Paper 1: The Properties of Light and Time

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Executive summary

This paper presents a possible explanations of how light can travel as both a particle, and as a wave. Two theories are presented on what may cause light to alter its direction when passing near a sun. The paper concludes with a discussion about the properties of time, and how variations in the rate of time can coexist within the universe.

1. Introduction

This is the first of three papers: *The Properties of Light and Time*, *The Properties of Matter and Space*, and *An Alternative Theory of Gravity*. A fourth paper has been prepared that provides comments on a paper authored by Dr. M.H. Khan of Chicago IL.

I started my research into gravity because I wanted to better understand the mechanics behind ocean tides. I found that the study of gravity requires a knowledge of time, which requires a knowledge of light, which brings you to space, which takes you through dark matter to physical matter, which returns you back to gravity (Figure 1). So if you want to learn about gravity, where do you start. I decided to start by looking at the properties of light and time.

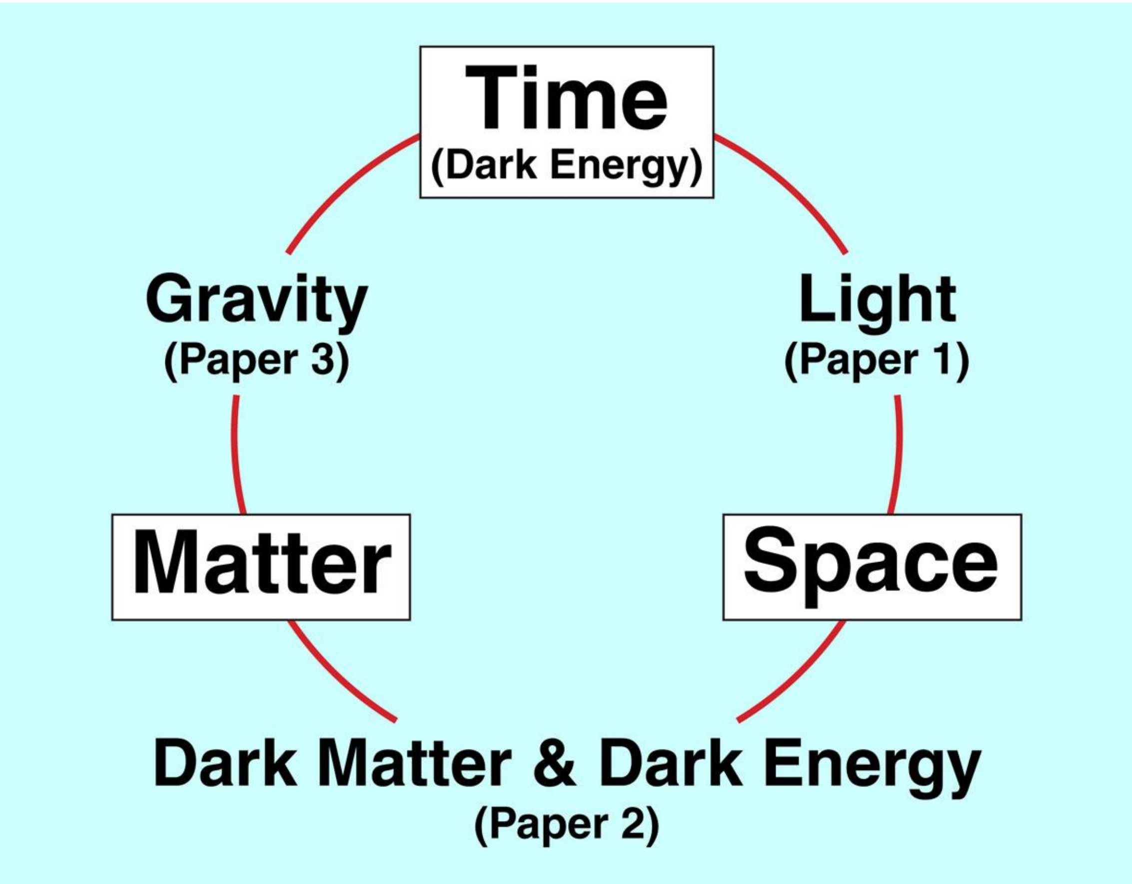

Figure 1: Possible relationship between time, space and matter

These three papers don't necessarily present scientific facts, instead the papers document my search for a more rational explanation of the mechanics associated with ocean tides. The papers focus on presenting alternative explanations of the scientific observations of time, light, space and matter.

To improve the flow of this paper I have adopted the following terminology:

- 'Time' (with a capital) as the mechanics of time (but not the time on a clock)
- 'time' (all lower case) as the time at any instant, such as the time on a clock
- 'time density' as the rate that time progresses at any given location
- 'time density gradient' as a region of variable time density (i.e. variable rate of time)
- 'time zone' as a location of uniform time density.

