Time Defines the Gravitational Constant and Fundamental Spacetime Curvature

Colin Thomas Lynch
Independent Researcher
colin@colinlynch.world

Abstract

This work shows that the rate of change in time for the universe defines the gravitational constant for the universe and defines the fundamental curvature for spacetime. This work removes current limits to our knowledge and offers new approaches to comprehensively understand how spacetime operates universally and not just on local scales. This document, along with my previous two documents, should act to support a foundation for a new branch of science of a temporal nature called "Temporal Sciences".

Please note that the proposals presented here are speculative and have not been peer-reviewed, tested, or formally examined. They are shared to encourage discussion and exploration. The foundational equations and formulas referenced are the remarkable work of scientists like Einstein, Maxwell, and others, and are fully acknowledged as their contributions. No claim is made regarding the creation or ownership of these established works.

1. Gravity does not exist

I postulate that **the rate at which time changes for a universe manifest as the illusory phenomenon we perceive as an attractive force, such as gravity**.

Like the core postulates in my other works – we will address and support this postulate as we move through this work.

2. *Time and Distance: A New Approach*[1] and *Universe Framework for Time, Distance, Energy, and Mass*[2] – Revisited

We must revisit the postulates and equations from my previous works as they are foundational to the work proposed here.

From *Time and Distance: A New Approach*[1]:

The first postulate states (updated in this work for clarity), "**clocks do not measure time – clocks measure the rate at which time changes**" and correlates to the following equations:

Measured time (T'):

$$T' = \frac{d^n T}{dC^n}$$

Actual time (T):

$$T = \int \frac{d^n T}{dC^n} dt$$

The second postulate states, "**time and distance are equivalent in a manner analogous to matter-energy equivalency in $\boldsymbol{E = mc^2}$**" and correlates to the following equations:

Time and distance equivalency:

$$D = cT$$

Time, distance, energy, and matter unified expression:

$$E = mc^2 = \frac{mD^2}{T^2}$$

Time equation time ($T_{\mathbb{U}}$) for a universe:

$$T_{\mathbb{U}} = \frac{D\sqrt{m}}{\sqrt{E}}$$

Measured time equation ($dT_{\mathbb{U}}$) for a universe:

$$dT_{\mathbb{U}} = \frac{\sqrt{m}}{\sqrt{E}} dD + \frac{D}{2\sqrt{m}\sqrt{E}} dm - \frac{D\sqrt{m}}{2E^{\frac{3}{2}}} dE$$

From *Universe Framework for Time, Distance, Energy, and Mass*[2]:

The first postulate states that "**the interdependence of time, distance, energy, and mass for any universe are constrained by a single fundamental relationship"** and correlates to the following equations:

Proportional relationships for a universe:

$$D\sqrt{m} = T\sqrt{E}$$

The second postulate states that "**it is the framework of a universe itself that dictates the immutability of the speed of light within it, not the other way around"** and correlates to the following equations:

Universe in terms of permeability and permittivity:

$$\frac{Dm}{TE} = \sqrt{\mu_0 \epsilon_0}$$

Framework for a universe:

$$\mathbb{U}\left(\frac{Dm}{TE}, F\right)$$

Framework for any closed and finite system:

$$\mathbb{S}\left(\frac{Dm}{TE}, F\right)$$

3. Defining the Gravitational Constant for a Universe

To define the gravitational constant (G) for any universe we must start by establishing the time (T) for that universe. We will denote universe time as $T_{\mathbb{U}}$ and its total derivative as $dT_{\mathbb{U}}$ to help conceptually separate them from clock time for now. The time that we measure with clocks (clock time) is a localized phenomenon and is based on the derivative of time for a universe ($dT_{\mathbb{U}}$). Clock time does not measure time itself but only measures the rate at which universe time changes within the clocks own frame of reference.

Additionally, we will denote other universe-based parameters with a double bar U subscript ($-_{\mathbb{U}}$) so these parameters are not confused with commonly used values. Therefore, the diameter of a universe will be denoted as ($D_{\mathbb{U}}$), and the total mass of a universe denoted as ($m_{\mathbb{U}}$), and the total energy of a universe denoted as ($E_{\mathbb{U}}$).

