acceleration in a space distortion region, but it has the same physical effect because time runs faster or slower depending on the distance from center of the mass generating the space distortion. Gravity and acceleration appear to be equivalent only when the gravitational field is homogeneous, but real gravitational fields are never homogeneous, their gravitational acceleration decreases with altitude. *More important, a gravitational field acts on any from of energy (not just mass) by interacting with that form of energy gravitational field while in uniform acceleration the force is acting on the energy form itself, not on the gravitational field that it generates, meaning the gravitational field attached to a mass object under uniform acceleration will experience an increased stress (just like the electrical field of a charged mass object under uniform acceleration which leads to energy loss by emitting electromagnetic radiation) as the object velocity increases because no force is acting on it. That will eventually also lead to energy loss by emitting gravitational waves which can't happen during motion in a uniform gravitational field where there is no stress on the moving object gravitational field (a gravitational field will equally interact with the gravitational field of the mass of an electrically charged object and the gravitational field generated by its electrical field because both contain energy. As a result, there will be no stress on the charged object electrical field and no energy loss by emitting electromagnetic radiation). At high velocities uniform acceleration becomes distinguishable from motion in a uniform gravitational field. An infinite amount of energy is required to accelerate an object to light velocity just because the object will lose energy by emitting gravitational waves at relativistic velocities.*

A major point about Quantum Mechanics is that it is an ambiguous theory. We can't possibly understand a theory that can be understood in so many ways. There is no unique understanding. To move forward we need to understand what quantum theory means as a description of reality, a unique and final understanding. To remain anchored to reality in QM at first, we used reductionism (the process of breaking things down into smaller pieces) because we have proof the large things are real. However, this process can only go on for so long and in quantum theory we reached a limit where we can no longer describe larger things in terms of their smaller parts (an electron is just a point particle with no constituents or other smaller pieces), so instead we constructed a theory that describes measurement outcomes. Instead of describing an object by its structure or smaller constituents we describe it in terms of its measurable properties. However, in doing so we are no longer anchored to what is real, because while the measurement results are real, the objects whose properties we measure cannot be considered real in a sense that we don't know their structure or composition. The result is a theory/model that successfully predicts measurement outcomes, but it does not describe reality.

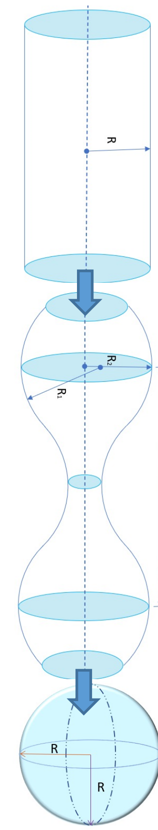
Both GR and QM theories are drifted from reality and clearly by different amounts because we can't use either to explain the other, however both seem to do a very good job in explaining their particular domains. GR is clearly the theory much closer to a description of reality because it is already a revision of a much older gravitation theory (Newton's theory) and certain issues with the original theory were addressed by Einstein : any form of energy generates gravitational fields (mass is just an example) and he no longer assumed that 'action at distance' has an infinite speed but is limited to the speed of light, however he still assumed the gravitational field homogeneity that uniform acceleration is indistinguishable from a uniform gravitational field. On the other hand, QM had no major revision to date and does a good job in explaining its domain but so did Newton's theory of gravitation for over 200 years. Reconceptualization of these pillars of modern science is necessary in order to complete their unification. We only need to understand what only one of these theories mean as a description of reality and if that description is correct, we can use similarities and apply that understanding to explain the second theory. Similarities help us understand other unrelated phenomena same as Einstein's equivalence principle led to the development of the general theory of relativity. Nature has a way of following similar patterns, leaving us clues to understand physical phenomena kind of like history or events that appear to repeat because they keep following the same pattern.

1b. A brief history of quanta

The birth of the quantization theory was in the early 1900s when a German physicist, Max Planck invented it in order to explain the radiations emitted from a black body. According to Plank, electromagnetic radiations can only be emitted in a discrete form and not continuous. He also suggested that all electromagnetic radiations, are emitted in certain packets of energy which he called "**energy quanta**". He associated the energy of the electromagnetic radiation with frequency 'f' and so, the energy of one quanta is E = hf, where E is the energy and 'h' is Planck's constant (= 6.626×10^{-34} Joule x second). {1}
Later, in 1905 Einstein's explanation of the **Photoelectric Effect** leaded to the same conclusion {2}. He extended Planck's idea and said that not only the electromagnetic radiation, but energy itself is quantized and can only be transferred in quantized packets which are integral multiples of the Planck's constant. This quantized picture of the energy has proven successful over time giving rise to **Quantum mechanics**, a theory that provides a description of the physical properties of nature at the scale of atoms and subatomic particles. In Quantum mechanics, energy, momentum, angular momentum and other quantities are quantized, but the theory does not answer one fundamental question : *Why is energy quantized and not continuous ?* To answer this fundamental question, perhaps we must understand the physical properties of the mathematical construct called space-time.

1c. Fluid dynamics : Surface tension, Plateau–Rayleigh instability & Young-Laplace equation overview

The **Plateau–Rayleigh instability** {3}, begins with the existence of small perturbations in a moving column of liquid due to vibration or friction with the external medium. Eventually these perturbations are resolved into sinusoidal components within the liquid. Some of these sinusoidal components will grow with time, while others decay with time until the column of liquid reaches a critical point and brakes up into smaller packets or spherical drops that have the same volume but less surface area. The driving force of the Plateau–Rayleigh instability is that fluids due to their *surface tension*, tend to minimize their surface area. A column of liquid in motion, has a circular cross-section and will break up into drops or packets when it reaches a critical point (when its wavelength 'Λ' exceeded its circumference, which is π times its diameter). This phenomenon is entirely a consequence of the effects of the liquid surface tension or more general is a consequence of the *interface tensions between the fluid and the medium it travels through.* The interface tension is responsible for the initial perturbations in the moving fluid and for the shape and size of the packets formed at the fluid break up (critical point when the perturbation wavelength exceeded the fluid column circumference : $\Lambda = 2\pi r$). The shape of the packets or liquid drops it is governed by the *Young-Laplace equation* {4} that was derived almost simultaneously by Thomas Young (1804) and Simon Pierre de Laplace (1805). The Young-Laplace equation is : $\Delta P = \gamma(1/R_1 + 1/R_2)$, {4} where ΔP is the difference in pressure between the inside and outside of the surface interface between two fluids, also known as the "*Laplace pressure*", 'γ' is the surface or interface tension between the two fluids. R_1 and R_2 are the two radii used to define the curvature of the two-dimensional surface (the principal radii of curvature in each of the axes that are parallel to the surface). *From the Young-Laplace equation it can be easily observed that the larger the radius 'R', the larger the interface tension 'γ' required to withstand a given difference in pressure 'ΔP' and so, for a given radius and difference in pressure, a spherical surface will have half the surface tension of a cylindrical surface : For a spherical surface, $\Delta P = 2\gamma/R$ resulting in, $\gamma = \Delta PR/2$ because R_1 and R_2 are the same = R, while for a cylindrical surface we have $R_1 = R$ and $1/R_2 = 0$ resulting in $\Delta P = \gamma/R$ and $\gamma = \Delta PR$* {5}*. In the Plateau–Rayleigh instability, a moving cylindrical column of fluid breaks up in spherical shaped packets in order to minimize the interface tension between the two fluids* (water and air is an example). The spherical shape of the packets minimizes the interface tension (which is initially twice the value) between the two fluids according to the Young-Laplace equation . Interface tension will also cause a fluid at rest to assume the minimum surface area possible.



In a simplified case of a spherical shaped bubble, the Young-Laplace equation becomes $\Delta P = 2\gamma/R$ as previously explained; however, this equation is not valid for a thin wall bubble where we have the same interface tension on the inside and outside of the bubble. Such spherical shaped bubble has two fluid interfaces (one on the outside and one on the inside of the bubble) and If the wall of the bubble is very thin, then $R_{outside} \approx R_{inside} = R$ and the Young-Laplace equation becomes $\Delta P = 4\gamma/R$ {5}. *$\Delta P = 2\gamma/R$ equation is only valid for a full bubble that only has an interface tension on the outside surface of the bubble.*

2. Energy-space-time interface tension is the Space-Time reaction to rest/motion energy action

By applying Newton's action-reaction law to energy interacting with space-time (*Every energy action has an equal and opposite space-time reaction as space-time reacts to the presence of energy by contracting or distorting*) one can observe that all type of electromagnetic radiation has the same space-time reaction corresponding to the kinetic energy action of one quanta/photon regardless of its frequency or wavelength.
That is because all electromagnetic radiation travels at the same velocity 'c' : From the photon energy, $E= hf = hc/\Lambda$ results in ***EΛ = hc = Γ****= space-time reaction to the kinetic energy action of a single photon*, where c - light speed , h- Planck's constant, f- frequency & Λ- wavelength. The space-time reaction '***Γ****' is the kinetic energy-space-time interface tension at the energy & space-time boundary.* Similar to massless photons, any mass particle, while in motion with velocity "v", has an instant kinetic energy. Kinetic energy for a nonrelativistic in motion particle is $E = mv^2/2$, because it is calculated from an average velocity $v = (v_0 + v_f)/2$, with v_0, being the initial velocity and v_f, being the final velocity of the particle. *Instant kinetic energy* will be $E_k = pv = mv^2$, because instant $v_0 \approx v_f = v = (v_0 + v_f)/2$ *[8]* (similar with the energy of one photon, imagine the instant kinetic energy calculated just over one wavelength, $\lambda = h/p$, and so, $v_0 \approx v_f = v$) and that will also have a space-time reaction/distortion, $\Gamma = E\Lambda = hmv^2/p = hmv^2/mv =$ **hv** = space-time reaction to the kinetic energy action of a single quantized kinetic energy packet, where v - particle speed , h- Planck's constant, $E = mv^2$ instant kinetic energy & $\Lambda = h/p$- wavelength, $p = mv$ is the linear momentum, "m" is mass. *In both cases, the space-time reaction to kinetic energy action is the interface tension at the boundary between energy and space-time. Equivalently, one can say that a gravitational field is the interface tension at the boundary between mass ($m = E/c^2$), and space-time. Gravity or the interface tension between at rest energy and space-time is caused by rest energy curving space-time and so space-time stores energy due to this change in the space curvature resulting in the gravitational energy wave pressure acting as an interface tension at the rest energy space-time boundary. It is very weak because a large amount of rest energy is necessary to curve space-time. While gravity is the space-time reaction to rest energy action, kinetic energy space-time interface tension is the space-time reaction to the kinetic energy action. Motion energy is only a fluid that travels through a medium that is space-time and can only travel as quanta or in quanta packets due to an energy-space-time Plateau–Rayleigh instability.*