2. How well do we understand the properties of light?

I began to research the properties of light in order to better understand the properties of Time; however my research left me with the feeling that the properties of light may not be fully understood. Below are some dot points that outline a few of the properties that have in the past been correctly, or possibly incorrectly, associated with light:

- *'Like all types of electromagnetic radiation, visible light propagates by massless elementary particles called photons that represents the quanta of electromagnetic field, and can be analysed as both waves and particles.'*
- *'When a beam of light crosses the boundary between a vacuum and another medium, or between two different media, the wavelength of the light changes, but the frequency remains constant.'*
- *'If the beam of light is not orthogonal (or rather normal) to the boundary, the change in wavelength results in a change in the direction of the beam. This change of direction is known as refraction.'*
- *'The speed of light in water is about 3/4 of that in a vacuum, and about 2/3 in glass.'*
- *'Light can exert physical pressure on objects in its path.'*
- *'One of the arguments against the wave nature of light is that waves were known to bend around obstacles, while light travels only in straight lines.'*
- *'The fact that light can be polarised supports the particle theory of light.'*
- *'Another argument against the wave theory is that light waves, like sound waves, would need a medium for transmission (i.e. not the vacuum of space).'*
- *'In 1847 Michael Faraday proposed that light was a high-frequency electromagnetic vibration, which could propagate even in the absence of a medium such as the ether.'*
- *'James Clerk Maxwell discovered that self-propagating electromagnetic waves would travel through space at a constant speed, which happened to be equal to the speed of light.'*
- *'In the quantum theory, photons are seen as wave packets of the waves described in the classical theory of Maxwell.'*
- *'In1923 Arthur Holly Compton showed that the wavelength shift seen when low intensity X-rays scattered from electrons could be explained by a particle-theory of X-rays, but not a wave theory.'*
- *'Modern physics sees light as something that can be described sometimes with mathematics appropriate to one type of macroscopic metaphor (particles) and sometimes another macroscopic metaphor (water waves).'*
- *'Physicists have noted that electromagnetic radiation tends to behave more like a classical wave at lower frequencies, but more like a classical particle at higher frequencies, but never completely loses all qualities of one or the other.'*

It would appear that there is still some debate about whether light travels as a particle, or as a wave. In response to this issue I would like to put forward the following explanation of light that could possibly satisfy both the particle theory and the wave theory.

3. An alternative explanation of light movement

To start this explanation I would like to point out that in nature we often find that the same physics of motion applies to both large and small scale objects. The difference is that gravitational forces usually dominate large-scale objects, while electromagnetic forces dominate small-scale objects.

Consider, for example, the rotation of objects around a central core. At a universe scale, galaxies rotate around a central core. At a galaxy scale, stars rotate around a central core or black hole. At a star scale, planets rotate around a central star. At a planet scale, moons rotate around planets. At an atomic scale, electrons rotate around a central nucleus. So why should a particle of light be any different?

When we think of the movement of a light photon travelling at the speed of light (c) we first imagine that the photon must be travelling in a straight line (Figure 2). It is hard to imagine what forces could possibly exist that would cause a photon to travel as a wave (Figure 3) while at the same time travelling at a velocity of almost 300,000 km/s.