Therefore, the updated time definition (T) for a universe ($\mathbb{U}$) is as follows:

$$T_{\mathbb{U}} = \frac{D_{\mathbb{U}}\sqrt{m_{\mathbb{U}}}}{\sqrt{E_{\mathbb{U}}}}$$

With the universe time ($T_{\mathbb{U}}$) established from an equation perspective, we need values for the diameter of the universe ($D_{\mathbb{U}}$), total mass within the universe ($m_{\mathbb{U}}$), and total energy within the universe ($E_{\mathbb{U}}$) to complete the framing of our universe ($\mathbb{U}$).

We currently have the following estimates:

$D_{\mathbb{U}} = 8.8\ x\ 10^{26} m$ (estimated length of our observable universe)

$m_{\mathbb{U}} = 1.5\ x\ 10^{53} kg$ (estimated mass of our observable universe)

$E_{\mathbb{U}} = 1.35\ x\ 10^{70} J$ (hypothetical total energy of our observable universe)

We can now define the gravitational constant (G) for our universe by calculating the rate at which universe time ($T_{\mathbb{U}}$) is changing. To utilize our total differential ($dT_{\mathbb{U}}$) for this calculation we assume that energy ($E_{\mathbb{U}}$) and mass ($m_{\mathbb{U}}$) are entropic and – even though they constantly change – we will consider their respective differentials as unchanging:

With:

$$dT_{\mathbb{U}} = \frac{\sqrt{m_{\mathbb{U}}}}{\sqrt{E_{\mathbb{U}}}} dD_{\mathbb{U}} + \frac{D_{\mathbb{U}}}{2\sqrt{m_{\mathbb{U}}}\sqrt{E_{\mathbb{U}}}} dm_{\mathbb{U}} - \frac{D_{\mathbb{U}}\sqrt{m_{\mathbb{U}}}}{2E_{\mathbb{U}}^{\frac{3}{2}}} dE_{\mathbb{U}}$$

given,

$$dm_{\mathbb{U}} = 0$$

$$dE_{\mathbb{U}} = 0$$

therefore,

$$dT_{\mathbb{U}} = \frac{\sqrt{m_{\mathbb{U}}}}{\sqrt{E_{\mathbb{U}}}} dD_{\mathbb{U}}$$

interpret $dT_{\mathbb{U}}$ per unit of measured time t,

$$\frac{dT_{\mathbb{U}}}{dt} = \frac{\sqrt{m_{\mathbb{U}}}}{\sqrt{E_{\mathbb{U}}}} \frac{dD_{\mathbb{U}}}{dt}$$

use Hubble's law for recession speed,

$$\frac{dD_{\mathbb{U}}}{dt} = H_0 D_{\mathbb{U}}$$

arrive at,

$$\frac{dT_{\mathbb{U}}}{dt} = \frac{\sqrt{m_{\mathbb{U}}}}{\sqrt{E_{\mathbb{U}}}} H_0 D_{\mathbb{U}}$$

We will incorporate our previously listed values for distance ($D_{\mathbb{U}}$), mass ($m_{\mathbb{U}}$), and energy ($E_{\mathbb{U}}$) along with a calibrated value for the Hubble constant (H_0) into the final equation above. The Hubble constant value we will use was calibrated so that it can accurately represent the current value of our universe's gravitational constant (G) based on the current estimate for the diameter of our universe ($D_{\mathbb{U}}$). The calibrated Hubble constant (H_0) value falls within the currently accepted range of values:

$H_0 = 2.27533 \text{ x } 10^{-18} s^{-1}$ (value lies between SHOES collaboration and Planck mission values)

we calculate,

$$\frac{dT_{\mathbb{U}}}{dt} = \frac{\sqrt{1.5 \ x \ 10^{53} \ kg} * (2.27533 \ x \ 10^{-18} s^{-1}) * (8.8 \ x \ 10^{26} m)}{\sqrt{1.35 \ x \ 10^{70} J}}$$

resulting in,

$$\frac{dT_{\mathbb{U}}}{dt} = 6.67430$$

Therefore, for every second of measured time ($dT_{\mathbb{U}}$), universe time ($T_{\mathbb{U}}$) increases by roughly 6.67 seconds based on our assumptions to this point.

