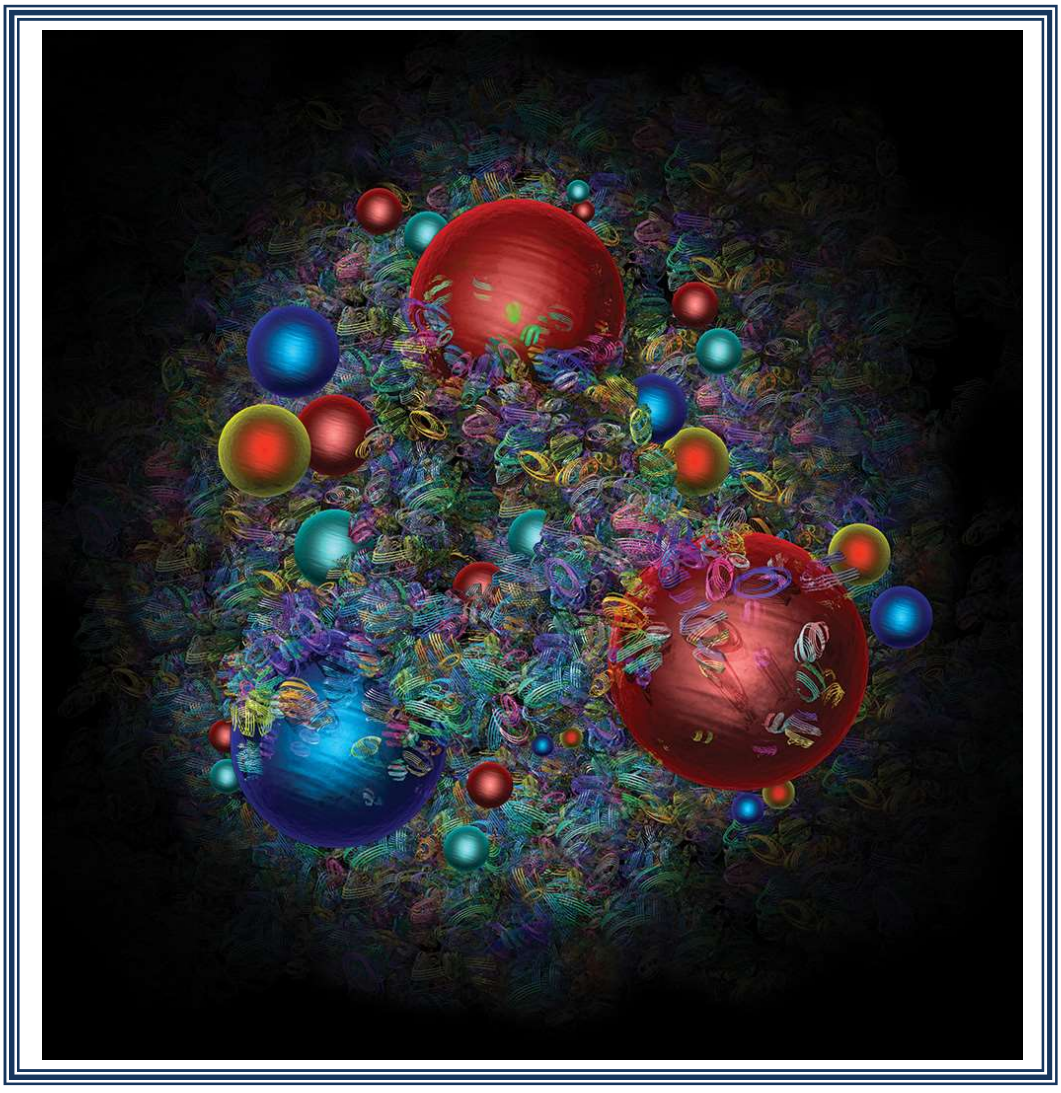
An Examination of Gluon Field Excitation as the Initiating Cause of Time Dilation, Gravity and Dark Matter



Andrew B. Evans

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An examination of gluon field excitation as the initiating cause of time dilation, gravity and dark matter

Andrew B. Evans – March 15, 2021, ABEvans@shaw.ca

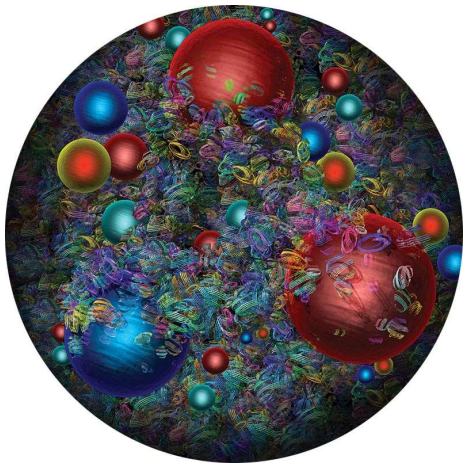
Abstract: Relying on known concepts of General Relativity, and using the Maxwell and Schwarzschild equations, this paper will investigate how charged gluon spin and subsequent excitation of the gluon field surrounding a gravitational mass result in the dilation of the particulate space of loop quantum gravity and the concurrent dilation of time; generally known as the warping of spacetime, which of course is gravity itself. This paper will also show that for any moving object the bow wave in the gluon field generates an analogous excitation of the field, thus leading to kinetic time dilation, gravity, and a new origin of dark matter. Furthermore, this paper will show that the gravitational behavior of a warped spacetime model based on a weather low pressure system is more appropriate than the commonly envisioned bowling ball in a trampoline. Finally, this paper will present a method of testing and proving this theory by means of frozen hydrogen, polarized with respect to the internal gluon spin.

Introduction: Theoretical Physicist John Wheeler provided a perfect explanation for the Einstein Equations when he said "Spacetime tells matter how to move, matter tells spacetime how to curve."[i] This paper will provide a new explanation for the second half of Wheeler's statement and describe exactly how an excitation of the gluon field is the initiating cause of both gravitational and kinetic time dilation, gravity and dark matter.