3. Kinetic energy, space-time & the Plateau-Rayleigh instability

When we consider kinetic energy and space-time as fluids, a mass or massless particle traveling through space-time at high velocity will have a *vibratory or high frequency wave like motion* due to the increased space compression ahead of the particle. This space fluid compression only occurs on the particle direction of motion so a high frequency wave like motion (a continuous change of direction) of the energy fluid is necessary to navigate the space compression build up ahead of the particle. That is the kinetic energy-space-time **Plateau–Rayleigh instability** where kinetic energy is the moving fluid and space-time is the fluid energy moves through. When a particle is in motion, an increased energy-space-time interface tension exists at the kinetic energy and space boundary (due to the space compression on particle direction of motion). The increased *interface tension between the moving fluid (energy) and the fluid it travels through (space-time)* is the reason for the perturbations (energy-space-time Plateau–Rayleigh instability) observed in the moving energy fluid. The interface tension, 'Γ = hv' is direct proportional with the particle velocity and Plank's constant. Kinetic energy- space-time interface tension is responsible for the wave like motion of particles traveling through space-time just as the rest energy is responsible for the gravitational field of a mass particle at rest. The shape of the wave like trajectory of the high velocity traveling energy fluid it is governed by an energy-space-time *Young-Laplace equation.*

All electromagnetic radiation has the same energy-space-time interface tension **Γ = ch** , so low energy radiation (radio waves) flow more continuously through space-time with wavelengths in the range of 10^3 m, while high energy radiation (gamma radiation) will flow more discontinuous with wavelengths in the range of just 10^{-12} m. The situation is similar for a mass particle in motion : Different mass particles that travel at the same velocity will have the same kinetic energy–space-time interface tension **Γ = vh**, while their instant kinetic energy is different ($E = mv^2$). As a consequence, the particle with a smaller mass (less instant kinetic energy) will travel more continuously through space-time (wavelength Λ = h/mv is larger when 'm' is smaller) because its instant kinetic energy is less, while a larger mass particle will travel more discontinuous through space-time (wavelength Λ = h/mv is smaller when 'm' is larger) because it has more kinetic energy. The wavelength 'Λ' is a measure of the kinetic energy flow continuity through space-time : a particle will travel more discontinuous through space-time when either the mass or velocity increases because both lead to an increase in instant kinetic energy. For gravity model, there is only at rest energy which does not travel through space-time, however there is energy-space-time interface tension at both, kinetic and rest energy interface with space-time ($E = mc^2$) so an *interface tension must exist* at the mass space-time boundary interface because mass is just another form of energy. This mass energy space-time interface tension can only be explained as being the gravitational field. *A gravitational field is the interface tension between space-time and energy at rest.* ***In general****, energy-space-time interface tension is responsible for the spherical shape of the planets due to the rest energy (mass) space-time interface tension (gravitational field), for the wave-particle duality (due to kinetic energy space-time interface tension), for electromagnetic energy quantum behavior when traveling through space-time, for energy to mass transformation and for the spherical symmetry, size (spatial extent) and creation of mass particles.*

4. Energy-space-time interface tension and the wave–particle duality

The wavelength λ, or the '*wave like behavior*' of a mass or massless particle is due to its instant kinetic energy-space-time interface tension 'Γ' (space-time reaction to the particle kinetic energy action). An increase in the particle instant kinetic energy (due to a larger mass or an increased velocity) will affect its ability to continuously flow through space-time resulting in a smaller wavelength -> $\lambda = h/mv$. Kinetic energy- space-time interface tension is responsible for the wave like motion of particles traveling through space-time just as the rest energy is responsible for the gravitational field of a mass particle at rest:

- All electromagnetic radiation energy-space-time interface tension (due to their kinetic energy) is always the same & a constant **Γ= hc** because electromagnetic quanta are massless particles and always travel at a constant speed 'c'. The particle wave like motion *due to the Plateau–Rayleigh kinetic energy-space-time instability* has a wavelength **Λ** = h/p = hc/E = **Γ/E** (E = pc) that is direct proportional with the energy-space-time interface tension and invers proportional with the kinetic energy of the particle , where h - Planck's constant, E – particle energy & p- linear momentum.
- Any mass particle, when in motion with a velocity "v", has a kinetic energy-space-time interface tension of **Γ= hv** due to its motion energy and its wave like motion through space-time *due to the Plateau–Rayleigh kinetic energy-space-time instability* also has a wavelength Λ = h/p = h/mv = hv/mv^2 = **Γ/E**, where $E = mv^2$ is the instant kinetic energy of the particle.

One can conclude that the kinetic energy and its space-time interface tension are responsible for the wave like behavior of a mass or massless particle because it affects the kinetic energy ability to continuously flow through space-time due to an energy-space-time Plateau–Rayleigh instability.

In general, any wave is a regular and organized disturbance in a medium that carries energy through that medium *without a net movement of the medium*. It may take the form of elastic deformation, a variation of pressure, etc, but the wave **cannot** travel to transfer energy or show observed interference properties without the medium. The medium through which the wave travels will experience some local oscillations as the wave (disturbance) passes, but the medium or any particle at rest in *the medium do* ***not*** *travel with the wave.* A particle at rest in the medium will only vibrate during wave propagation : In the case of a transverse wave, the particles vibrate up and down and vibrations are perpendicular to the direction of wave propagation.

In the specific case of the wave-particle duality, we have an electron, or a photon emitted by an atom as a particle which travels through space-time as a wave until the moment when is detected again as a particle.

It is fundamental to realize here that *a propagation medium must exist*, because our particles travel as waves. No wave can form, interfere or propagate unless there is a medium which is necessary for the disturbance to form, and that medium here *can only be space-time*. Photons do not exist as particles inside the atoms that emits them. They only begin to exist as particles from the moment when are emitted by the atom and their spatial extent and wave like trajectories through space-time depend on their kinetic energy and the energy space-time interface tension 'Γ = ch'. The spatial extent of these energy packets and their trajectories are governed by an energy-space-time *Young-Laplace equation such that E = Γ/r, where 'E' is the instant kinetic energy of the particle, 'Γ' is the kinetic energy space-time interface tension and 'r' is the* radius of the particle wave like motion while traveling through space-time as defined in a plane perpendicular on the direction of motion.

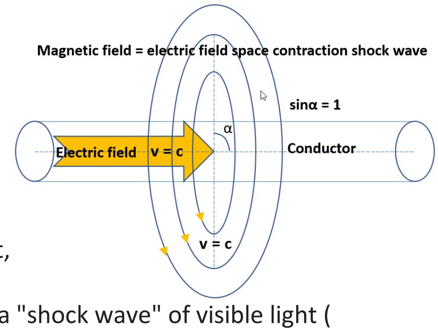
In a special case of energy at rest (mass energy), the geometry of the mass is also governed by the rest energy-space-time interface tension which is the gravitational field : large mass bodies such as planets have a spherical shape due to a strong gravitational filed. Rest energy-space-time Young-Laplace equation is also *E = Γ/r, where 'E' is the gravitational stored energy (due to curved space-time), 'Γ' is the mass-space-time interface tension and 'r' is the distance from the center of the mass, This equation can be developed as follows :* The force of gravity between two planets with identical masses 'm' is $F = Gm^2/r^2$ [11], where 'F' is the force, 'm' is the mass of the planets, 'r' is the distance between the centers of the masses and 'G' is the gravitational constant. Using the work-energy equivalence principle, gravitational stored energy of each planet is $E = Fr = Gm^2/r$ = *Γ/r, so the rest energy (mass) space-time interface tension is* $\boldsymbol{\Gamma = Gm^2}$

Assuming similarity with a gravitational field which is the energy-space-time interface tension at the mass-space-time boundary, a mass/massless particle motion/kinetic energy-space-time interface tension, 'Γ = hc or Γ = hv' should act as *a space-time contraction energy pressure wave at the kinetic energy-space-time boundary because velocity causes space contraction as confirmed by an at rest observer. This space-time contraction/compression energy pressure wave acts as a wave guide for the moving particle*. Inside a beam containing many particles, these space-time compression energy pressure waves will interfere with each other to form specific wave interference patterns. Mass particles or massless energy pockets guided by these space-time energy pressure waves will end up forming the same interference patters as they follow the space-time compression waves energy redistribution process. If we have a wave equation describing the particle beam, we are going to find more particles where the wave amplitude is large versus no particles where the wave amplitude is 0, indicating that more particles end up where there is constructive wave interference, and none will end up where there is destructive wave interference, so kinetic energy-space-time interface tension inducing a gravity like space-time compression energy pressure wave can explain the wave like interference patterns formed by particles in motion. Kinetic energy-space-time *Plateau–Rayleigh instability is the reason of observed particle 'wavelike' motion and together with the energy-space-time interface tension (space-time contraction energy pressure wave)* explains the wave-particle duality behavior of individual particles (mass or massless) in motion.