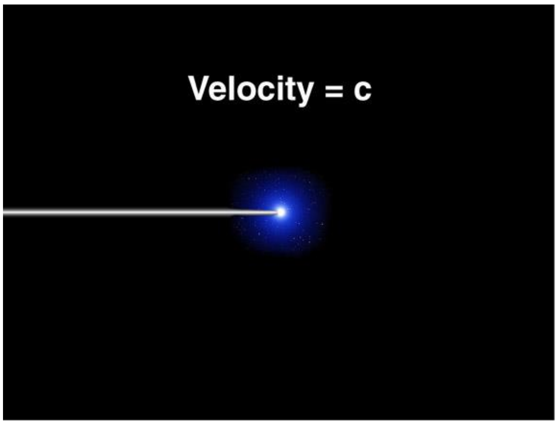

Figure 2 – Light travelling along a straight path

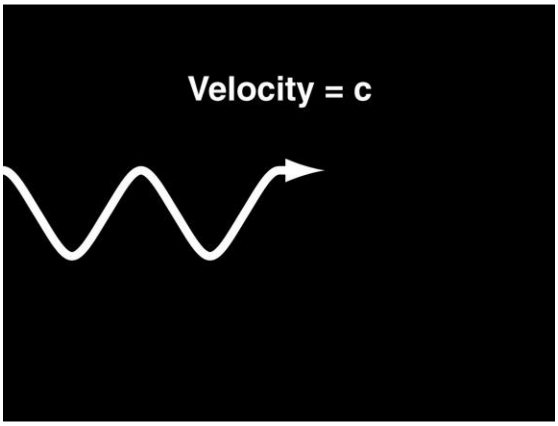

Figure 3 – Light travelling as a wave

Well, why can't light exist in the same state as an atom (Figure 4), with numerous photons rotating around a central core of dark matter/energy. This central core would have electromagnetic properties, but not the properties of mass. Each proton (or pair of protons) could travel at a different radius with a different rotational velocity, which would ultimately result in each pair of protons having a different amplitude and wavelength, and therefore, 'colour' (Figure 5).

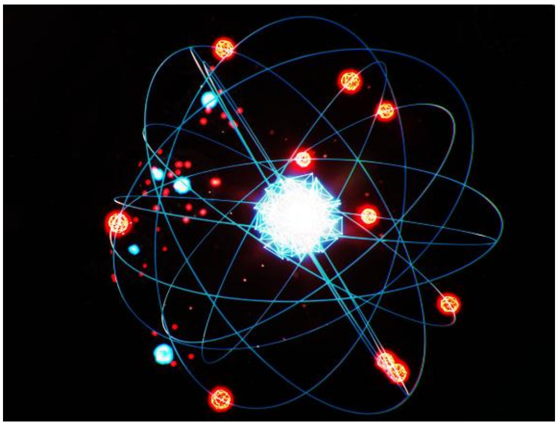

Figure 4 – Possible atom-like configuration of a light particle

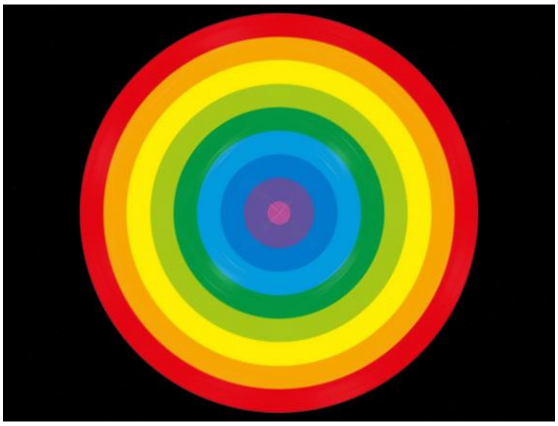

Figure 5 – Photons rotating in different orbits could result in the colour separation of white light

This would mean that for an observer travelling with the light particle, each individual photon would travel in a simple orbit (Figure 6), or possibly each photon would be motionless because time had stopped.

However, if we now give this light particle a forward velocity equal to the speed of light (Figure 7), then to an outside observer, each photon would appear to be travelling with a wave-like motion. Figures 8 to 11 show the wave profiles for a photon with a rotational velocity equal to 1.0, 0.5, 0.25 and 0.167 times the speed of light.