The driving characteristic of gravity is the mass number, i.e. the number of subatomic particles of the element in question. A planet made of lead has a higher mass number, a higher number of subatomic particles (quarks, gluons and electrons) and stronger gravity than a similar sized planet made of tin. Thus it is not the size of the body that determines gravity; it is only the number of subatomic particles inside that body. Solomon made the statement that "mass is only a proxy for the amount of matter"[ii] in his concept of quark spin as the origin of gravity.

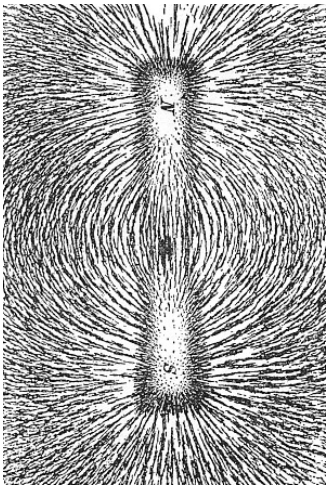
The protons and neutrons ("nucleons") that make up matter are themselves composed of the elementary particles quarks and gluons. There are three valence quarks connected by gluons inside each nucleon, but there are also a very large number of "sea" quarks and gluons that continuously pop in and out of existence.

Why gluons? Quarks have mass and thus radiate a limited field. Gluons are massless exchange particles (vector gauge bosons with spin 1) for the strong force between quarks, analogous to the exchange of photons in the electromagnetic force between charge particles.[iii] Although gluons are massless, they account for more than 99% of the total mass of the nucleon through mass/energy equivalence.[iv] It is this very high level of energy that leads to the most energetic possible gluon field. Gluons carry a colour charge, analogous to the negative electrical charge carried by an electron. The spin of a gluon carries this colour charge out into space surrounding a gravitational body. It is this charge, combined with the charge emanating from the gluons in the other 10^{50} atoms in a typical



Depicting a single proton with a sea of quarks (red, blue and green spheres) and gluons (spring-like connections) popping in and out of existence and generating excitation of the gluon field.

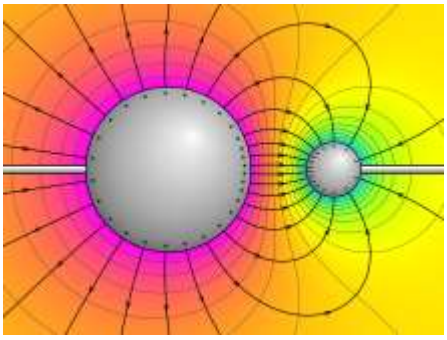
planet that generates the field excitation necessary to dilate particulate space and time.
Space is not empty. It's filled with the quark and gluon fields of Quantum Chromodynamics (QCD), the quantum field theory of the strong interactions governing the structure of subatomic matter. Contrary to the concept of an empty vacuum, QCD induces chromo-electric and chromo-magnetic fields throughout space-time. It's reminiscent of the magnetic field that appears around a bar magnet in its lowest energy state.[v]


Excitation of the electromagnetic field around a bar magnet

There are strong similarities between gluons and electrons that make a comparison appropriate:

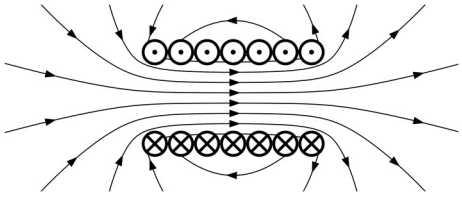
Subatomic particles such as electrons and gluons have the property of "spin". A standard bar magnet functions because the composite atoms are aligned so all the internal free electrons are polarized to spin in the same direction to generate an additive magnetic field. Each individual atom in the universe is itself a tiny magnet with spin generating a tiny electric charge[vi], but because each is spinning in random directions, the force is too small to be noticed. If one was to cut a bar magnet into many pieces and randomly spread these on a table, there would still be a magnetic field but it would have much less power than the field of the whole bar magnet because the free electron spin between pieces are no longer aligned.

Each gluon has one of eight colour charges, analogous the electrical charge of an electron, so there are actually eight fields. The gluon field for each colour charge has a time-like component[vii] analogous to the electric potential or the amount of energy required to move a unit of charge from a reference point to a specific point in the electric field.[viii]

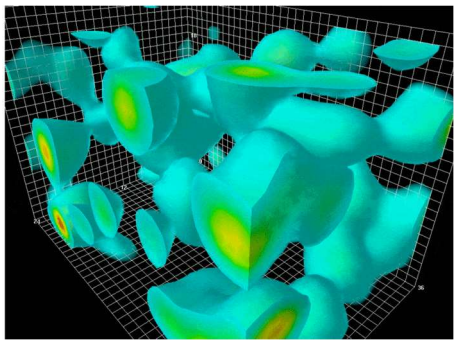

Electric potential energy between two oppositely charged spheres.

Each gluon field also has three space-like components, analogous to magnetic vector potential that can be used to specify the electric field.[ix]

Thus the gluon field is a four-vector field that plays the same role in quantum chromodynamics as the electro-magnetic four-potential in quantum electrodynamics.


Magnetic vector potential can be used to specify the electric field.

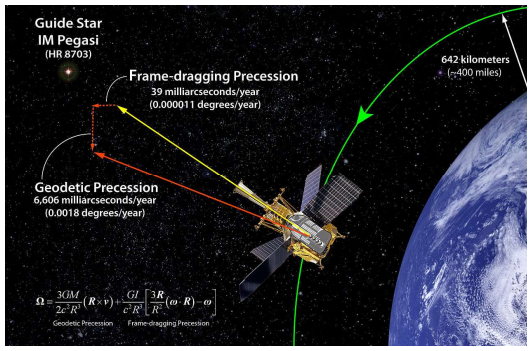
All matter, regardless of size or density, gives rise to time dilation based on mass. For example the planet Earth has gravity. And if the Earth was blown to dust stretching across our solar system, it would still have the exact same level of gravity to a distant observer.[x]
Thus we know that a random gluon field is not additive, analogous to a randomly spread bar magnet.