A sufficiently sensitive photon counter can detect the reception of light as one photon at a time. It receives the light as a series of discrete packets of energy separated by gaps in time and so would appear that there are gaps in space between the photons as they travel, but that cannot be true because a light beam is continuous. All photons travel at the same speed of light and gaps between them cannot form in space while traveling. Current explanation is that each photon collapses from being wave-like to being particle-like upon being detected. Since the photons act like waves while traveling, there are no gaps between them while traveling and since the photons act like particles when being detected, there *are gaps* in the time when the photons are detected. The act of detecting causes the photon wave function to collapse and therefore introduces the gaps, *however it is unclear* what is the actual mechanism causing the collapse. *A more consistent explanation is that energy travels through space-time as quanta or discrete energy packets due to an energy-space-time* ***Plateau–Rayleigh instability*****,** a phenomenon that is entirely a consequence of the effects of the energy-space-time interface tension or more general is a consequence of the *interface tensions between the fluid (energy) and the medium (space-time) it travels through.* Electromagnetic energy travels through space-time at the speed of light 'c' and each energy packet or photon will have an energy-space-time interface tension, Γ = hc**.** Due to this maximum energy-space-time interface tension, the space is contracted/compressed to zero on the photon direction of motion while the time is frozen. The photons are separated by gaps in time and space when received by a detector because of the space contraction and time dilation in their local reference frame (a consequence of the energy-space-time interface tensions). Energy can only travel through space-time, and the photons or energy packets become disconnected or separated by gaps in time because energy can't travel through contracted space. Similar to sound waves, energy requires a medium to travel through and that medium is space-time. " Energy cannot travel through totally contracted space" might need an explanation : It is only a simple consequence of the universal speed limit 'c' : An energy packet traveling through space-time at a velocity 'c' has the space compressed to 0 in its reference frame (only on its direction of motion), however on its direction of motion, the energy packet is already traveling through space-time at a maximum velocity and cannot increase its velocity any further (meaning cannot travel though totally contracted space because space is already compressed to 0 on that direction). That is valid for any observer that is not in the energy packet reference frame. *There can be no motion without space & time.*

5. Electric and magnetic fields : Dynamic space-time phase transition & Energy shock waves

For any observer at rest, the energy of a photon can only oscillate perpendicular on its direction of motion because of the total space contraction on its direction of motion : energy cannot oscillate/travel through contracted/compressed space. Electrical energy (electric field) travels through a conductor at the speed of light (the speed of light in that conductor material) and for any at rest observer the space is contracted or compressed on its direction of motion.



The magnetic field generated by this moving electric field is only the *space contraction shock wave caused by the electric field* that carry the electrical energy. The half-angle 'α' between the electric field direction of motion and the shock wave is 90 degrees because the velocity of the space contraction shock wave (magnetic field) and the velocity of the electric field are the same and equal with the velocity of light (sinα = 1 = magnetic field velocity/electric field velocity). A good analogy to understand this better are the sound waves generated by a supersonic aircraft (travels at velocity equal or greater than sound), which are slower than the aircraft and cannot propagate forward from the aircraft, instead forming initially a plane (v sound = v aircraft) and then a conical shock wave front (v aircraft is greater than v sound) *[12]* . In a similar way, a charged particle can generate a "shock wave" of visible light (Cherenkov radiation) as it travels through a dielectric medium at a speed greater than the velocity of light in that medium *[13]* . In either case, different type of waves that carry energy (sound, light or electric field waves) *cannot propagate in their respective medium at velocities greater than the velocity of the source that emits them* and 'at and after' the formation of the shock wave, the half-angle 'α' between the source direction of motion and the shock wave is given by: sinα = v sound or v light or v magnetic field/v aircraft or v charged particle or v electric field, respectively. In the electrical energy case, the magnetic field or the electric field space contraction shock wave forms on a direction perpendicular to the electrical field direction of motion where there is no space contraction because the total space contraction is what causes the formation of the shock wave (energy can't travel through totally contracted space because it needs a medium to travel and that medium is space-time). The space contraction shock wave forms due to the abrupt space contraction difference between the direction of motion versus perpendicular on the direction of motion. The magnetic field, or the space contraction shock wave and the electrical field are complementary to each other, three-dimensional flow of electric field lines generates two-dimensional magnetic field planes through the explained space compression/contraction shock wave phenomenon.

In general, space-time acts like a fluid to any moving objects or energy disturbance. Space-time compresses and distorts as energy travels through it. Whenever an energy disturbance or a mass object travels through space-time, space-time distortion waves are produced locally because space-time reacts to the presence of energy. In the case of an object moving at a velocity much less than the speed of light, these space-time distortion waves can travel ahead of the object (massless energy can travel at the speed of light), however when the object velocity is *close to the light velocity space-time distortion waves became space-time compression waves* and can no longer travel ahead of the object and *merge to form a space-time contraction/compression shock wave perpendicular on the object's direction of motion similar to a magnetic field*. In fact, the pocket of compressed space-time distortion waves 'over-pressure' at the front of the moving object creates a corresponding pocket of space-time distortion waves 'under-pressure' at the rear of the object. Unlike a supersonic aircraft that has a double sonic boom due to its "overpressure profile" or N wave (the pocket of over-pressure at the front of a supersonic aircraft creates a corresponding pocket of under-pressure near its rear followed by a sudden return to normal pressure, an N wave because of its shape), a mass object or energy disturbance approaching light velocity should experience these space contraction shock waves simultaneously due to the time dilation phenomenon, so the 'over-pressure' and 'under-pressure' space contraction shock waves will be in superposition or exist at the same time, however both compressed energy shock waves are necessary for energy conservation, such as the energy stored by the 'over-pressure' and 'under-pressure' shock waves it would add up to zero if the shock wave collapses. Any observer at rest in the moving object reference frame will not experience any space-time disturbance as long as he remains at rest in his reference frame. In the case of an energy disturbance such as the electric field, the energy flow is continuous and only the space contraction shock wave at the front of the disturbance (magnetic field) will be observed. In the case of an energy disturbance such as a photon which is emitted by atoms in wave packets, we are going to have two space contraction shock waves in superposition (described 'over-pressure' and 'under-pressure' energy shock waves and not a mesh of oscillating electric and magnetic fields that travel with the photon) because photons are emitted and travel in wave packets or the energy disturbance is not continuous.

The abrupt changes in the features of the space-time medium (space contraction and time dilation), that cause the formation of space contraction shock waves, can be interpreted as a *dynamic space-time phase transition*. Energy travelling through space-time reach a point when due the space compression/contraction, it cannot travel any further upstream and the space-time distortion energy progressively builds in that region: the 'compressed energy' space contraction shock wave forms perpendicular on the upstream direction of motion. *Space contraction shock waves are not conventional space-time distortion waves (gravity waves); a space contraction/compression shock wave takes the form of the sharp change in the space-time medium properties (they are the result of a dynamic space-time phase transition). Space contraction shock waves are compressed space-time distortion waves and can take the form of either a line or a plane if the flow of the compressed space-time distortion energy field is two-dimensional or three-dimensional, respectively*. For example, electric and magnetic field lines are line space contraction shock waves : electric field is composed of radial line space contraction shock waves formed from a charged particle compressed space-time distortion energy two-dimensional flow (a spherical surface at the kinetic energy space-time interface and the charge of the particle is the motion/kinetic energy space-time interface tension 'Γ = ħc'), while the magnetic field plane space compression shock wave, forms from three-dimensional flow *of a compressed space-time distortion energy region or from a* three-dimensional flow of packets of line space contraction shock waves (electric energy field) and takes the form of a plane space contraction shock wave perpendicular on the direction of the compressed space distortion energy three-dimensional flow.

Electric and magnetic fields originate from subatomic particles that could be at rest relative to surrounding space-time, but their internal energy is not. Kinetic energy within the particle structure results in a spherical shell space contraction region : the region surface flow at the energy-space-time boundary (kinetic energy-space-time interface tension '$\Gamma = \hbar c$') generates space compression line shock waves (electric field) while the region space-time distortion volume flow/spin generates space contraction plane shock waves (magnetic field). Electric field or space contraction line shock waves can be 'over-pressure' or 'under-pressure' shock waves corresponding to positive or negative charge, respectively. Charge is quantized because the particle kinetic energy space-time interface tension is a constant, '$\Gamma = \hbar c$' .

6. A physical meaning of energy quanta wavelength – Linear vs Circular quanta motion

The electromagnetic energy quanta or a mass particle kinetic energy quanta wavelength relation is, $\Lambda = h/p$, where 'h' is Planck's constant and 'p' is the linear momentum of the energy packet. Energy cannot travel continuously on a straight line through space-time due to the energy-space-time interface tension (*linear motion* energy-space-time interface tension is '$\Gamma = hc$ or $\Gamma = hv$ ' for a massless or mass particle respectively) and instead in order to minimize the space-time interface tension is forced to curve its motion and divide itself in quanta packets. Energy quanta motion through space-time, will follow a sinusoidal trajectory with a profile radius 'R' (perpendicular on quanta direction of motion) and because energy quanta carry a linear momentum 'p' ($E = pc$) , it will also have an angular momentum due to the sinusoidal motion. The angular momentum of the energy packet or quanta will be $L = pR$ and it should not exceed the Planck's constant value 'h', due to the restriction set by the linear motion energy-space-time interface tension ($\Gamma = hc$ for an energy wave traveling at a velocity 'c' through space-time) and so Planck's constant 'h' must always equal the energy quanta packet angular momentum 'L' causing high energies to divide in smaller wavelengths (R) energy packets. The maximum angular momentum that energy can apply on space-time is $h = L = pR = p\Lambda$, so the energy quanta wavelength, $\Lambda = h/p = R$ is the radius of the mass/massless particle wave like motion due to the energy-space-time interface tension. Electromagnetic quanta wavelength should not be defined along its direction of motion (such as a classical wave would be) due to the total length contraction in the observer reference frame when energy travels at light velocity. When the wavelength is defined as the radius of the quanta wave like motion, that is perpendicular on the direction of motion where no length contraction occurs and the wavelength 'Λ' or 'R' becomes infinite if a mass/massless particle could move on a continuous straight line (moving on a straight line would mean that no energy-space-time interface tension exists because the energy-space-time interface is the cause of the wave like motion).

Analysis so far was done for energy quanta in *linear motion* through space-time that has an energy-space-time interface tension of $\Gamma = hc$, but energy quanta can also have a *circular motion* through space-time when the energy quanta continues to be in a circular motion within a small spatial extent but at rest relative to the surrounding space-time (a mass particle can be at rest, but its mass stored energy it is not and would be expected to be an oscillating standing wave energy packet with the energy wave oscillating in a radial direction only, due to the space contraction on circular quanta direction of motion). When kinetic energy and space-time are considered to behave like fluids, *at critical point of transformation (linear to circular direction of motion) linear quanta wavelength $\Lambda = 2\pi r$* and the energy of one quanta in circular motion becomes $E = hf = hc/\Lambda = hc/2\pi r = \hbar c/r = \Gamma_c/r$, where $\hbar = h/2\pi$ is the reduced Plank's constant and "r" is the radius or the spatial extent of the quanta circular motion. *At the critical point of transformation*, the energy-space-time interface tension of electromagnetic quanta in a circular motion will be $\Gamma_c = \hbar c$ instead. The reduced energy-space-time interface tension with the continuous change in the direction of motion is the driving force of the *energy-space-time* **Plateau–Rayleigh instability.** *At quanta critical point transformation from linear to circular motion, the wavelength Λ equals $2\pi r$, while in linear motion Λ is equal to R, the radius of the energy quanta sinusoidal wave like motion. The energy-space-time interface tension also changes from $\Gamma = hc$ to $\Gamma_c = \hbar c$ or $\Gamma = 2\pi\, \Gamma_c$.* The energy-space-time ***Plateau–Rayleigh instability*** phenomenon is entirely a consequence of the effects of the energy-space- time fluids interface tension or more general is a consequence of the interface tensions between the energy fluid and the space-time medium it travels through. Energy quanta critical point transformation occurs in order for the energy fluid to minimize its interface tension at the space-time fluid boundary.