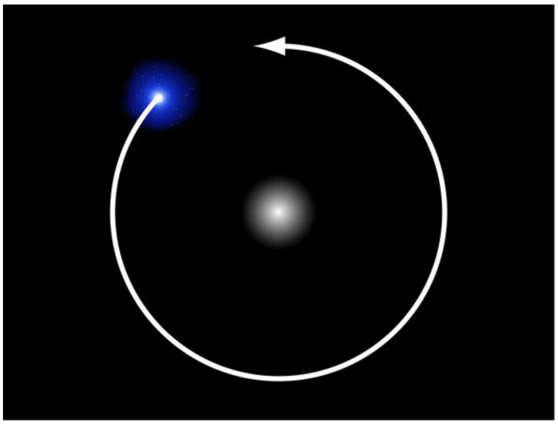

Figure 6 – Possible rotation of a single photon around a central core

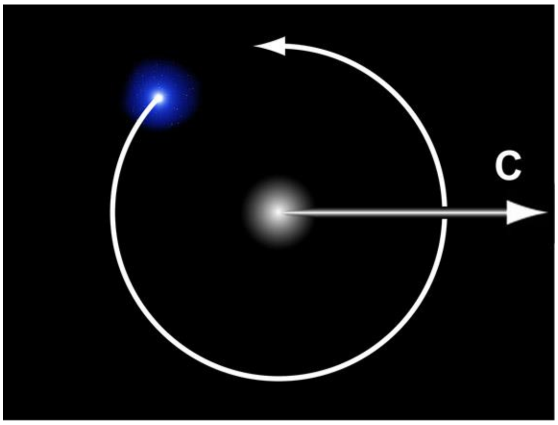

Figure 7 – Rotating single photon with a forward velocity equal to light speed

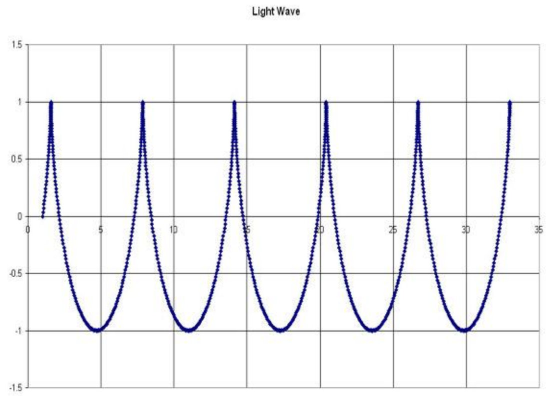

Figure 8 – Travel path of photon with a rotational velocity equal to the light particle's forward velocity (c)

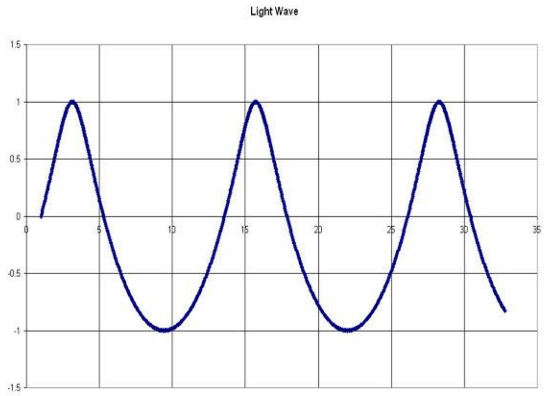

Figure 9 – Travel path of photon with a rotational velocity equal to a half of the light particle's forward velocity (c)

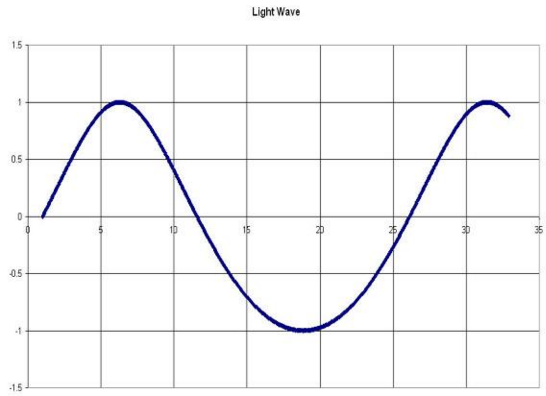

Figure 10 – Travel path of photon with a rotational velocity equal to a quarter of the light particle's forward velocity (c)

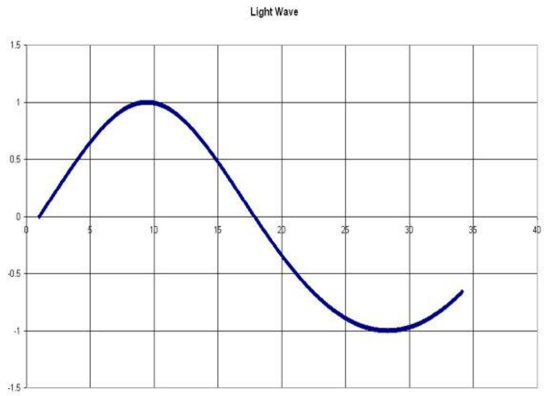

Figure 11 – Travel path of photon with a rotational velocity equal to a sixth of the light particle's forward velocity (c)

So through this simple process we end up with an explanation of light movement that satisfies both particle theory and wave theory, as well as providing for a wide range of wave lengths (colour bands) within an individual beam of light (i.e. each different orbit radius would produce a different wave length).

It should also be noted that as light enters a translucent material such as water or glass, the collective light particle may be slowed through its interaction with physical matter, but this does not necessarily mean that the rotational velocity of the protons would be slowed by the same amount. So light may enter a dense material and refract, but not necessarily change its colour to the same degree. However, this just an idea, and it needs a lot more thought.

I believe this theory of light would also comply with the following properties of light:

- When a beam of light crosses the boundary between a vacuum and another medium, or between two different media, the wavelength of the light changes, but the frequency remains constant.
- If the beam of light is not orthogonal (or rather normal) to the boundary, the change in wavelength results in a change in the direction of the beam.
- Light particles would travel in a straight line, and would generally not bend around obstacles.
- Light can be polarised.
- Light can travel through the vacuum of space.

4. Explaining the apparent instantaneous velocity of light

Have you ever questioned the idea that the moment you switch on a light, light rays (photons) are instantaneously accelerated up to the speed of 299,792,458 m/s?