Topological charge density of the gluon field in empty space. This becomes much more active near a planet or star. Courtesy: D. Leinweber

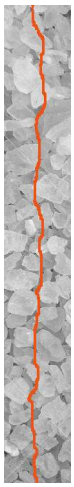
"Like the photon that transmits the electromagnetic force, a gluon is massless. But unlike the photon, a gluon is charged. It generates its own colour field, exerts its own strong force and interacts with other gluons. The colour field, like the electromagnetic one, can be thought of as having two components, call them colour electric and colour magnetic. A fast-moving colour charge (gluons move at c) generates a strong colour magnetic field. Gluons are thus like little dipole magnets. The gluons that surround a quark align themselves parallel to its colour field, they strengthen it. They antiscreen the quark, amplifying its field."[xi]

This falls squarely into the theories of gravito-electromagnetism,[xii] the set of analogies that allows us to make direct mathematical comparisons between Maxwell's equations for electromagnetism and the Einstein field equations for relativistic gravitation. The Gravity Probe B experiment[xiii] was strong evidence of the existence of a field surrounding Earth, and the concept of charged gluons generating this field becomes evident. "According to general relativity, the gravitational field produced by a rotating object can be described by equations that have the same form as classical electromagnetism."



Gravity Probe B

Thus we see that analogous to the magnetic field surrounding a bar magnet, there also exists a charged gluon field surrounding a planet or any other gravitational body. It is the movement of charged gluons, residing inside the protons and neutrons of the mass that generate this charged field. Paraphrasing from Nobel Lauriat Frank Wilczek; In the case of screening a charge induces a cancelling cloud of virtual particles. From a large charge at the centre, you get a small influence far away. Antiscreening, or asymptotic freedom implies that a small magnitude charge catalyzes a cloud of virtual particles that enhances its power; a thunder cloud that grows thicker as you move away from the source. Gluons themselves carry colour charge and play a much more active role than do photons in electrodynamics. It is the effect of the virtual gluons that is responsible for antiscreening.[xiv]



Light travels quickly around small particles and slowly around large particles.

Thus we understand that a moving gluon colour charge is responsible for an excitation of the gluon field surrounding a planet, analogous to the way spinning electron charge from the many pieces of a cut up magnet will cause an excitation of the magnetic field around a table.

The question now becomes, exactly how does this excitation of the gluon field cause time dilation? I propose that this answer lies in particulate space and the well defined theory of "loop quantum gravity". In this, space is made up of particles or loops, with each being extremely small, on the order of 10^{-35} metres. Physicist Carlo Rovelli, in describing them shaped as tetrahedra (a 3 dimensional triangle), noted, "The physics of quantum gravity is the physics of the quantum fields that build up spacetime… A region of space can be

described by a set of interconnected grains of space… The length of these links is determined by the field itself, because geometry is determined by gravity."[xv]

What I have done with the present hypothesis is to reverse the chicken and the egg from these concepts. It occurred to me that in a different universe, if the size of a space particle was larger or smaller, then the speed of light would itself be slower or faster. This works directly in conjunction with Maxwell's equations with $c=\sqrt{(1/\mu_0\varepsilon_0)}$. That is, c is inversely proportional to the permeability and permittivity of free space. In this formula, ε_0 (8.8542×10^{-12}) is the permittivity of free space. This can be thought of as the resistance of free space to the formation of fields, or the viscosity of space.

Paraphrasing from Arvin Ash; Why are μ_0 and ε_0 these exact values? These are the constants of nature. These are properties of free space that tell us how fast magnetic fields and electric fields can interact with each other. This sets a limit on how fast these fields can propagate through space. In a different substance, or in a different universe, these constants could be different.[xvi] Thus if ε_0, the permittivity of space was lower, c would increase. Likewise if ε_0 was larger, as with the dilation of particulate space, c would decrease as we see with time dilation in gravity. Paraphrasing from Review of the Universe, "Just as space is defined by a network's discrete geometry, time is defined by the sequence of distinct moves that rearrange the network. Time flows not like a river but like the ticking of a clock, with "ticks" that are about as long as the Planck time: 10^{-43} second. Or, more precisely, time in the universe flows by the ticking of innumerable clocks - in a sense, at every location in the network where a quantum "move" takes place, a clock at that location has ticked once."[xvii]

To show how this works in a gravitational field, we want to compare the permittivity of free space versus the permittivity of space on the surface of the gravitational body:

- In Free Space: $c=1/\sqrt{\mu_0\varepsilon_0}$, where $\mu_0=1.25663706 \times 10^{-6}$ and $\varepsilon_0=8.85418782 \times 10^{-12}$
- And using the Schwarzschild metric to determine time dilation relative to free space: $t^{!}=t/\sqrt{(1-2Gm/rC^2)}$

On the Earth: Mass=$5.9722\text{x}10^{24}$kg Radius=$6.371\text{x}10^{6}$m
We find a time dilation factor of t_E=1.000,000,000,699,68
Thus we find a permittivity factor of $\varepsilon_E = \varepsilon_0 \text{ x } t_E=8.85418783\text{x}10^{-12}$
or 21 centimeters per second in spacetime dilation compared to free space