If we assume that whatever its trajectory, an electron orbiting a nucleus (most simple case of a hydrogen atom where a single electron orbits a proton) has a velocity just 10 times less than the speed of light because of its mass and then calculate its wavelength as a *free particle* instead $\Lambda = h/mv$, where $v=c/10$, 'm' is the electron mass and 'h' is Planck's constant. It results in a wavelength or trajectory radius $\Lambda = 0.24\ 10^{-10}$ m, which is in agreement with the covalent radius or the nominal radius of the hydrogen atom when covalently bound to other atom ($r = 0.25\ 10^{-10}$ m, *[17]*), as deduced from the separation between the atomic nuclei in a molecule (the distance between two atoms that are bound to each other in a molecule is equal the sum of their covalent radii). *This agreement indicates that the radius ($r = \Lambda$) of a free electron trajectory is the same as the radius of an electron orbiting a nucleus (this time is constrained by the electrostatic force) at a velocity 10 times less than the vacuum speed of light.* That is **the balance** for an electron to orbit a positively charged nucleus without experiencing an acceleration (same radius trajectory as a free electron in uniform motion with a velocity $v=c/10$) that can lead to loss of energy (emit photon radiation) and quickly falling on the nucleus. Furthermore, the values of the fundamental constants such as the Planck's constant, light velocity and the electron mass must have the values they do, so atoms can have the size they do, and in turn the value of the electron's kinetic energy can balance out the energy resulting form the electrostatic force and that finally results in a stable atom. **The fine structure constant, Planck's constant, the electron mass and the light velocity must have the values they do so stable atoms can exist.**

7. Kinetic energy-space-time interface tension & the stability and structure of atoms

The stability and structure of atoms is a consequence of the electron's kinetic energy-space-time interface tension, $\Gamma_c = \hbar c = hc/2\pi$: the electron's kinetic energy-space-time interface tension is the reason the electron doesn't experience any acceleration and ***can*** revolve/orbit around the nucleus without radiating any energy.

A free electron (not bound to a nucleus by the electrostatic force) moving at a velocity 10 times less than the vacuum speed of light will have a wavelength, $\lambda = h/mv = 0.24 \ 10^{-10}$ m which happens to be the same as the covalent or the nominal radius of a single electron atom (the hydrogen atom covalent radius is r = 0.25 10^{-10} m, *[17]*)), so an electron natural trajectory (assuming that its wavelength and wave like motion radius are the same) radius due to its kinetic energy-space-time interface tension is the same as the radius of a single electron atom. The electron motion orbiting the nucleus it is not an accelerated motion but a natural trajectory due to its kinetic energy-space-time interface tension and therefore ***can*** revolve around the nucleus without radiating any energy. The electron orbital motion is not the same but similar to motion in a gravitational field where a charged particle also does not emit radiation because it is not accelerated (because its motion follows a geodesic in curved space-time and therefore a uniform motion or its mass and electric filed energies any equally accelerated during this motion causing no stress between its mass and electric field components). The electron orbital motion is not accelerated because it follows a 'geodesic like' motion due to its kinetic energy-space-time interface tension and therefore does not emit any radiation.

Furthermore, to understand the structure of atoms and why electrons exist as standing waves within an atom (instead of following circular orbits) we need to look at the space-time distortion caused by the electron kinetic energy while orbiting an atom, due to the **Lorentz factor** (it is a velocity dependent quantity that expresses how much the measurements of time, length, and other physical properties change for an object while that object is moving) *[18]*). The Lorentz factor due to the electron mass energy is insignificant as deducted from the electron's mass escape velocity value (just around 1.1 x 10^{-14} m/s assuming an electron radius of 10^{-12} m), however the Lorentz factor value due to the electron kinetic energy is significant or about 1.005 *[18]*) when its velocity is 10 times less than the vacuum speed of light resulting in a significant local space-time distortion caused by any orbiting electron : space-time acts like a fluid to any moving object or energy disturbance. Space-time compresses and distorts as an electron travels through it. When an electron travels through space-time at high velocity, space-time distortion waves are locally produced because space-time reacts to the presence of energy. In fact, a pocket of compressed space-time distortion waves 'over-pressure' forms at the front of the moving electron which creates a corresponding pocket of space-time distortion waves 'under-pressure' at the rear of the electron. The electron circular motion creates a space-time distortion waves cloud that surrounds the nucleus. *Constructive and destructive interference of these space-time distortion waves lead to the formation of the atomic orbitals and the electron will only be present where there is constructive interference (gravity like attraction for the electron mass) while no electron can orbit in the destructive (flat space-time) region.*

An atom is a space-time distortion standing waves system (such as sound standing waves in a musical instrument) that vibrate at certain discrete frequencies corresponding to discrete energy levels of the electrons whose kinetic energy create the space-time distortion waves. Once vibrating at a certain frequency, the orbitals' structure takes that resonance corresponding shape, then when it absorbs a photon of the right frequency (like playing notes on a musical instrument) the orbitals take another resonant corresponding shape (orbitals lobe shapes can be seen as local space-time distortion standing waves interference patterns between the two-counter rotating space-time distortion rings). Chladni (1756 –1827), a physicist and musician invented a technique to visualize sound waves (modes of vibration) on a rigid surface, known as **Chladni figures** *[19]* due to the various standing wave shapes created by multiple vibration modes. When resonating, a flexible plate with a constraining point in the center is divided into regions that vibrate in opposite directions, bounded by nodal lines where no vibration occurs. Each resonance frequency reveals a unique standing waves pattern that is symmetrical around the central constraining point, just line an atom orbital shapes are symmetrical around the nucleus. An atom is a Chladni three-dimensional, spherical space-time distortion standing waves system where the nucleus is the constraining point while the electrostatic force provides the rigidity of the system so the space-time distortion standing wave orbitals can form. Eigenfrequencies of the system depend on its geometry, rigidity, and constraints. The number of eigenfrequencies it can exhibit is infinite. The orbitals of any element will take the same form if ionized down to a single electron, similar to the hydrogen atom one electron system, because the nucleus only provides the system constraining point, while the electrostatic force regardless of its increased strength still provides the required rigidity to holds the system parts together.

8. Energy can only travel in quantized packets due to the Energy-Space-Time Plateau–Rayleigh instability. Quanta energy equation is the kinetic energy-space-time Young-Laplace equation

To establish a connection with the classical **Plateau–Rayleigh instability,** we first observe that physical quantities such as energy or pressure are scalars and energy in any form (at rest as mass or kinetic energy) can be thought as a "pressure" that when applied on space-time is causing it to warp, contract or distort. Energy itself can also be thought as a fluid (that can flow through space-time) and its magnitude is the pressure applied to space-time (energy magnitude is the equivalent Laplace pressure applied by the energy on space-time and the more energy is applied, the more space-time is going to warp, contract or distort). The space-time reaction to the presence of energy as previously defined is the interface tension between energy and space-time.

The wavelength ʎ, a measure of the energy flow discontinuity and the radius of the energy quanta wave like motion is governed by an energy-space-time *Young-Laplace equation :* $\Delta P = \gamma(1/R_1 + 1/R_2)$ {4} is the classical equation and for electromagnetic radiation in linear motion, this equation equivalently becomes $E = hf = hc / ʎ = \Gamma/ʎ = \Gamma/r$, where : kinetic energy 'E' is the 'ΔP' Laplace pressure equivalent that acts on space-time causing it to curve, contract or distort, 'ʎ' is the energy quanta wavelength or the radius 'r' of the energy quanta wave like motion due to the Plateau–Rayleigh instability when flowing through space-time and '$\Gamma = hc$' is the energy space-time interface tension or the space-time reaction to the quanta energy action. The energy-space-time *Young-Laplace equation* formula no longer contains $ʎ_1$ and $ʎ_2$ wavelengths as equivalents for R_1 and R_2 (the two radii used to define the curvature of the two-dimensional surface in the original *Young-Laplace equation*), because the space-time distortion/contraction or the energy flow discontinuity wavelength 'ʎ' only occurs on the direction of motion allowing for the simplification of the *Young-Laplace equation that governs the electromagnetic energy flow through space-time : $E = \Gamma/r = hc/ʎ$. Equivalently, this equation becomes $E = \Gamma/r = hv/ʎ$ for a mass particle instant kinetic energy flow through space-time ($ʎ = h/mv$). Energy cannot flow continuously through space-time due to the space-time reaction/distortion caused by the energy action. Energy experience a space-time interface tension and can only travel as quanta packets due to an energy-space-time Plateau-Rayleigh instability : **Quantum phenomenon** is entirely a consequence of the effects of the energy-space-time interface tension or is a consequence of the interface tensions between the energy as a fluid and the medium it travels through (space-time) **In general**, fluids in motion or at rest tend to minimize their surface area due to their surface tension. That is also valid for energy which is also a fluid with a linear motion interface tension* of *$\Gamma = hc$ for massless electromagnetic energy or $\Gamma = hv$ for a mass particle kinetic energy, while in motion through space-time.*

9. Energy to mass transformation via kinetic energy-space-time Plateau–Rayleigh instability

We have now established that the kinetic energy-space-time interface tension is responsible for the initial quanta perturbations in a moving energy fluid but should also be responsible for the shape, size or spatial extent of the massless energy packets or mass particles when the energy fluid breaks up in order to minimize its interface tension at the boundary with space-time.

Similar to the classical Plateau–Rayleigh instability, this quanta behavior or perturbations of the energy traveling through space time will reach a critical point (transformation from linear to circular quanta motion due to collision with a dense energy region such as an atomic nucleus in a pair creation process) when the energy packet with a wavelength 'ʎ' will assume a spherically symmetrical shape in order to minimize its tension at the space-time energy interface **:** Interface tensions will cause the energy fluid (still in motion on a spherical surface but at rest relative to the surrounding space-time) to assume the minimum surface area possible and condensate into a spherically symmetrical shape, as mass energy. The sphere circumference at the critical point of transformation (energy-space-time interface tension changes from $\mathbf{\Gamma = hc}$ to $\mathbf{\Gamma_c = \hbar c}$) follows the same classical relation and the *critical energy quanta wavelength $ʎ = 2\pi r$* (energy packet angular momentum change from 'h' to 'ħ' due to circular motion), where 'r' is the radius of the energy fluid spherically symmetrical region. On a spherical shell structure however, it is necessary for the energy to continue to flow at light velocity 'c' on the *inside and outside* surface of the spherical shell in order to maintain the energy spherical shape structure stability within the space-time fluid.