We now multiply the rate at which universe time is changing ($dT_{\mathbb{U}}$) by a scaling factor to produce the gravitational constant (G) for a universe which we will denote as ($G_{\mathbb{U}}$). I envision – in the future – a constant like the Hubble will be created that contains the needed units for direct conversion to a gravitational constant ($G_{\mathbb{U}}$). Perhaps that constant or scaling factor would become part of an overall temporal sciences framework. For now, we must convert the dimensionless H_0 result using a scaling factor:

With,

$$Scaling\ factor = (1x10^{-11}\ m^3kg^{-1}s^{-2})$$

we arrive at,

$$G_{\mathbb{U}} = dT_{\mathbb{U}} * (1x10^{-11}\ m^3kg^{-1}s^{-2})$$

therefore,

$$G_{\mathbb{U}} = 6.67430x10^{-11}\ m^3kg^{-1}s^{-2}$$

The above value for $G_{\mathbb{U}}$ exactly matches the currently used value of the gravitational constant (G) for our universe.

I postulate that **the rate at which time changes for a universe ($dT_{\mathbb{U}}$) is the definition of the gravitational constant ($G_{\mathbb{U}}$) for that universe.**

We used currently established estimates for our universe parameters in our calculations for gravitational constant ($G_{\mathbb{U}}$) for illustrative purposes. However, we can reduce the equations and overall process for calculating a gravitational constant ($G_{\mathbb{U}}$) for a universe ($\mathbb{U}$) as follows:

With,

$$\frac{dT_{\mathbb{U}}}{dt} = \frac{\sqrt{m_{\mathbb{U}}}H_0D_{\mathbb{U}}}{\sqrt{E_{\mathbb{U}}}}$$

substitute $\frac{\sqrt{m_{\mathbb{U}}}}{\sqrt{E_{\mathbb{U}}}}$ with $\frac{1}{c}$,

$$\frac{dT_{\mathbb{U}}}{dt} = \frac{H_0D_{\mathbb{U}}}{c}$$

establish equation for $G_{\mathbb{U}}$,

$$G_{\mathbb{U}} = \frac{dT_{\mathbb{U}}}{dt} * (scaling\ factor)$$

substitute and arrive at,

$$G_{\mathbb{U}} = \frac{H_0D_{\mathbb{U}}}{c} * (scaling\ factor)$$

Where ($D_{\mathbb{U}}$) represents the diameter of a universe, (H_0) is the expansion rate of a universe, and (c) is the speed of light for a universe.

Additionally, since $T_{\mathbb{U}} = \frac{D_{\mathbb{U}}}{c}$, we have the following option:

$$G_{\mathbb{U}} = T_{\mathbb{U}} H_0 * (scaling\ factor)$$

With the equation above – we could have arrived at the gravitational constant ($G_{\mathbb{U}}$) through the time equation ($T_{\mathbb{U}}$) versus using the total differential ($dT_{\mathbb{U}}$) equation.

We will use our reduced total differential ($dT_{\mathbb{U}}$) equation to calculate the gravitational constant ($G_{\mathbb{U}}$) so that we can compare it with our previous results. With the current estimate of the diameter ($D_{\mathbb{U}}$) of our universe, the calibrated Hubble constant (H_0), and the speed of light (c) we have:

$$G_{\mathbb{U}} = \frac{H_0 D_{\mathbb{U}}}{c} * (scaling\ factor) = \frac{2.27533 \text{ x } 10^{-18}\text{s}^{-1} * 8.8\ x\ 10^{26} m * \ 1x10^{-11}\ m^3 kg^{-1} s^{-2}}{299{,}792{,}458 \frac{m}{s}}$$

arrive at,

$$G_{\mathbb{U}} = 6.678921x10^{-11}\ m^3 kg^{-1} s^{-2}$$

The above value comes in roughly 0.0692% higher than our currently accepted gravitational constant (G) for our universe. Taking variables into consideration we can quickly adjust our current estimates for universe distance ($D_{\mathbb{U}}$) or the calibrated value for the Hubble constant (H_0) and arrive at our currently accepted gravitational constant (G) value for our universe. It is not the values that are immutable but only their proportionality with each other.

Now, with Newton's law of universal gravitation:

$$F = G \frac{m_1 m_2}{r^2}$$

and with the gravitational constant ($G_{\mathbb{U}}$),

$$G_{\mathbb{U}} = \frac{H_0 D_{\mathbb{U}}}{c} * (scaling\ factor)$$

substitute for (G) and arrive at,

$$F = \frac{H_0 D_{\mathbb{U}} m_1 m_2 * (scaling\ factor)}{c r^2}$$

We have completely removed the gravitational constant (G) from consideration and now rely fully on the temporal nature of the universe to define and calculate force in Newtonian physics.