We are only able to accept this seemingly impossible outcome because we tell ourselves that a photon has no mass, and therefore it can experience instantaneous acceleration. But how does a photon know that it needs to stop accelerating once it reaches light speed?

Well there is a saying: 'If you don't like the answers you're getting, check your premises.' So maybe a particle of light does not instantaneously achieve light speed because the particle of light is already travelling at the speed of light when you turn on the light switch!

In the following discussion it could be assumed that a 'particle of light' consists of either a complex arrangement of rotating photons such as shown in Figure 4, or an individual photon as shown in Figure 3.

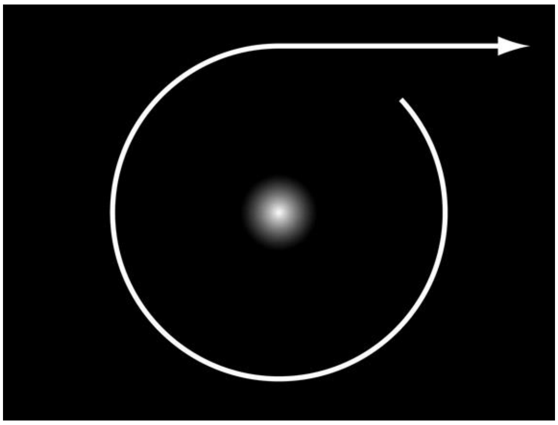

Figure 12 – Possible travel path of a light particle once released from its orbit

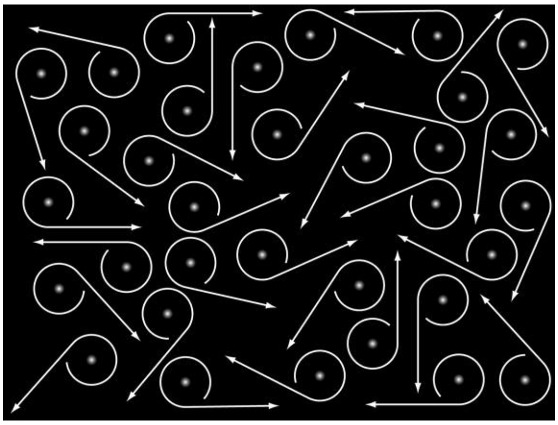

Figure 13 – Possible release of light particles in all directions following an injection of energy

Imagine that while the light switch is off, trillions of light particles are happily rotating around their individual central core, possibly travelling at the speed of light. Switching on the light injects these particles with energy. This input of energy causes the particles to jump to a larger orbit where the electromagnetic properties of the central core are insufficient to hold the particles in orbit. So the particles of light travel off in a straight line at the speed of light. The direction of travel would correspond to its location within the orbit at the time the light switch was triggered (Figure 12).

Given that there would be trillions of light particles energised at the same time, particles of light would be sent off in every possible direction (Figure 13). It is just an idea, and again this idea needs a lot more thought.

5. Speculating the properties of light

From the existence of gravity waves we can speculate that space acts as a continuous substance.

From the frictionless movement of matter through space we can speculate that space (or more correctly, what fills space) has the properties of a frictionless superfluid.

From gravity we can speculate that space has the ability to exert a force on physical matter.

If it is true that **Time** can store energy, then we can speculate that it is Time (or time energy) that acts like a superfluid, which fills space, and has the ability to exert a force on physical matter.

By studying the 'spin' of planets and stars we can speculate that something in space begins to take on the properties of physical matter. These properties include mass, inertia and the ability to exert a force on physical matter. We can further speculate that this substance is 'dark matter'.

From the time density gradient that is assumed to exist around large objects of physical matter we can speculate that the generation of this time density gradient is directly linked to the properties of dark matter. We can also speculate that the density of dark matter around large objects of physical matter varies with the inverse of the square of the distance from the centre of the physical matter.

If we bring all these speculations together we can further speculate that:

- Changes in the rate of time (or time density) can alter the speed of light as viewed by an observer outside that particular time zone, but variations in the speed of light will not necessarily cause a variation in the time density. In other words, time changes light, but light does not necessarily change time.
- It is possible that dark matter surrounds all physical matter.
- The effective density of dark matter is inversely proportional to the square of the distance from the centre of the physical matter.
- The speed of light is reduced by the existence of dark matter, and some types of physical matter (e.g. gases, water and glass).
- The existence of a time density gradient around physical matter generates a force on both dark matter and physical matter, which is the force we know as gravity.
- It is possible that Time has the ability to store and release energy, and that time energy acts like a superfluid, that fills space, and has the ability to exert a force on physical matter.
- Matter is formed from the concentration of energy.
- Light is produced when all mass energy and time energy is converted into kinetic energy, which is the reason why light has no mass or time.
- The fact that light has no 'time' does not mean that light cannot move. Light travels at the speed of light because it exists within the continuum of spacetime where Time exists.
- Light exhibits the properties of both particle and wave motion.