A photon frame of reference has a "frozen clock". That is because its energy travels through space-time at the speed of light. A photon energy can't change and decay into other particles because its energy travels through space-time at the speed of light. Particles like electrons and protons (which have mass and as a particle can't travel through space-time at the speed of light) also can't decay (or have very large mean lifetimes) which only means that their internal binding energy (that we measure as mass) frame of reference must also have a "frozen clock" (be in motion with the speed of light). They don't decay because their internal binding energy can't change just as a photon energy can't change.

A mass particle can be at rest, but its mass stored energy it is not. The particle rest mass would be a spherically symmetric oscillating standing wave energy packet with the energy wave oscillating in a radial direction only, due to the space contraction on circular quanta direction of motion, such that $E = mc^2 = \hbar\omega$

What is actually mass ? From $E = mc^2$ we know that the inertial mass of an object is equivalent to its energy-content in the object's own rest frame of reference, so let's imagine the following thought experiment: Take a sphere that is lined on the inside with perfect mirrors. Let some light inside the sphere and seal it so the light can't get out. Now the light inside the sphere can never escapes or be absorbed (perfect mirror) : the photons will continue to bounce back-and-forth inside the sphere forever. The sphere will resist acceleration due to its inertial mass, but the photons inside the sphere will also provide some small additional resistance to acceleration. In fact, the inertial mass of the sphere will have increased by the amount of energy that corresponds to the photons trapped inside the sphere. The photons do not have mass, however when trapped inside an energy structure will resist acceleration just like the inertial mass would. Similar, the mass of elementary particles could be just an oscillating energy structure resisting acceleration.

Quanta is energy in motion through space-time, as the energy-space-time interface tension restricts travel to quantized wave energy packets due to the Plateau-Rayleigh instability. Mass is energy at rest relative to the surrounding space-time. Energy to mass transformation occurs due to the energy-space-time Plateau–Rayleigh instability where energy in order to minimize its interface tension with space-time, tends to assume the minimum surface area possible (spherical shape). Energy to mass transformation via the Plateau–Rayleigh instability is also governed by an energy-space-time *Young-Laplace equation.*

10. Energy-Space-Time instability Young-Laplace equation for energy to mass transformation

The classical Young-Laplace equation for a thin wall bubble, **$\Delta P = 4\gamma/r$** {5}, equivalently becomes **$E = 4\Gamma_c/r = 4\hbar c/r$**, where : 'E' is the mass stored kinetic energy of the particle ($E = mc^2$) or the equivalent to the Laplace pressure ΔP, 'r' is the radius of the sphere (critical wavelength $\Lambda = 2\pi r$) and '$\Gamma_c = \hbar c$' is the energy space-time interface tension for circular quanta motion. After substitutions, the modified Young-Laplace equation for energy-space-time interface becomes, **$mc^2 = 4\hbar c/r = 4hc/2\pi r$**, simplification leads to **$mc = 2h/\pi r$** or **$r = 2h/\pi mc$** as the energy-space-time *Young-Laplace equation* for energy to mass transformation though energy-space-time Plateau–Rayleigh instability.

An alternate way to obtain this equation is to start with the energy-space-time *Young-Laplace equation for electromagnetic energy quanta flow through space-time : $E = \Gamma/r = hc/\Lambda$ and $E = \Gamma_c/r = \hbar c/r = hc/2\pi r = hc/\Lambda$, are the Young-Laplace equations for energy flow through space-time on a linear and circular direction of motion, respectively. When the energy flows on a curved surface instead (spherical, ellipsoidal, etc), this equation becomes :* ***$E = \Gamma_c (1/r_1 + 1/r_2) = \hbar c (1/r_1 + 1/r_2)$***, where two radii are used to define the curvature of the two-dimensional surface (the principal radii of curvature in each of the axes that are parallel to the surface). This equation becomes then ***$E = 2\hbar c/r$*** *when the energy perturbation is spherical because $r_1 = r_2 = r$, however the energy flows on both sides of the thin shell energy sphere (both, inside and outside surface of the sphere experience the same energy-space-time interface tension) and if the wall of the sphere is very small, $r_{inside} \approx r_{outside} = r$ then the equation becomes,* ***$E = 2\hbar c/r + 2\hbar c/r = 4\hbar c/r = 4hc/2\pi r$****.* 'E' is the mass stored kinetic energy = **$mc^2 = 4\hbar c/2\pi r$** and simplification leads also to **$r = 2h/\pi mc$** as the energy-space-time *Young-Laplace equation* for energy quanta to mass transformation.

All known subatomic particles will follow the energy-space-time Plateau–Rayleigh instability transformation in order to obtain their masses, however the modified *Young-Laplace equation may not be valid or be just an approximation for particles that are not at equilibrium with space-time (same energy-space-time interface tension inside and outside of the thin shell energy bubble) : Only the electron & proton particles appears to be at equilibrium with space-time because they have mean lifetimes of* 6.6×10^{28} & 1.67×10^{34} years, respectively, as published by the Particle data group {6}. The neutron mean lifetime as a free particle is only 885.7 seconds{6} suggesting that it is not *at full equilibrium with space-time.* The neutron decays into a proton, an electron, and an antineutrino of the electron type suggesting that only *electrons and protons are* at *full equilibrium with space-time as free particles*. The neutron does not have an electric charge and that is likely the main reason for the neutron not being at full equilibrium with space-time as a free particle. The neutron energy-space-time interface tension will fluctuate from the electromagnetic standard $\Gamma_c = \hbar c$ value for a charged particle, when outside of the nucleus. There should however also be further fluctuations in the neutron lifetime due to influences from surrounding energy-space-time interface tension when outside versus inside the nucleus because it does not carry a charge. Based on this analysis, one can conclude that the energy quanta to mass *transformation Young-Laplace equation* **$r = 2h/\pi mc$** should also be valid to determine the neutron radius *when inside the nucleus* (the neutron is stable and does not decay inside a nucleus because its energy-space-time interface tension is $\Gamma_c = \hbar c$, the same as any charged particle, that is because of the surrounding protons that carry an electric charge). Any charged mass particle, even at rest has an energy-space-time interface tension of $\Gamma_c = \hbar c$ because its internal binding energy just as a photon is in motion with the speed of light.

In general, the energy-space-time instability *Young-Laplace equation for a free particle at equilibrium with space-time is* **$r = 2h/\pi mc$,** where c - light speed , h- Planck's constant, r- particle charge radius & m- mass of particle. No free mass particle can be at a full equilibrium with space-time unless it carries an electric charge (charge space-time interface tension is $\Gamma_c = \hbar c$, the same as any electromagnetic quanta is circular motion). A charged particle frame of reference has a "frozen clock" (its internal binding energy is in motion with the speed of light). It can't decay because its internal binding energy can't change just as a photon energy can't change. The Compton wavelength of any mass particle is $\lambda_c = h/mc$, so for further simplification the free mass particle energy-space-time instability *Young-Laplace equation* becomes **$r = 2\lambda_c/\pi$**, where λ_c is the Compton wavelength of the particle.

11. Mass energy Young-Laplace equation confirmation against known particle charge radius

The proton is a particle at equilibrium with space-time (has a mean lifetime of 1.67×10^{34} years {6}) and the NIST published CODATA value for the proton charge radius is **$r_s = 0.8414\ 10^{-15}$ m** {7}. Proton charge radius calculation with the energy-space-time instability *Young-Laplace equation* yields **$r_s = 2h/\pi mc = 2\lambda_c/\pi = 0.8412\ 10^{-15}$ m**, *which agrees with the NIST measured value* (where 'm' is the proton mass and λ_c is the proton Compton wavelength).

An obvious question arises here as how is this agreement possible when the nucleons are not elementary particles (are composed of other particles). This agreement is possible, because regardless of its constituents, the nucleon binding energy is about 99% of the nucleon's mass. That is assuming that the nucleon's mass energy is 99% due to the kinetic energy of the nucleon's constituents which are moving at or near the speed of light, contributing greatly to the nucleon's mass as binding energy.

For protons, the sum of the rest masses of the three valence quarks (two up quarks and one down quark) is approximately 9.4 MeV/c^2 {7}, while the proton's total mass is about 938.3 MeV/c^2 {7}. For neutrons, the sum of the rest masses of the three valence quarks (two down quarks and one up quark) is approximately 11.9 MeV/c^2 {7}, while the neutron's total mass is about 939.6 MeV/c^2 {7}. Furthermore, considering that nearly all the atom's mass is concentrated in the nucleons, this means that about 99% of the mass of matter is, in fact, kinetic binding energy. We don't know of any quark constituents, but if they exist it is very likely that 99% of their mass is also kinetic binding energy. *The quarks themselves because were never seen in isolation, could only be the result of some specific nucleon energy modal vibration phenomena (not actual particles).*

The neutron as a free particle, it is not at equilibrium with space-time (has a mean lifetime of only 885.7 seconds), however its energy structure is stable and at equilibrium with space-time when inside the nucleus. Its radius is believed to be about **r_s = 0.8 10^{-15} m.** The neutron radius calculation with the energy-space-time instability *Young-Laplace equation* yields **$r_s = 2h/\pi mc = 2\lambda_c/\pi$ = 0.8400 10^{-15} m** (where 'm' in the neutron mass and λ_c is the neutron Compton wavelength).

The electron is also a particle at equilibrium with space-time (has a mean lifetimes of 6.6 x 10^{28} years) and the Standard Model currently considers the electron to be a point particle, however Compton scattering clearly indicates that the electron must have an energy structure because photons are scattered by its charge in an organized manner. The electron charge radius calculation with the energy-space-time instability *Young-Laplace equation* yields **$r_s = 2h/\pi mc = 2\lambda_c/\pi$ = 1.54463707184 10^{-12} m** (where 'm' in the electron mass and λ_c is the electron Compton wavelength).