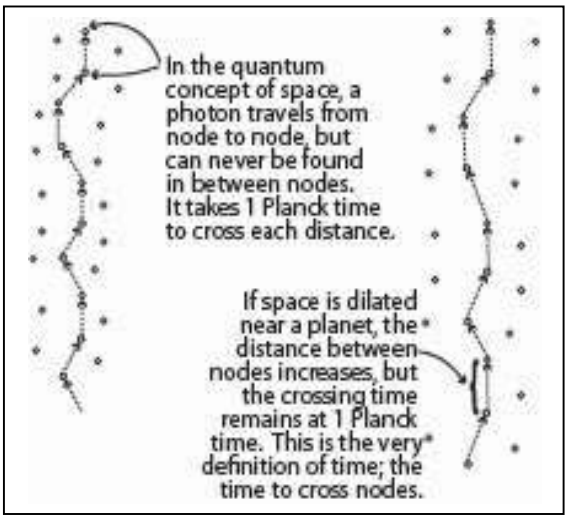
On the Sun: Mass=$1.989\text{x}10^{30}$kg Radius=$6.9634\text{x}10^{8}$m
We find a time dilation factor of t_S =1.000,002,121,041,69
Thus we find a permittivity factor of $\varepsilon_S = \varepsilon_0 \text{ x } t_S=8.85420660\text{x}10^{-12}$
or 635 metres per second in spacetime dilation compared to free space

On star R136a1: Mass=$6.263\text{x}10^{32}$kg Radius=$2.089\text{x}10^{10}$m
(The largest known star) We find a time dilation factor of t_R =1.000,002,226,755,19
Thus we find a permittivity factor of $\varepsilon_R = \varepsilon_0 \text{ x } t_R=8.85438498\text{x}10^{-12}$
or 6,675 metres per second in spacetime dilation compared to free space

Thus we can see the extremely small distortion of spacetime surrounding Earth when compared to the larger distortion around the Sun and much large distortion surrounding star R136a1.

Of course we must not think of particles of space as hard physical objects, like grains of sand, in the same way that we must not think of an electron as a tiny moon orbiting a nucleus planet. Any particle is nothing more than a vibration or an excitation of the underlying field. Particulate space, as defined in loop quantum gravity, is not in space but rather is that underlying field.

Dr. Don Lincoln from Fermilab said "When you add mass and energy, you can distort the shape of the little volumes of quantum space… Bending space and time has a property that you can distort the local definition of space."[xviii] Likewise Arvin Ash noted "How do particles traverse this quantized space? When mass and energy are added to the spin foam the shape of the volumes of the spin network is distorted. This distorts space and time… This distortion of space and time is what we perceive as gravity."[xix] Thus we are left with the conclusion that the added energy of the gluon flied surrounding a gravitational body causes a dilation, or swelling, of particulate space and subsequent time dilation. This becomes a clear definition of the warping of spacetime (and an understanding of the second half of Wheeler's statement) as used throughout relativity; it defines exactly how matter tells spacetime how to curve.



In a different way to envision this process in loop quantum gravity, we can speak of a photon traveling along a path of nodes in space like a man walking across scattered rocks in a river. These nodes define the quantum nature of space in that a photon can only move instantly from node to node, but can never be found in between two nodes. The travel time from node to node is defined as the minimum possible tick of the quantum clock, i.e. 1 Planck time. If, near a planet, space is dilated by an excitation of the gluon field, then the distance between these nodes is increased and it takes longer (in relative terms) for a photon to cross that difference. But the travel period remains defined as 1 Planck time. Referring to Carlo Rovelli, "The central physical result obtained from loop quantum gravity is the evidence for a physical quantum discreteness of space at the Planck scale."[xx]

Why is time dilation a reasonable cause of gravity? The answer is based on the third law of thermodynamics that all matter tends towards entropy. As an interpretation of this, we can say that in order to increase entropy, all matter wants to give up energy.

In his famous lecture, Nobel Lauriat Kip Thorne referred to what he calls "Einstein's Law of Time Warps". He said, "Things like to live where they age the most slowly. Gravity pulls them there. And so as an application, the Earth's mass warps time according to Einstein. It slows time near the surface of the Earth. And this time warp is what produces gravity."[xxi] This might also be related to the principle of least action, whereby any moving object will take the route that requires the least energy.

Thorn showed that mathematically the amount of time dilation required to produce the gravity we see on earth versus a height of 10,000km is one second per century. Recently, a rocket containing atomic clocks was sent to 10,000km and verified this estimate with great precision. Thus the tie between time dilation and gravitational potential is confirmed.

This testing also shows why gravity is such a weak force on Earth. It is the rate of time dilation that gives rise to the force. Thus, time dilation of only 1 second per century over a distance of 10,000km is very small. Near the sun, time dilation is greater and gravity is greater, and much greater still near a very large star, where the force of gravity is much stronger.

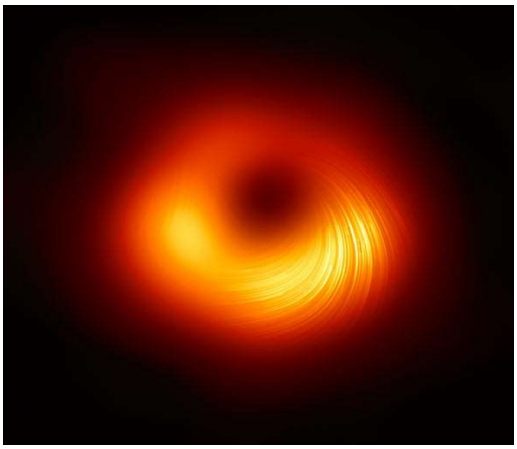
It is clear that a region of space where time has greater dilation (i.e. where time runs slower) has less energy than a region with less dilation. Thus any object and will achieve greater entropy by moving into a region of lower energy (greater dilation). This is what we call gravity.

Gluons and gravity in the big bang period. A recent study from the University of Copenhagen has investigated the state of the universe in the shortest possible time seconds after the big bang.[xxii] They determined that the universe was made up solely of a quark-gluon plasma during the first 0.000001 second of the big bang. Associate Professor You Zhou stated "We have studied a substance called a quark-gluon plasma that was the only matter during the first microsecond of the Big Bang." It was only later that hadrons were formed by the combination of quarks and gluons.