4. How Time Defines the Fundamental Curvature of Spacetime

With Einstein's field equations:

$$R_{\mu\nu} = \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

and with the gravitational constant ($G_{\mathbb{U}}$),

$$G_{\mathbb{U}} = \frac{H_0 D_{\mathbb{U}}}{c} * (scaling\ factor)$$

substitute for (G) and arrive at,

$$R_{\mu\nu} = \frac{1}{2} R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi H_0 D_{\mathbb{U}} * (scaling\ factor)}{c^5} T_{\mu\nu}$$

We see the gravitational constant (G) removed and replaced with the rate of temporal displacement for the universe. What we previously thought was gravity is clearly and unequivocally now replaced foundationally with a temporal rate of change. We can now remove references to gravity (G) and replace those instances with temporal displacements.

5. To The Quantum World

For the quantum space – I dare not peer into the quantum world. Its amazing beauty is far too complicated, and I do not have the mind for it. My comfort level is at the macro level. I currently have two choices – investigate the strong force or, go down the infinitely long road to never-never land – that of unpacking the F in the universe framework. I am choosing the latter.

However, I envision diagrams and schemes whose energy values are replaced with temporal displacement values. For now, all I can offer is that the strong force distance may be a starting point for investigating how the changes in universe time support – or drive - the strong force. I imagine that the strong force distance acts as a boundary along which the universe must balance its temporal stability with making allowances for the existence of matter.

I may pop out a document if I run into something (with only the most respectful intentions of sharing).

6. Final thoughts

Most of the current work with spacetime is clock-to-clock, meaning it reflects analysis of one localized framework (clock) relative to another localized framework (clock). In more fundamental terms – our current body of science compares the localized effects of ($dT_{\mathbb{U}}$) to another localized effect of ($dT_{\mathbb{U}}$) and not to time ($T_{\mathbb{U}}$) itself. With that in mind, what is presented here acts orthogonally to and introduces no interruption to our large body of work to-date.

The work proposed here may serve to create efficiencies in our current processes and serves to not only answer questions but to apply the concepts more broadly across our entire universe.

Please note that my work contains '*postulates'* which are expressions of my vision and act as central themes to the work being presented. Their intention is to make up for lack in areas of math (or other skill) that I may have. The idea being that the reader can create their own mathematical solutions sourced from my "postulates" more easily than the reader can create ideas and concepts from my broken math. They also serve to remind myself as to when I may be off (or on) track during my work.

My many apologies to the readers. This work lacks examples, however, I am confident that whoever may be reading this document has the talent and fortitude to make substitutions within their own area of expertise and see if they can remove references to gravity as a general exercise and still have their work come out as expected.

I grew up with gravity as a fundamental concept with GR coming later in life. I find gravity to be an old friend, and I will miss it. Our new friend is temporal in nature versus physical, and where we used to think of distance – it is now time – and the rate at which it changes – that drives everything.

You will notice that I sometimes phrase "*the* universe" or "*a* universe". Let's address that now. If we look at the universe framework below:

$$\mathbb{U}\left(\frac{Dm}{TE}, F\right)$$

and its' corresponding proportional relationship,

$$D\sqrt{m} = T\sqrt{E}$$

Its symmetry and self-maintaining proportionality are infinitely portable and so I say "*a*" universe versus "*the*" universe in my work when possible. The words "*a* universe" may be used to reference any closed system. I envision the potential of applying these ideas to closed systems (universes) such as black holes, galaxies, or possibly atoms. I do not know what its limits are but I didn't want to limit it right from the start and so I refer to it as "a universe" and leave it up to the recipient of this work to define what that may mean.

I think we have supported the core postulate for this document and can conclude this work.

7. In closing

I humbly and respectfully present this speculative document with the sincere intention of sparking meaningful conversation. Its contents have not been reviewed or seen by others and represent my personal explorations into the nature of time and the universe.

The time you have spent reading these works is greatly appreciated.

With Gratitude –

Colin Lynch

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References

1. Colin Lynch, *Time and Distance: A New Approach* (https://doi.org/10.5281/zenodo.14560148)

2. Colin Lynch, *Universe Framework for Time, Distance, Energy, and Mass* (https://doi.org/10.5281/zenodo.14597436)