12. Time as a property of space and how that explains Entanglement

Consider Time, not as another dimension, but as a property of space. Time cannot exist independently of space and just like other properties in physics it *should be understood as an emerging property of space.* In a gravitational field time runs at different rates (depending on the distance from the center of the mass generating the field) as the space distortion gradually decrease with the distance from the center of the mass just because time is an emerging property of the distorted space. High velocity subatomic particles do not appear to exist (or exist as waves) until they interact (slowdown) with something else. That is when the time component of the 'space-time' medium becomes more relevant because a slowdown occurs at interaction. High velocity will cause contraction/compression of the space on direction of motion which in turn will cause the *particle personal time* to slowdown or freeze in the case of the photons. *Time is experienced differently by particles depending on their actual velocity (just like time is experienced differently at different locations in a gravitational field).* Time is only an emerging property of the space fluid, while the particle velocity decreases. *For a photon time will emerge as a dimension only when is being absorbed in an interaction. Generally speaking, time is not really a fourth dimension like Einstein suggested, but a property of the space that emerges as the fourth dimension when velocity is less than the speed of light 'c'.* It can only flow in one direction because velocity is limited to 'c' and that is where time no longer exists as a fourth dimension.

"For an energy structure traveling at the speed of light, there can be no change in its internal state during motion, that is because any change is an indication of a working clock"

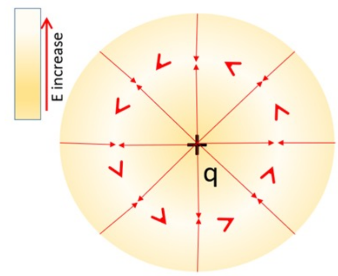
Now, let's consider a simple s-shaped energy structure like a sine wave that continuously oscillates up and down with a certain frequency f, while traveling through space (not space-time) at the light velocity c. If this energy structure travels on a horizontal direction, then the two sides of the s-shape (left and right side of the zero-displacement node) will oscillate vertically to their respective anti-node (maximum displacement) position in a symmetrical manner : when the left side is at the positive anti-node, the right side is at the negative anti-node and that motion repeats with the frequency f. This energy structure only travels through space because it travels at velocity *c* and time is frozen in its local reference frame, however it will continue to oscillate in the explained manner at the frequency *f* because time is only frozen on its direction of motion which is horizontally (oscillating motion is on a vertical direction). *Now, imagine this energy structure being involved in an interaction where it is separated at the zero-displacement node* (like a high energy photon being split into an electron and a positron) *and the half s-shaped energy structures continue to travel at the same velocity c but in different directions now away from each other*. Because there was no change in velocity, the time was and remains frozen in each energy structure local reference frame before and after the interaction, however the oscillation of the separated half s-shaped energy structures *will remain synchronized* (when one half is up, and the other half is down) because no time has passed in either reference frame. It should mathematically appear however that the up and down oscillations of the energy structure are in superposition or up/down simultaneously because no time is passing in the energy structure reference frame before or after the interaction. Time is only an emerging property of space that becomes the fourth dimension when velocity is less than the speed of light 'c'.

Now take any of the separated half s-shaped energy structures and measure if their oscillation is either up or down at the time of the measurement : *when the first one is measured the result will randomly be either up or down, however the measurement will restart time in the local reference frame of the energy structure because the structure will have to slow down or be absorbed in order to be measured*, when the second half s-shaped energy structure is measured the process of restarting time is the same but the measurement must be down if the first structure was up or the other way around. That is because time has the same origin for these structures and regardless when is restarted in our reference frame or how far these separated structure are from each other it will always restart when *the half s-shaped oscillations are synchronized* because that is where it stopped in the first place, however this *synchronization will be lost once the time is restarted in their local reference frames* (when they slow down). Basically, if the time restarts for the first half S structure when the oscillation is up, at that exact time mark/origin the second half S structure must have the oscillation down, so that must be the oscillation where the second structure restarts time (they have an identical origin of time). *For the second energy structure time must restart in sync with the first energy structure regardless when it restarted for the first one (up or down) because they have the same time origin, or they were separated in a timeless frame*. In a simplified way that is how entanglement works. *The key is to understand time not as another dimension, but as a property of space that can change (slow down or freeze due to the space compression at high particle velocity).* Mass particles like electrons become entangled or have certain physical properties (spin) corelated not because they travel at the light velocity *c*, but because their internal energy structure was and remains in motion with velocity *c* before and after the interaction where the entanglement is born… remember that interacting particles don't have working clocks in their local reference frames.

13. Energy-Space-Time interface tension & The Fundamental interactions Electrostatic vs Gravitational interaction

13a. The Electrostatic interaction

For a simple case of electron/positron interaction, the electrostatic attraction force is $F = k\frac{e^2}{r^2}$ [9] , where 'e' is the elementary charge of the electron/positron, 'k' is Coulomb's constant, and 'r' is the distance between the two charges. The fine structure constant, $\propto = ke^2/\hbar c$ [10], where $\hbar = h/2\pi$ is the reduced Plank's constant and 'c' is the speed of light in vacuum. Substitution of e^2 into the force equation results in $F = \propto\hbar c/r^2$ or $F = \propto\Gamma_c/r^2$, where $\Gamma_c = \hbar c$ is the electromagnetic quanta circular motion energy-space-time interface tension . From the work-energy equivalence principle, the electrostatic interaction stored energy of each particle is $\mathbf{E_e = Fr = \propto \Gamma_c/r}$. A charged particle energy structure is a spherical electromagnetic quanta, a photon wave energy packet taking a spherical shape in order to minimize its energy-space-time interface tension at the boundary with space-time. *The quantized electrical charge is the interface tension at the spherical quanta energy-space-time boundary, quantized because all circular electromagnetic quanta has the same space-time-energy interface tension* $\Gamma_c = \hbar c$. *The charged particle electrical field are radial space compression/contraction line shock waves : compressed space-time distortion waves that due to the abrupt space contraction on quanta direction of motion cannot travel in front of the spherical energy wave packet and the space-time distortion energy progressively builds as 'compressed space-time distortion energy' line shock waves that form perpendicular on the spherical wave packet direction of motion*. Spherical electromagnetic quanta energy-space-time interface tension or ***the charge*** is the cause of the abrupt space contraction and so also responsible for the formation of the *electric field energy shock waves* : an energy pressure field that forms on radial direction as compressed standing energy waves at the spherical quanta energy space-time boundary. Electric field space contraction line shock waves can be 'over-pressure' or 'under-pressure' energy shock waves corresponding to positive or negative electric field respectively and their interference give rise to the electromagnetic interaction. Electric field line energy shock waves are not regular space-time distortion waves (gravity waves) but are the compressed energy of regular space-time distortion waves, they are *space contraction line shock waves taking the form of the sharp change in the space-time medium properties (they are the result of a dynamic space-time phase transition)*.



Electron electric field standing waves energy potential mapping at kinetic energy-space-time boundary $E = \Gamma_c/r= \hbar c/r=hc/2\pi r$

The radial lines shock standing waves form an energy pressure field and its **energy** decreases with the distance from the charge geometrical center. The standing *shock waves field energy* also propagates through space-time (radially because there is no space contraction on radial direction) and is also governed by an energy-space-time Young-Laplace equation : The general electromagnetic quanta energy-space-time *Young-Laplace equation* is $E = \Gamma/\Lambda = \Gamma/r = hc/r$, where $\Gamma = hc$ is the electromagnetic quanta linear motion energy-space-time interface tension and '$\Lambda = r$' is the linear electromagnetic quanta wavelength.

In a special case of electromagnetic quanta circular motion, the energy-space-time interface tension is $\Gamma_c = \hbar c$ and the *Young-Laplace equation for circular quanta motion becomes* $E = \Gamma_c/r = \hbar c/r = hc/2\pi r$ with 'r' being the distance from the geometric center of the circular quanta perpendicular on its direction of motion similar to the linear motion quanta wavelength. The electric charge (as the electromagnetic circular quanta energy-space-time interface tension) is responsible for the formation of the electric field or the compressed energy standing shock waves at the motion energy space-time boundary, and its stored kinetic energy is $\mathbf{E = \Gamma_c/r = \hbar c/r = hc/2\pi r}$ on any radial direction. ***The energy of each particle involved in the electrostatic interaction is $E_e = \propto\Gamma_c/r = \propto E$, where 'E' is the energy stored by the compressed energy standing shock waves field (electric field) and the fine structure constant '$\propto$' is the field interaction/interference constant. The energy-space-time Young-Laplace equation also governs the unified electric field stored energy structure.***

13b. Gravitational interaction

Gravitational interaction was correctly described by Einstein's general theory of relativity, not as a force but as a consequence of curved space-time at the rest energy space-time boundary, this space-time curvature is what is measured as a "force, but Einstein did not explain that the space-time distortion occurs due to an energy-space-time *Young-Laplace instability and that the gravitational field is the interface tension at the mass-energy and space-time boundary.* **In a special case of energy at rest** (mass energy), the geometry of the mass is also governed by the rest energy-space-time interface tension which is the gravitational field : large mass bodies such as planets have a spherical shape due to a strong radial gravitational filed. Rest energy (mass) space-time interface tension is the curved space-time energy pressure field that radially propagates at the rest energy space-time boundary with the speed of light. The interface tension field **energy** decreases with distance from the mass center point, however the field energy also propagates through space-time and so the geometry of the energy field will be governed by a 'rest energy-space-time' Young-Laplace equation : *$E = \Gamma/r$, where 'E' is the gravitational stored energy (due to curved space-time), 'Γ' is the mass-space-time interface tension and 'r' is the distance from the center of the mass, This equation can be demonstrated as follows :*

For simplification and to analyze a case study similar to previously discussed electrostatic interaction, where charge is quantized, will consider the force of gravity between two planets with identical masses 'm' : $F = Gm^2/r^2$ [11], where 'F' is the attraction force, 'm' is the mass of the planets, 'r' is the distance between the centers of their masses and '*G*' is the gravitational constant.