It is also known that gravity predates matter. Jacob Brun noted: "It is at this stage after 10^{-43} seconds that the effects of gravitational interactions become distinguishable from electronuclear interactions and have a describable effect on spacetime. Interestingly enough, gravitation existed before matter did, and therefore, before mass. As what actually manipulates space-time is energy and its propagation through space. It is only when the strong force became distinguishable from the electroweak that we started seeing objects that could be described as "particles," and eventually matter, once electromagnetism separated from weak interaction."[xxiii]

Thus we have confirmation that the only possible initiating source of time dilation and gravity must be either quarks or gluons, and as discussed above, gluons become the logical choice.

Black Holes offer a special situation but with exactly the same cause and effect. A black hole initiates when a star collapses into a singularity. Understanding the Pauli Exclusion Principle, we realize that two or more fermions (1/2 spin particles such as quarks or electrons) cannot simultaneously occupy the same quantum state within a quantum system.[xxiv] Thus, as a star collapses to a singularity, these particles must transform into energy that exits the rapidly forming black hole. However, bosons (spin 1 particles such as gluons) can occupy the same quantum state without limit. Therefore when a star collapses all that remains of the original star are the gluons, compacted down into the singularity. Analogous to the example of the Earth being blown to dust, to a distant observer a black hole has the same level of gravity as the original star. Gluons are neither added nor subtracted during the collapse. We can arrive at a new definition of a black hole singularity – a star's worth of gluons captured in a single point.



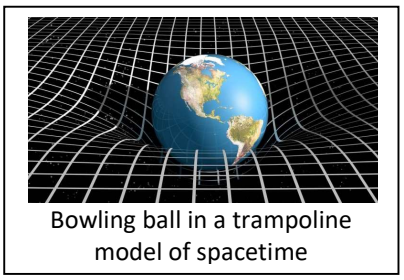
Polarization of light is evidence of a magnetic field surrounding the black hole in galaxy M87. Courtesy Scientific American

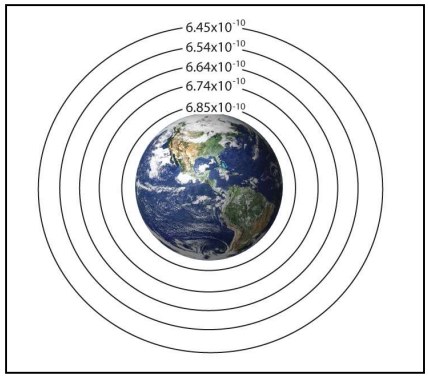
Further evidence of the gluon field theory was confirmed with the discovery of polarized light surrounding a black hole, indicative of strong magnetic fields.[xxv] Although nothing can escape a black hole, including light or any theoretical particle such as a graviton, the black hole can

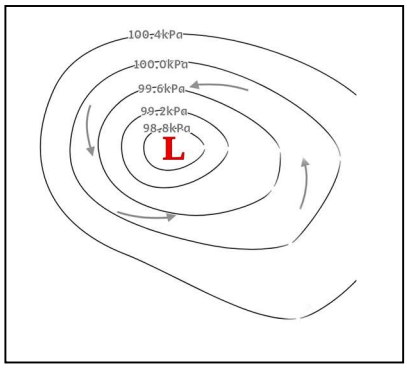
generate a very strong surrounding field such as an electromagnetic field or the strong gluon field of this paper.

This description of a black hole provides further evidence of the general theory of this paper, that gluon colour charge and spin are the initiating cause of gravity. Since there is nothing else remaining inside a black hole singularity, we are left with the sole choice of gluons.

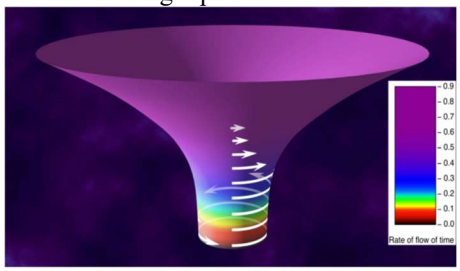
Gravity as a low pressure system: Gravity functions exactly like a weather low pressure system on Earth. Since Einstein, we have pictured gravity with the bowling ball in a trampoline model of warped spacetime. This is not the best image to use. Rather, in a low pressure system, wind circulates around and towards the centre of the Low. This could be referred to as frame dragging. If the wind travelled at c, it would not move in a circular way, but would simply travel straight into the centre of the Low. Since the Earth rotates at a high speed relative to wind speed, the wind must move towards the centre in a spiral fashion. Einstein proposed that the warping of space time is the cause of gravity. This paper merely reverses the causal relationship and proposes that the gradient of time dilation is the warping of space. This low pressure system is simply a clearer definition of what physicists refer to as the geodesic in spacetime, as mathematically described with the Einstein Field Equations $G_{\mu\nu}+\Lambda g_{\mu\nu}=8\pi G T_{\mu\nu}$


Bowling ball in a trampoline model of spacetime





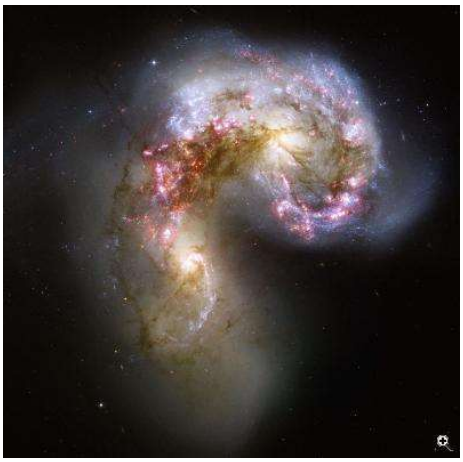
A rapidly spinning black hole drags space with it.