Yes, that is a lot of speculation without much proof!

6. The refraction of light around physical matter

It has been demonstrated through visual observations that the travel path of light from distant stars can be bent if it passes close to our Sun (Figure 14). It has been suggested that the Sun's gravity causes this light to bend, and of course this is probably true.

However, 'light' is said to have no mass, and it is my understanding that the lateral forces exerted on an object passing through a time density gradient (i.e. a gravitational field) are proportional to the mass of the object, which in the case of light would be zero.

There could be two possible alternative explanations to the bending of the travel path of light:

- the light is actually being refracted around the Sun because light travels with the properties of a wave, and the speed of light is governed by the local rate of time, which varies in circular contours around the Sun
- light converts some of it kinetic energy into mass energy when it is slowed by the existence of matter, and this introduction of mass would then allow gravity to bend the light beam, but only if the properties of mass stayed with the light. This may also explain how light is able to exert a force on physical matter.

I would also suggest that both of these effects could exist concurrently, thus causing a greater curvature than would be predicted solely by Newtonian forces. Again, it is just a thought!

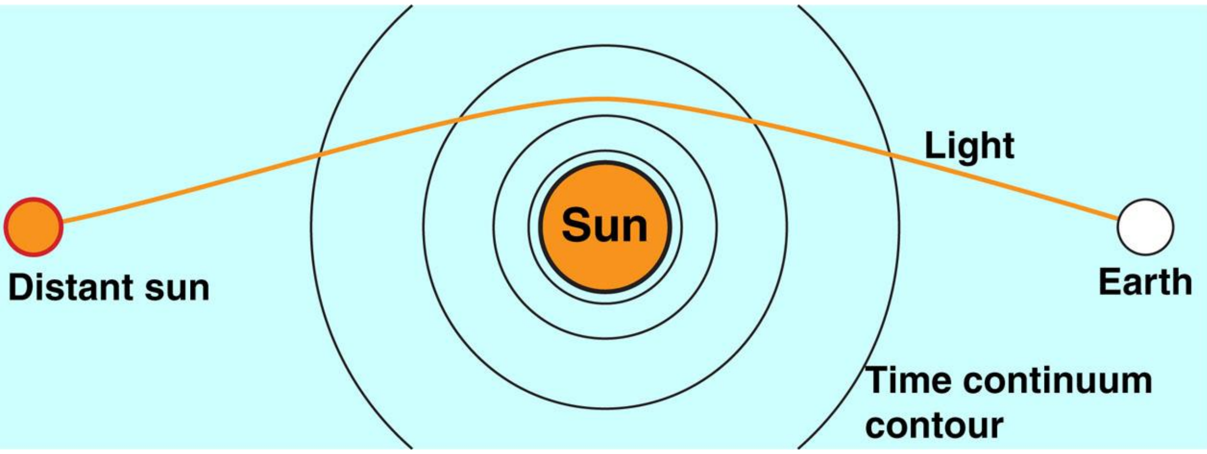

Figure 14 – Refraction of light around the Sun (not to scale)

With regards to the recent (2022) images produced of our galaxy's black hole, I am confused by the apparent lack of distortion (i.e. the effects of gravity) of the travel path of the stars orbiting the black hole.

7. The properties of time

Firstly I would like to note that Time (i.e. the mechanics of Time) is different from what humans measure as time. How humans see time with regards to clocks and calenders is not the same as how the universe uses Time in connection with matter, space, energy and light.

Only on Earth is 'Time' equivalent what we humans think of as 'time'.

The properties of the mechanics of Time can be summaries through the following points:

- If a clock is located on a planet that experiences a slower rate of time, then for an observer on that planet (i.e. an inside observer) the clock would appear to operate normally, but to an outside observer located in a place where time moves faster, the clock would appear to be running slow.
- If a clock travels at the speed of light, then time is said to have stopped, which means the clock would have stopped. However, for an outside observer (say an observer on Earth) where the

rate of time is much faster, the clock would still appear to have stopped, but the clock would be moving through space at the speed of light.

- If a galaxy is located within a region of space where time passes at a faster rate than it does on Earth, then to an observer on Earth (i.e. outside observer) the galaxy would appear to be moving faster than if its speed were measured at the location of the galaxy at the time the light left this galaxy and made its way to Earth.
- If the rate of time has been continually slowing since the Big Bang, then nothing will change for those living on Earth. The only change will be our observations of matter outside the Earth's time zone, such as the speed of distant galaxies.