Using the work-energy equivalence principle, gravitational stored energy of each planet is E = Fr = Gm^2/r = *Γ/r, so the rest energy (mass) space-time interface tension is Γ =* Gm^2. **Gravitational constant 'G' is the rest energy space-time interface tension field interaction/interference constant.**

Einstein's equivalence principle (an assumption that gravity was equivalent to acceleration that leads to the "geometric interpretation" of gravity), which was the key to the relativistic theory of gravity, only holds because accelerated motion and motion in a gravitational field have the same space-time curved trajectories, the first because an accelerated object has a force applied and the second because the space-time itself is already curved. There is no force or acceleration in curved space-time, it only appears to be (same physical effect) because objects must follow the curved space-time trajectories which are the same as they would be if an object is accelerated in flat space-time. However, *at relativistic velocities acceleration is no longer equivalent to gravity because a mass object will start to lose energy by emitting gravitational waves* ***(acceleration acts only on the mass of the moving object while gravity acts on the gravitational field generated by the mass)****. An infinite amount of energy is required to accelerate an object to light velocity just because the object will lose energy by emitting gravitational waves at relativistic velocities. We know that because similarly, an electrically charged object emits electromagnetic radiation losing energy when accelerated in flat space-time, but it does not emit any radiation while moving in a gravitational field* ***(acceleration acts only on the mass of the charged moving object while gravity equally acts on the gravitational fields generated by the mass and by the attached electrical field)****.* Also, the state of uniform motion can't be distinguished from the state at rest because in both cases the energy-space-time interface tension is a constant (Γ = hν). Following up on that observation, motion due to a gravitational field (free falling along a geodesic) must also be 'like' uniform motion because the rest energy-space-time interface tension is a constant as well (Γ = Gm^2) and therefore no acceleration exists.

13c. Electrostatic vs Gravitational interaction

The electrical field radial compressed energy line shock waves are a consequence of the space contraction on circular electromagnetic quanta direction of motion, while the gravitational energy field is a consequence of curved space-time at the rest energy space-time boundary. They are both a consequences of energy-space-time interface tension but also fundamentally different : Space contraction line shock waves (electric field) are not space-time distortion (gravitational) waves, they are compressed energy stored by the space-time distortion waves that cannot travel forward due to the space contraction and *merge to form a space-time contraction/compression shock wave perpendicular on the direction of motion* . This fundamental difference between the fields is what makes their unification very difficult. They are also similar because both result in radial energy pressure waves, so they are **Open** energy fields, meaning their stored energy is the same on any direction of interaction : **The force between two interacting electric charges does not change if one of them starts to interact with a third charge (the same is also true for mass charges).** Their energy flows on radial direction to infinity and **not on a closed** two-dimensional surface (spherical circumference).To be more specific, a **Closed** spherical electric field energy-space-time *Young-Laplace equation* would be, E = $\Gamma_c/r + \Gamma_c/r = 2\Gamma_c/r$ = 2hc/ 2πr = hc/πr because the energy would flow on a two-dimensional surface, however if this was the case then the interaction between two charge fields will be affected by the presence of a third. The change in the field on one direction does not impact the interaction energy available on another direction and the same is true for the gravitational interaction, therefore they are both **Open** energy fields with a stored energy of E = Γ/r on each radial direction of motion.

An electrically charged particle at rest generates an electric field because its energy structure contains an electromagnetic spherical wave packet (charge is spherical electromagnetic energy space-time interface tension and it is quantized because spherical electromagnetic energy -space-time interface tension is always $\Gamma = c\hbar$). The electric field are line space contraction shock waves that form at the energy-space-time boundary due to a dynamic space-time phase transition on the spherical wave packet direction of motion. A mass particle at rest distorts space-time to generate a gravitational field (a gravitational field is rest energy- space-time interface tension field , $\Gamma = Gm^2$).

14. The Strong interaction

Before 1971, physicists did not know how an atomic nucleus was bound together. It was known that the nucleus was composed of protons and neutrons and that protons had positive electric charge while the neutrons were electrically neutral, so positive charges would repel one another causing the nucleus to fly apart. New physics had to be at play to explain this phenomenon, and a stronger attractive force was postulated to explain how the atomic nucleus was bound despite the proton's electromagnetic repulsion. This new hypothesized force was called the *Strong force*, which had to be acting on both the protons and neutrons that make up the nucleus of an atom.

The force that binds protons and neutrons together to form the nucleus acts on a very small scale (about 0.9 to 2.5 fm {14}, 1 fm = 10^{-15} m) and was modeled as the most complicated interaction, mainly because of the way it varies with distance : The nuclear force between nucleons is approx. 100 times as strong as electromagnetism and attractive at distances of about 0.9 femtometre (slightly more than the radius of a nucleon) and 10^{38} times as strong as gravitation, but it rapidly decreases to insignificance at distances more than 2.5 fm {14}. At distances less than 0.7 fm, the nuclear force becomes very repulsive.

The energy-space-time interface tension, introduced to explain *Why energy can only travel through space-time as quanta and How gravitational and electrostatic interactions are connected because both are consequences of interference between rest or kinetic energy-space-time interface tension fields,* can also be used to show that the strong interaction is a consequences of a direct contact between the energy-space-time interface tension fields at the nucleon's energy-space-time boundary. *Due to the direct contact between the nucleon's energy structures, an interaction constant is no longer required because the entire energy stored by the nucleon boundary energy-space-time interface tension is used during the interaction.*

14a. Proton-Proton strong interaction

The sum of the rest masses of the proton's three valence quarks (two up quarks and one down quark) adds up to approx. 9.4 MeV/c^2 {7}, while the proton's total mass is about 938.3 MeV/c^2 {7, so the nucleon kinetic binding energy accounts for about 99% of the nucleon's mass. A mass particle can be at rest, but its mass stored energy it is not. Quanta is energy in motion through space-time, as the energy-space-time interface tension restricts travel to quantized wave energy packets due to the energy-space-time Plateau-Rayleigh instability. Mass is energy at rest relative to the surrounding space-time. Energy to mass transformation occurs due to the energy-space-time Plateau–Rayleigh instability where energy in order to minimize its interface tension with space-time, tends to assume the minimum surface area possible (spherical shape). The internal energy structure of particles like protons or electrons is very stable and can't decay (or have very large mean lifetimes) into other particles because their internal binding energy (measured as mass) frame of reference has a "frozen clock" (is in motion with the speed of light and can't change just as a photon energy can't change). A charged particle frame of reference has a "frozen clock" (its internal binding energy is in motion with the speed of light) and its energy-space-time interface tension is $\Gamma_c = \hbar c$ as minimized by the energy structure spherical shape (minimum surface area possible due to the energy-space-time Plateau–Rayleigh instability) where $\hbar = h/2\pi$ is the reduced Plank's constant and 'c' in the vacuum speed of light.

The interface tension $\Gamma_c = \hbar c$ *is the quantized electrical charge at the proton binding energy-space-time boundary. When the nucleon kinetic binding energy travels on a sphere at light velocity, the space-time distortion energy waves that it creates can no longer travel in front of the energy wave packet (due to the dynamic space-time phase transition) and the space-time distortion energy progressively builds as 'compressed space-time distortion energy' line shock waves forming rapidly perpendicular on the spherical wave packet direction of motion. These compressed energy line shock waves are the charged particle electrical field (radial space compression/contraction line shock waves that form due to the abrupt space contraction on nucleon binding energy direction of motion) lines that participate in the electromagnetic interactions. The protons would normally interact with each other through the electromagnetic interaction and the energy-space-time Young-Laplace equation that governs the unified electric field stored energy is* $\mathbf{E_e = \propto \Gamma_c/r = \propto E}$, *where 'E' is the energy stored by the charge (light velocity energy-space-time interface tension) or the compressed energy standing shock waves field (electric field) and '∝' (the fine structure constant) is the field interaction/interference constant, 'r' is the distance between the center of the particles. The energy of each proton involved in the electrostatic interaction is* $\mathbf{E_e = \propto E = \propto \Gamma_c/r}$ *and the electrostatic repulsion force can be recovered from the work-energy equivalence principle* : $\mathbf{E_e = Fr = \propto \Gamma_c/r}$, *results in* $\mathbf{F = \propto\Gamma_c/r^2 = \propto hc/ 2\pi r^2}$

In a special case when the protons energy structures can touch each other, while they will continue to experience the electrostatic repulsion force, ***at the point of contact*** *the compressed energy line shock waves of electrical field can no longer form and the electrostatic repulsion force (which is the result of the energy line shock waves interference) transforms into a strong attraction force, the strong force that binds the nucleons to form an atomic nucleus despite their continued mutual electrostatic repulsion. The strong force is a nucleons energy structures* ***contact force*** *and almost 100 times stronger than the electrostatic force because it has no interaction constant, and the entire energy stored by the charge (nucleon boundary energy-space-time interface tension) is used during the interaction. The energy-space-time Young-Laplace equation that governs the strong force field stored energy is* $E_s = \Gamma_c/r$ *, where* $\Gamma_c = \hbar c$ *is the energy-space-time interface tension at the proton binding energy-space-time boundary and 'r' is the distance between the nucleon's centers. The strong force equation can be recovered from the work-energy equivalence principle* : $E_s = F_s r = \Gamma_c/r$, *results in* $\mathbf{F_s = \Gamma_c/r^2 = hc/ 2\pi r^2}$ *as the equation for the nucleons binding strong force.*

Mass energy of elementary particles relates to the size of elementary particles because energy to mass transformation occurs through energy-space-time Plateau–Rayleigh instability and is also governed by an energy-space-time energy quanta to mass transformation *Young-Laplace equation :* $\mathbf{r = 2h/\pi mc = 2\lambda_c/\pi}$, where λ_c is the Compton wavelength of the particle and 'r' is the radius of the particle. The proton charge radius calculation with the energy-space-time instability *Young-Laplace equation* yields $\mathbf{r_p = 2h/\pi mc = 2\lambda_c/\pi = 0.8412\ 10^{-15} m}$. *The distance between the proton centers when their spherical energy structures are touching is* $\mathbf{R = 2r_p = 1.6824\ 10^{-15} m}$ *resulting in a strong force of* $\mathbf{F_s = hc/ 2\pi R^2 = 1.1169 \times 10^4 N}$. When the protons no longer touch, the strong force will drop to 0 and they will only continue to experience the long-range electrostatic repulsion.