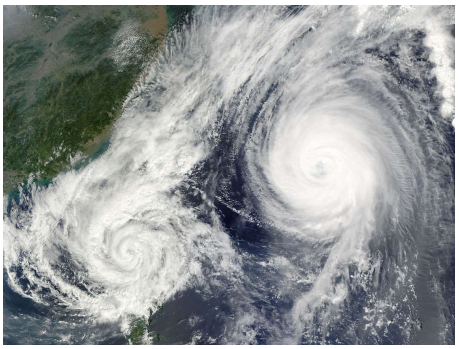
It has been shown with Gravity Probe B that gyroscopes in a satellite in Earth orbit move in a similar manner. They do not simply point down straight at the Earth's surface. Rather they are tilted slightly, reflecting that the rotation of the Earth is causing a slight dragging of space. Likewise a rapidly spinning black hole will drag space in a tight spiral. Physicists refer to this as Frame Dragging.

Another aspect of weather low pressure is that even though the wind is blocked by the walls of my house, the air pressure inside equalizes with the air pressure outside. Thus we understand that although changes in the gluon field itself might be blocked, time dilation equalizes out with the surrounding region of space, so that gravity is not impacted.

In a further similarity between gravity and a weather low pressure system, the Fujiwhara Effect describes when two tropical cyclones rotate around a common center of mass and merge. This is the same effect seen when two galaxies merge. Two cyclones can orbit around each other or merge in the same way that two galaxies merge.



The Antennae Galaxies merging. The resemblance to two typhones merging is striking.

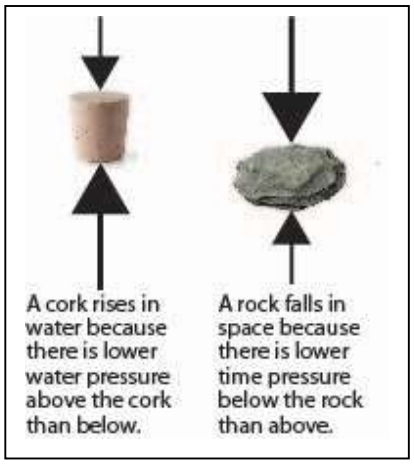


Typhones Parma and Melor merging as described by the Fujiwhara Effect..

In yet another similarity between gravity and a weather low pressure system, we can look to a simple balloon on a string. If the balloon is carried from a high pressure to a low pressure region, the balloon will expand such that the relative pressure between inside and outside the balloon remains constant. Likewise, if a clock is dropped from height, the time measured on that clock will itself dilate, in exact proportion to the time in space surrounding the clock.

We know that all objects, from a feather to an anvil, fall at the same speed and acceleration in a vacuum due to gravity. This is because of the density of time through which they are falling. As an analogy, imagine three pieces of cork: 1kg, 10kg and 100kg and each is shaped so that they have the same resistance when dragged through water. Now imagine that we pull each piece under water to a depth of 100 metres. In exactly the same way as lifting the 10kg and 100kg corks up in the air would be more difficult than lifting the 1kg cork, pulling the larger corks down under water would be more difficult than pulling the smaller cork.

If the corks are released simultaneously, they would all rise to the surface with the same acceleration of 39.2 m/s^2. The only real resistance faced by the rising corks is the pressure of the water, which rapidly diminishes as the corks rise. All three corks will hit the surface at the same instant, exactly as if they had fallen from the sky. The buoyancy is due to the pressure above and below the cork. That is, the pressure of the water pushing down from above is lower than the pressure pushing up from below, so it rises.



A cork rises in water because there is lower water pressure above the cork than below.

A rock falls in space because there is lower time pressure below the rock than above.

We can pose the issue that although the three corks have different mass, they all have the same density relative to water and a different floating object will have a different relative density. Luckily, we can say the same about all matter when compared to spacetime; all matter, be it anvil or feather, have the same density when compared to time, i.e. c.

We can imagine a race of people living under the sea. They would see gravity where rocks fall to the sea floor with equal acceleration[xxvi] and analogous anti-gravity where corks rise to the surface in with equal acceleration[xxvii]. In both cases, it is not the characteristics of the rock or cork that establishes the gravitational or anti-gravitational acceleration. It is the pressure of the medium above and

below the rock or cork that creates the acceleration rate. I.e. it is the pressure of time above and below that establishes the rate for the falling rock and the pressure of water above and below that establishes the rate for the rising cork. The actual falling object has no importance in the process of the fall.

Some[xxviii] have proposed that the reason an object falls to Earth is because the high side of the object is running at faster time than the low side of the object, causing the object to curve downwards in its pathway through spacetime. This view is significantly misleading in that it assumes that only the object is subject to time dilation and not the space surrounding it. In fact time dilation within the falling object is irrelevant. Space itself is subject to time dilation and it is the gradient of time, in space that is why an object falls. An object falls because the space below it has lower time pressure than the space above it. As a further counter-example, light itself falls at exactly the same rate as an anvil or a feather, but light does not experience time. It cannot be said that the high side of the light is experiencing time at a faster rate than the low side. The gradient of time in the space above and below the light is the reason it falls.

The examples given above are very significant evidence of the similarity of time dilation/gravity to any other type of low pressure system. If natural phenomena have very similar characteristics, it makes most sense to consider that they work in the same manner. Thus it is proposed that gravity caused by time dilation works in the same manner as a weather low pressure system. This does not detract from the warped spacetime concept of Einstein; it merely indicates that the low pressure system is a better model than the bowling ball in a trampoline. At the same time, it does corroborate the idea that it is the relative density of time that becomes the cause of gravity.