The expected observations of one planet's movement from another planet within a universe of multiple time zones is summarised in Table 1.

Table 1 – Observation of a distant plant existing within a different time continuum

Condition on plant	Observations from Planet A	Observations from Planet B
Planet A has a faster rate of time	N/A (Planet A looking at Planet A)	Planet A appears to be moving faster than its locally recorded speed
Planet B has a slower rate of time	Planet B appears to be moving slower than its locally recorded speed	N/A (Planet B looking at Planet B)
Planet C has an unknown rate of time	Planet C appears to be moving slower than that recorded by Planet B	Planet C appears to be moving faster than that recorded by Planet A

This leads us to the following question: Are our observations of an expanding universe a true reflection of the universe's actual expansion, or is Time playing a trick on us?

If time energy exists, and both 'Space' and 'Time' existed before the Big Bang, then the time density, or rate of time, at the outer edges of the universe would likely be similar to that in our solar system, which means there would be no tricky Time issues.

If time energy exists, and 'Time' was created during the Big Bang, then this time energy would likely be spreading out across space, which means that a time density gradient would likely exist across space, and the time density at the outer edges of the universe would likely be significantly slower (at any given point in time) than it is at the centre of the universe, or within our solar system.

Therefore, measurements of the speed of distant galaxies would depend not only on the Time difference between our solar system and the outer edges of space, but also on how much Time has slowed since these images of distant galaxies were generated. These outcomes would be independent of whether Space was created during the Big Bang, or if Space existed prior to the Big Bang.

If time energy exists, and a time density gradient exists across the width of the universe, then this would suggest that the time density (i.e. the rate that time passes) would have been much greater immediately after the Big Bang (i.e. time progressed extremely fast). This would suggest that Time has been continually slowing since the Big Bang. If this were the case, then nothing would change for those living on Earth except our observers of events viewed outside the Earth's time zone (i.e. outside our solar system).

If Time and matter are both created by the slowing of light at the edge of space (refer to Paper 2), then the time density would likely be near uniform across the universe at any given point in time, but this time density would likely be decreasing as space expands.

8. A time difference between the top and bottom of a mountain

Our understanding of the mechanics of gravity is based on the idea that the rate that time passes is slowest on the surface of the Earth, it then slightly increases as you move either higher into the atmosphere, or deeper underground. In theory there would be zero gravity at the centre of the Earth.

So this means that time will progress slower at the base of a mountain compared to the top of a mountain. However, this does not mean that the bottom of a mountain drifts backwards in time. It simply means that a clock would operate a fraction slower (or a fraction of a fraction, of a fraction, of a fraction slower) in comparison to a clock at the top of the mountain.

If a person at the base of a mountain timed exactly how long is took for the Earth to complete a single rotation, they may determine the time to be exactly 24 hours and zero seconds.

If a person at the top of a mountain timed exactly how long is took for the Earth to complete the same rotation, they may determine the time to be 24 hours and 1 seconds (just a number for demonstration purposes).

The different time periods occur because each observer is located within a different time zone, and what they are observing is technically located outside each of these time zones. Neither observer would have moved forwards or backwards through time relative to the other observer. However, if each of the observers measured how long it would take for their own digital watch to advance one hour, the answer would of course be exactly one hour in both cases. This is because each observer's watch is located within their own time zone.

9. How can different rate of time coexist within the universe?

One way to think about the properties of Time across the universe is to think about Time the same way we manage different financial currencies around the world.

Each country has its own currency, and at any given instant, there will be an exchange rate between any two currencies, but this exchange rate may change from day to day. However, if you wish to buy a clock from Switzerland, then no matter where you are in the world, or what currency you use at home, the Swiss clock will cost you, say 200 Euros at a given instant in time. And at that given instant in time this may be equivalent to $US215 or $AUS300.

Similarly, when it comes to understanding variations in both 'time' and the 'rate of time' across the universe, we should note that at any given instant, there will be an exchange rate between two different 'time zones', and this exchange rate may change from day to day. However, if you purchased your Swiss clock at exactly 12 noon Swiss-time on the 25th of September, 2022, then it will be exactly 12 noon Swiss-time on the 25th of September, 2022, everywhere across the universe.

In other words, the whole of the universe experiences the same Swiss-time, London-time, or New York-time, which is different from space-time. But note, at one micro-second past 12 noon, that particular time would have past, and nobody (thing, object, or creature) in the universe could return to that time (i.e. time travel is not possible).