Due to the *Young-Laplace energy-space-time instability, the* protons spherical energy structure can not have a smooth boundary at the energy-space-time interface *(some resonant energy modal phenomena must exist)* resulting in an uncertainty value for the radius of the proton that in return will introduce an uncertainty in the strength of the *Strong force* :

Introduced first in 1927 by the German physicist Werner Heisenberg, the **uncertainty principle** {15} states that the more precisely the position of a particle is determined, the less precisely its momentum can be predicted from initial conditions, and vice versa, introducing a fundamental limit to the accuracy with which the values for certain pairs of physical quantities such as the position and momentum of a particle can be predicted: $\mathbf{\Delta x \Delta p \geq \hbar/2}$ {16}. The energy linear momentum at the nucleon energy-space-time boundary from *Young-Laplace energy-space-time instability equation is,* $E = \Gamma_c/r_p = hc/ 2\pi r_p = pc$, resulting in linear momentum $p = h/ 2\pi r_p$. At the limit of the nucleon energy-space-time boundary position uncertainty, $h\Delta x/ 2\pi r_p = \hbar/2 = h/4\pi$ or $\Delta x/r_p = 1/2$, resulting in $\mathbf{\Delta x = r_p /2 = 0.4206 \times 10^{-15} m}$.

Each nucleon energy-space-time boundary position minimum uncertainty is **Δx = 0.4206 x 10^{-15}m** and to be in contact and experience the strong interaction they can be as close as **R - 2Δx = 0.8412 x 10^{-15}m** or as far as **R + 2Δx = 2.5236 x 10^{-15}m**. The strong force variation corresponding to these nucleon-to-nucleon distance values is **F_s = 4.4678 *x* 10^4N to F_s = 0.4964 *x* 10^4N with an average value of F_s = 2.4821 *x* 10^4N. Beyond these limits the strong force either becomes strongly repulsive or it does not exist.**

14b. Neutron-Neutron strong interaction

The sum of the proton's three valence quarks (two up quarks and one down quark) is approx. 9.4 MeV/c^2 {7}, while the proton's total mass is about 938.3 MeV/c^2 {7}. For neutrons, the sum of the rest masses of the three valence quarks (two down quarks and one up quark) is approx. 11.9 MeV/c^2 {7}, while the neutron's total mass is about 939.6 MeV/c^2 {7}. The difference between their total mass is 1.3 MeV/c^2 but the difference between the sums of the rest masses of the three valence quarks is 2.5 MeV/c^2 and that is likely because the neutron does not have an electric field (its binding energy-space-time interface tension is slightly less than 'ħc' when the electric field space contraction shock lines form due to the dynamic space-time phase transition) because its internal binding energy (that we measure as mass) frame of reference has a slow but not "frozen clock" (is in motion with the speed less than the speed of light and can change as the neutron has a mean lifetime of 885.7 seconds {6}). By comparison, a charged particle frame of reference has a "frozen clock" (its internal binding energy is in motion with the speed of light) and its energy-space-time interface tension is Γ_c = ħc. *The neutrons do not have an electric field and can't interact with each through the electromagnetic interaction; however, they do have a magnetic field, meaning that some of their internal binding energy is in motion with the speed of light but not at the boundary with space-time so an electric field can't form.*

In a special case when the neutrons energy structures can touch each other, they will also experience a strong attraction force due to the direct contact between their binding energy-space-time interface tension fields (space-time distortion waves that form due to the space contraction on binding energy direction of motion at the nucleon space-time boundary). This strong force is almost 100 times stronger than the electrostatic force because the entire energy stored by the nucleon boundary energy-space-time interface tension field is used during the interaction (an interaction constant is not necessary). The energy-space-time Young-Laplace equation that governs the strong force field stored energy is $E_s = \Gamma_c/r$, where the binding energy velocity at the space-time boundary is v < c, Γ_c = ħv is the energy-space-time interface tension at the neutron binding energy-space-time boundary and 'r' is the distance between the nucleon's centers. The strong force equation can be recovered from the work-energy equivalence principle : $E_s = F_s r = \Gamma_c/r$, *results in* **$F_s = \Gamma_c/r^2$ = hv/ 2πr^2** *as the equation for the neutrons binding strong force. For calculations we will consider that v = c, because the neutron has a magnetic field and a relatively long lifetime (885.7 seconds {6}) indicating that the neutron binding energy velocity at the space-time interface is very close to 'c' the threshold for the space-time dynamic phase transition.*

The neutron radius calculation with the energy-space-time instability Young-Laplace equation (energy quanta to mass transformation) yields **r_n = 2h/πmc = 2λ_c/π = 0.8400 x 10^{-15}m,** *where λ_c is the Compton wavelength of the neutron and 'r_n' is the radius of the neutron.* The distance between the neutron centers when their spherical energy structures are touching is **R = 2r_n= 1.6800 x 10^{-15}m** resulting in a strong force of **F_s = hc/ 2πR^2 = 1.1201 *x* 10^4N.** The strong force is a **contact force** and will not longer exist when the neutrons binding energy-space-time interface tension fields are no longer contacting each other.

Due to the *Young-Laplace energy-space-time instability,* the neutrons spherical energy structure will not have a smooth boundary at the energy-space-time interface *(some resonant energy modal phenomena must exist)* resulting in an uncertainty value for the radius of the neutron that in return will introduce an uncertainty in the strength of the strong force :

From Heisenberg's **uncertainty principle** {15} **(ΔxΔp ≥ ħ/2** {16} **)** that limits the accuracy with which the values of quantities such as the radius and linear momentum of the energy at the nucleon energy-space-time boundary can be predicted, we can calculate the energy linear momentum at the nucleon energy-space-time boundary from *Young-Laplace energy-space-time instability equation : E = Γ_c/r_n* = hc/ 2πr_n = pc, resulting in linear momentum p = h/ 2πr_n. At the limit of the nucleon energy-space-time boundary position uncertainty, hΔx/ 2πr_n = ħ/2 = h/4π or Δx/ r_n = 1/2, resulting in **Δx = r_n /2 = 0.42 x 10^{-15}m**. Each nucleon energy-space-time boundary position minimum uncertainty is **Δx = 0.42 x 10^{-15}m** and to experience the strong interaction they can be as close as **R - 2Δx = 0.84 x 10^{-15}m** or as far as **R + 2Δx = 2.52 x 10^{-15}m**. The strong force variation corresponding to these nucleon-to-nucleon distance values is **F_s = 4.4806 *x* 10^4N to F_s = 0.4978 *x* 10^4N with an average value of F_s = 2.4892 *x* 10^4N. Beyond these limits the strong force either becomes strongly repulsive or it does not exist.**

15. Summary and Conclusion

It is known by now that gravitational waves **can** travel through space-time by using space-time as a medium {20} and that their propagation speed is precisely the same as the speed of light. An energy wave speed of propagation is dependent on the nature of the medium it travels through. It is only logical to conclude that light and gravitational waves must use the same medium for propagation because they both travel at the same speed. In this paper I propose a reconceptualization of how kinetic energy (such as a photon) travels through the space-time medium by considering energy and space-time as fluids. The current understanding of this phenomena is that electromagnetic radiation is emitted as particles/photons, travel through space-time as waves and then again is being absorbed as particles/photons. Light energy is supposed to be this mesh of oscillating electric and magnetic fields that travel with the light leaving the light without a clear medium for propagation(a propagation medium can't travel with the energy wave).

A wave that transfers energy is a regular and organized disturbance in a medium and carries energy through that medium *without a net movement of the medium*. For kinetic energy caried by light waves, that medium is space-time because as any medium through which a wave travels, space-time experiences *local* oscillations (stretching and compressing) as the energy wave passes through, and unlike the abstract electromagnetic field, space-time medium does not travel with the energy wave. Realistically, light waves **cannot** travel to transfer energy or show observed interference properties without the space-time medium. *As a result of this re-conceptualization of how kinetic energy travels through space-time, a new and much more simplified concept for the fundamental interactions arises naturally from the energy-space-time Plateau-Rayleigh instability where both kinetic energy and space-time are considered as fluids. The presence of energy affects the properties of the surrounding space-time which in turn affects the energy motion/trajectory through space-time giving rise to all known fundamental interactions that can be described through energy-space-time Young-Laplace equations.*

Gravitational energy field is a consequence of energy- space-time interface tension at the rest energy space-time boundary, while the electrical energy field is a consequence of a dynamic space-time transition on a spherical electromagnetic wave packet direction of motion, space-time contraction/compression line shock waves perpendicular on the energy disturbance direction of motion. Gravitational constant G and the fine structure constant ∝ are respectively, the energy interface fields interaction constants. The Strong force, despite of being modeled as the most complicated interaction is the simplest, a consequence of a direct contact between the nucleon's energy-space-time interface tension fields and has no interaction constant. The range and variation in the strength of the Strong force is due to Heisenberg's uncertainty principle. The nuclear force becomes strongly repulsive at very small distances between nucleon centers because their binding energy can not travel through their boundary space contraction region. From the Reid potential (1968) if the spins of a neutron and a proton are aligned, the attractive force has a maximum of about 25,000 N at a distance of 0.9 fm {14} which agrees with the average previously calculated in this paper.

Kinetic energy-space-time interface tension and the Plateau-Rayleigh instability explains the electromagnetic energy quantum behavior and gives us an insight into the size and stability of atoms and why the fine structure constant, Planck's constant, the electron mass and the light velocity must have the values they do (so stable atoms can exist).

Kinetic energy of any mass object in motion through space-time cannot continuously flow due to kinetic energy-space-time Plateau-Rayleigh instability, a consequence of the interface tensions between the energy as a fluid and the medium it travels through (space-time). Kinetic energy-space-time interface tension and the Plateau-Rayleigh instability are responsible for the wave-particle duality.

Energy to mass transformation occurs to high energy quanta due to increased quantum perturbations or energy flow discontinuity. Kinetic energy quanta wavelength is the radius of the energy packets wave like motion due to energy-space-time interface tension while traveling through space-time. Similar to classical fluid dynamics, quanta energy perturbations can reach a critical point (when quanta direction change from linear to circular motion) when energy must assume a spherical shape (minimum surface area possible) in order to minimize the tension at the space-time energy interface and so it condensates as mass energy. It is shown that both, quanta & energy to mass transformation occurs via the Plateau–Rayleigh energy-space-time instability and is governed by a similar Young-Laplace equation (in general, $E = hv\,(1/\lambda_1 + 1/\lambda_2)$ *or* $E = \hbar v\,(1/r_1 + 1/r_2)$*, for quanta linear or circular motion respectively and* $R = 2h/\pi mc$ *for spherical mass transformation). All known subatomic particles should obtain their masses through the energy-space-time Plateau-Rayleigh instability.*

At last, time is described not as a fourth dimension but as an emerging property of the space fluid and that leads to a simple less mysterious explanation of entanglement.

Conflicts of Interest

The author has no competing interests to declare that are relevant to the content of this article.

Data availability

All data generated or analysed during this study are included in this published article.

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