One might ask the question of whether it is the swelling of particles, and the subsequent reduction in the density of space, that in itself becomes the source of gravity, and that time dilation is merely a by-product? I believe that if this lower density of space was the cause of gravity, then gravity could be blocked simply by blocking the quantum particle waves that are the cause of the space particle swelling. So, for example, a planet would block the gravity of the sun. But we know that this blocking does not occur, so it makes sense that the time dilation distributes itself evenly across space regardless of individual space particles being impacted by quantum particles waves.

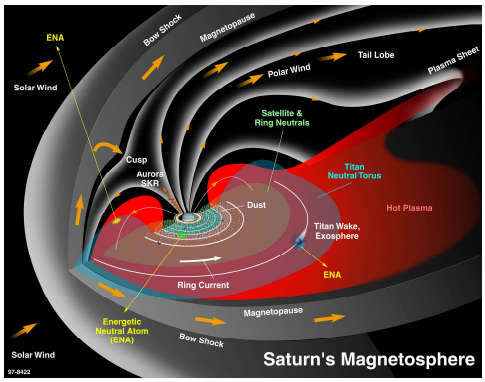
Unification of Gravitational and Kinetic time dilation: From the discussion above, we are led to understand that gravitational time dilation is caused by the excitation of the gluon field near a gravitational body. Let us now look at kinetic time dilation from objects moving in space. We know from Einstein that as objects move faster, they experience time dilation with the formula: $\Delta t=\Delta t_0/(\sqrt{(1-(v/c)^2)})$ Where:

- Δt = observer time (for example the time on Earth)
- Δt_0 = proper time (the time inside a fast moving rocket ship)
- v = velocity in m/s (velocity of the rocket ship, relative to the Earth)
- c = speed of light

Key to understanding the present theory of kinetic time dilation is that if a relativistic rocket passes very close to a clock on Earth, for the instant that the rocket was passing, the clock would tick slower, matching the time dilation of the rocket itself. This indicates that it is not merely the fast moving object that experiences time dilation, but the region of space surrounding it as well.

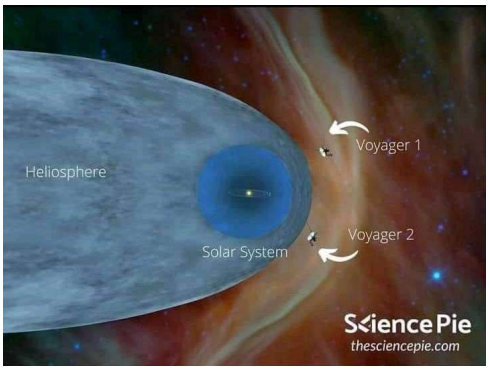
If we look at the analogy of a ship traveling in the water; the ship will create what is called a “bow wave” which is a wave of the water starting at the bow and moving back along the ship. This type of wave is true for any object moving through any liquid medium. It is just as true for a ship on the water or a jet in the air (called a “shock wave”). Likewise, any object moving through space generates a three dimensional bow wave in the quantum field. This could be a rocket ship, a planet, solar system or galaxy. The faster and the larger that the object is moving in space, the larger will be the amplitude of the bow wave.

Thus we can see that a fast moving object creates a bow wave in the gluon field, causing an excitation of the field, analogous to that created by the gluons inside a gravitational body, leading to the subsequent dilation of particulate space and time dilation. There is absolutely no difference between the primary causes of kinetic or gravitational time dilation. They are both caused directly by an excitation of the gluon field. It is only the origin of that excitation that is different.



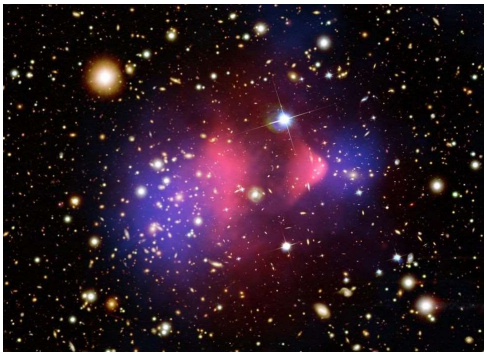
Bow shock wave - the outermost layer of Saturn’s magnetosphere. Note the size of the bow wave compared to the planet. NASA.

Of particular note is that in exactly the same way as it is impossible for any object with mass to reach c, it is impossible for a displacement ship travelling through the water to climb up and over its own bow wave (unless it moves up on plane and is thus no longer in the water medium.) This is known as the hull speed. As a ship moves faster it will build a higher and steeper bow wave, using an exponentially greater amount energy to travel slightly faster but never able to exceed its hull speed. This is analogous to a rocket moving faster through space when the bow wave becomes higher and steeper. It requires more and more energy for the rocket to continue accelerating, until the bow wave is vertical at c and further acceleration becomes impossible. Thus we can see how time dilation, velocity and the bow wave are all related.



Bow shock wave of our solar system.

Dark Matter: Dark matter is said to be unseeable matter that gives a strong gravitational pull on the surrounding space. Strong evidence of its existence was given with observations of the Bullet Cluster, in which two clusters of galaxies with a total mass of 2.5×10^{14} solar masses are passing through each other at an incredible 10 million kilometers per hour (about 1% of c), with gas temperatures of 100 million degrees and creating a massive bow shaped shock wave.

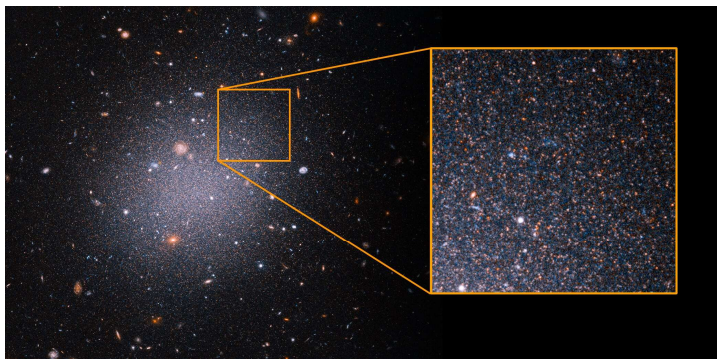


Gravitational lensing from the Bullet Cluster of 40 Galaxies in pink with dark gravity in blue. The resemblance to a bow wave is unmistakable.