So just like financial currencies, different rates of time can coexist across the universe. The price of any item can be converted to an equivalent value in any other currency. Similarly a rate of time in one location can be converted to a rate of time in any other location. If you live for a while in another country, your wealth rises and falls depending on your actions within that country. If you then move back to your old country, your wealth will be adjusted to that new currency, and you may be a little richer or a little poorer than you thought you were. Similarly, when you return from a space trip you may be a little older, or a little younger, depending on where you have travelled.

If you still have trouble understanding how variations in the 'rate of time' can coexist at the same 'time' within the universe, then try to think of these variations in the rate of time as simply variations in the rate of motion, or the rate of aging.

We know that when we place a tub of butter in the frig, the rate of 'aging' of the butter slows, but this does not mean that things inside a frig go back in time. Similarly, when a twin travels to a zone of space that has a slower rate of time, then all that really happens is a slowing of the twin's aging process. The travelling twin's aging in Earth years remains the same as for the twin that remained on Earth, but the travelling twin's actual aging (in Space years) is less than it is in Earth years, and the space travelling twin will have aged less than his or her Earth-bound twin.

10. The interaction between space, time and matter

In the beginning there was only energy, so:

- Did 'space' need to be created?
- Is space an element of the universe that can be created?
- Does space have a structure, like a bookshelf in which we place the books of time, light, energy and matter?
- Do we live a universe with a structured space that has dimensions, or do we live in an unstructured universe?

If space exists, then the size of space must at least be able to contain the first rays of light that left the Big Bang 13.77 billion years ago. So space would either need to be created at the speed of light, or it would need to have existed before the Big Bang.

Light cannot move without Time or space, so this would suggest that Time and space existed before the Big Bang, or the movement of light is directly linked to the creation of Time and space.

I note that the size of space is usually defined by the 'visible universe', which is defined by the position of galaxies, but light would have travelled much further into space than this.

Using logic, not science, it would appear that space is without a structure, and therefore it did not need to be constructed, which means:

- no energy resources were used to form space
- space cannot store energy
- space alone cannot be curved or distorted by matter.

This means that within the spacetime structure discussed by Einstein, it is only Time that needed to be created, and it was Time that required energy in order to be formed. It also means that if matter has the ability to curve spacetime, then it must be physical matter that is able to slow Time, or there must be something stored in space that has the ability to alter Time when in close proximity to physical matter. This space-filling 'element' can be either:

- Time
- dark energy
- dark matter; or
- physical matter (i.e. gasses, etc.).

I suspect that Time was both created with energy, and that time has the ability to store and release energy, but I don't see how matter could directly slow Time, unless there was a conflict between the type of energy that formed Time, and the type of energy that formed matter.

I suspect that what we call as dark energy is actually time energy.

If dark matter exists, then it must have been made from energy, which suggests that it could also store energy.

I simply do not see the connection between Time and physical matter. Therefore I believe that there must be a 'substance' that connects these two items, such as dark matter or dark energy.

In addition to its ability to alter the rate of time, one of the above four elements must have the ability to store potential energy (refer to Paper 3, *An Alternative Theory of Gravity*).

In the end we are left with the following options:

- potential energy is stored in Time as time energy or dark energy, and physical matter directly slows time (unlikely)
- potential energy is stored in Time as time energy or dark energy, and physical matter has a direct influence on the density of the dark matter that surrounds physical matter, which in-turn slows time (possible)
- potential energy is stored in dark matter, and physical matter has a direct influence on the density of the dark matter that surrounds physical matter, which in-turn slows time (possible).

The two most likely options suggest that physical matter interacts with dark matter, and that it is dark matter that slows the rate of time.

11. Conclusions

Light can have the properties of both particle motion and wave motion. Through this understanding of light it is possible for a single ray of light to consist of multiple colours. Time has the ability to change the speed of light, but a change in the speed of light caused by its interaction with matter will not necessarily change time. The bending of light beams can be cause by the wave properties of light, or by the conversion of some of the light's kinetic energy to mass as the light interacts with matter.

Various 'times' and 'rates of time' can coexist across the universe. If Time slows at a given location, then nothing changes at that location, except for how observers at that location view events outside their time zone.

It is possible that gravity results from physical matter interacting with dark matter, which then causes the slowing of time.

Upon consideration of the properties of Time, light, space, matter and gravity, I believe that it is likely that:

- Time is just another form of concentrated energy, which means Time was created and therefore it can be modified.
- Time has the ability to receive, store and release energy.
- Time energy fills space.
- Time energy and dark energy are the same things.
- Time energy interacts with dark matter, which in-turn interacts with physical matter.
- Time energy acts like a superfluid, and is the media through which light and gravitational waves travel.
- Changes in the rate of time (or time density) can alter the speed of light as viewed by an observer outside that particular time zone, but variations in the speed of light may not necessarily cause a variation in the time density.