Rather than using the term "dark matter" I suggest that we should use "dark gravity", because it is not an issue of matter, but rather an issue of gravity. If we look at the bow wave concept above, we see that any object moving at a high speed will cause a bow wave and excitation of the gluon field, then dilation of particulate space leading to time dilation and thus gravity. Solomon made the statement "The importance of these gravity modification experiments is that they can lead to the confirmation that mass is not necessary for gravitational fields and therefore, matter and not mass is the cause of gravitational fields."[xxix] Hooft took this concept even further when he made the statement "Absence of matter no longer guarantees local flatness."[xxx] The bow wave concept agrees with this idea that it is only an excited gluon field that is required for time dilation and gravity.

A map of dark matter superimposed over visible galaxies.

Galaxies generally reside at the centers of vast clumps of dark matter called haloes. A recent study published in the Royal Astronomical Society monthly newsletter examined dark matter gravitational lensing surrounding 3200 galaxies.[xxxi] It found that massive galaxies have more massive dark matter haloes, and for galaxies with similar mass, those that are more extended also have more massive dark matter haloes. A similar study found "a clear connection between the distribution of stars within massive galaxies and halo mass…. At fixed total stellar mass, massive galaxies with more extended mass distributions tend to live in more massive dark matter haloes."[xxxii] The similarities between dark matter and the bow wave of a ship on the ocean are striking. Would the heliosphere of each star along with the massive amount of matter and gas in the Bullet Cluster, moving at this incredible speed, be sufficient to create the bow wave that generates the measured gravitational effect?



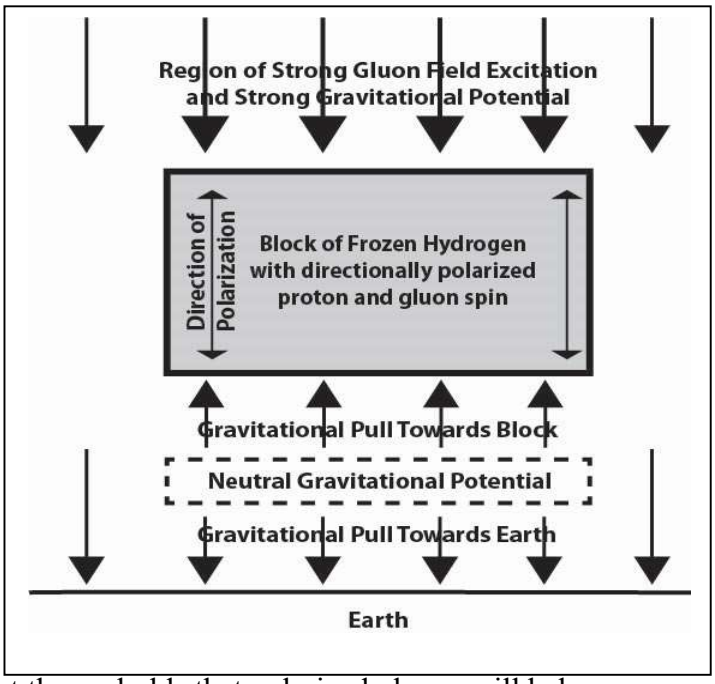
Ultra Diffuse Galaxy NGC1052-DF2 Credit NASA

Further evidence is provided by a 2021 study[xxxiii] on the Ultra Diffuse Galaxy NGC1052-DF2 which found a lack of dark matter. This galaxy is the same size but with only 1% the mass of the Milky Way. It is logical that such a galaxy would generate a much smaller bow wave (or no bow wave at all) compared to galaxy with greater density. A group of row boats would not generate the same bow wave as an aircraft carrier.

Gravitational Waves: Working further from the above concepts, it provides evidence of what makes up the recently confirmed gravitational waves[xxxiv]. The collision of two black holes would inevitably generate a significant wave in the gluon field. This wave would propagate

across space, leading to a momentary expansion of particulate space as it passes. As described earlier, this leads to the momentary dilation of time and thus gravity.

Testing and Proof: (patent pending[xxxv])



A relatively simple means and method of testing this theory can be provided with polarized frozen hydrogen. Hydrogen freezes to a solid at a temperature of 14°K[xxxvi]. It has been shown by Ohata et al [xxxvii] that frozen hydrogen can be polarized with respect to internal proton spin by passing an electromagnet back and forth along the block of frozen hydrogen. Likewise, it has been theorized by de Florian et al [xxxviii] that polarized gluons make up the major proportion of polarized protons. Thus we can conclude that the act of polarizing protons within frozen hydrogen will result in a large proportion of polarized gluons. The present theory holds that polarized gluons will behave analogously to polarized electrons within a bar magnet. That is, they will cause a stronger excitation of the gluon field surrounding the frozen hydrogen. In the present theory, this in itself will lead to a dilation of particulate space surrounding the frozen hydrogen. This will become a localized gravitational field surrounding the hydrogen. Such a block of frozen hydrogen, if positioned above the Earth would generate a stronger gravitational field above the block and a weaker gravitational field and a region of neutral gravitational potential in between the block and the Earth. Thus proof of the present theory will be readily apparent.

Conclusion:

This paper has shown the strong causal relationship between gluon colour charge, the excited gluon field, the particulate space of quantum loop gravity, time dilation and then gravity. Strong evidence for this concept is provided through the examples of the first second after the Big Bang and the singularities of a Black Hole. This paper has also shown the very close resemblance between a gravitational field and a weather low pressure system. Finally, this paper has provided a relatively simple means and method of testing and proof. We are thus left with a complete theory of spacetime, gravity and time dilation.

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