Orbital Dynamics of Timespace:

Deriving Einstein's mass-energy and Field Equations

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Abstract: While General Relativity has strong mathematical underpinnings that predict much of our spacetime observations, convincing physical understandings of these principles are vague and unconvincing. Herein we explore the physical assumption that the primary element of relativity is an orbit, which can take place either in time (space-time) or outside of time (time-space) and we use this assumption to derive Einstein's most famous relativity equations from this first principle. Herein we explore the origin of mass, and how gravity, time and light are intimately connected aspects of a universal orbit.

Key Words: Time-space, Einstein field equations, Multiverse Theory, Mass generation, Time spatial dimension, Light horizon, Orbital acceleration

Introduction: The key assumption in this paradigm which differs from that of mainstream physics is that time is principally a spatial dimension rather than durational. This doesn't change any of the other physical assumptions of mainstream physics and durational time is locally a successful approximation for much of our worldly encounters (such as all kinetics equations). However, consider that in a more ultimate reality, time as durational does not exist. In this postulation, time as we experience it is the result of observable periodic motion within our universe which gives rise to the perception of duration to observers within it. This periodic motion is mathematically shown to be resulting from orbiting bodies with acceleration and velocity components which can be observed on a local and universal level. In a prior publication, dark energy equations and constants are derived by recognizing time as a spatial dimension and identifying the universal orbital acceleration as Hubble's constant.[1] In another previous publications, time dilation was derived algebraically assuming time as a spatial dimension with the speed of light as the orbital velocity component.[2]

In this publication we set out to demonstrate how the nature of time is one of periodicity that can be modeled through orbital mechanics. We utilize orbital mechanics to show how time as a spatial dimension can be thought of as the distance to light barriers which result from orbital acceleration. Using these assumptions, we show the physical origin of Einstein's famous mass-energy equation. We expound on the implications of orbital velocity approaching light speed and how this influences the probabilistic character of orbital dynamics to be that of a 3D spherical orbit (rather than simply a 2D circular orbit). This probabilistic 3D spherical character can be said to be the representation of timespace, where all possible microstate paths in time are considered simultaneously in space. We discuss the mathematics of the orbital timespace character and derive Einstein's field equations using simple algebra from those assumptions.

Physical Assumptions, Explanations and Mathematics:

Orbits and Time Spatial Dimensions:

In a previous publication, we showed how our universe can be organized into spacetime and timespace orbitals using the concept of time as a spatial dimension and quantum degrees of freedom for orbits which were shown to mathematically influence each other to give rise to the phenomenon known as dark energy.[1] Herein we will describe how the time orbit concept can be generalized to give rise to gravitational field equations.

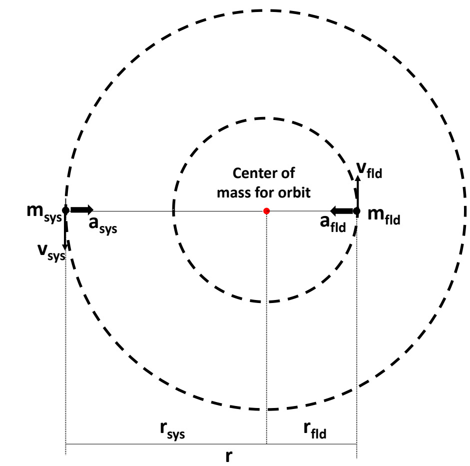

Figure 1: Standard orbit in 3D spacetime with sub-light speed orbital velocity.

Let us begin with a system with mass, m_{sys}, gravitationally attracted to a field with mass, m_{fld}, such that they form a stable orbit at an average distance, r, depicted in Figure 1. For convenience we will be showing all equations from the perspective of m_{sys}, however, all equations are symmetrical with regards to m_{fld}.

The force on the system in orbit, F_{orb}, experienced by the system can be described by a series of equalities below in equations (1), (2), (3), and (4):

$$F_{orb} = m_{sys}^{i} a_{sys} \quad (1)$$

$$F_{orb} = m_{sys}^{i} v_{sys}^{2}/r_{sys} \quad (2)$$

$$F_{orb} = m_{sys}^{g} m_{fld}^{g} G/r^{2} \quad (3)$$

$$F_{orb} = E_{orb}/r \quad (4)$$

The superscripts m_{sys}^{i} (m_{fld}^{i}) and m_{sys}^{g} (m_{fld}^{g}) represent the inertial and gravitational masses, respectively. These are differentiated because of quantized inertia at slow accelerations and are represented by equation (5) below.[3]

$$m_{sys}^{g} = (1 + H_o'/a_{sys})m_{sys}^{i} = \Phi_{sys} m_{sys}^{i} \quad (5)$$

Note that H_o' is Hubble's constant as an acceleration based on lambda CMB (representing the acceleration constant at the universe's conception). This relationship is important on galactic and universal scales. For now we will condense the difference between inertial and gravitational mass into a universal acceleration variable, Φ.

Newton's law of motion equalities, a_{sys}, v_{sys} and r_{sys} are the orbital acceleration, orbital velocity, and distance to the center of the orbit (center of mass for the m_{sys} + m_{fld} orbit), respectively, for the system of mass, m_{sys}. In the Newton's law of gravity portion, G is the gravitation constant, and r is the average distance between m_{sys} and m_{fld}.

These terms also exist for the field side of the equation with the same relationships to each other and m_{fld}. The relationship between r, r_{sys} and r_{fld} which can also be seen in Figure 1, are simply additive in (6):

$r = r_{sys} + r_{fld}$ (6)

Going forward, as we explore the nature of orbital effects on light barriers and spacetime curvature, it will be helpful to isolate terms for a_{sys}. To do this, we set equations (1) and (2) equal to each other and cancel m_{sys}^{i} to generate (7):

$a_{sys} = v_{sys}^2/r_{sys}$ (7)

If we use (5) to convert m_{sys}^{g} to m_{sys}^{i} in equation (3), we can set (3) equal to (1) and cancel the m_{sys}^{i} term to generate (8):

$a_{sys} = \Phi_{sys} m_{fld}^{g} G/r^2$ (8)

It is important to consider here that acceleration in our spacetime produces light barriers which must be included in these descriptions moving forward for a fuller understanding of the physics herein.

Firstly, it's worth considering relativistic effects durational time, τ, compared with 'normal' time, t^{o}, as was derived in our previous publication[2] on time dilation in (9):

$\tau = t^{o}\sqrt{[1 - (v^2/c^2)]}$ (9)

Now let's consider durational time as equivalent to the distance to a light horizon, t_h, which can be converted to a time spatial dimension (aka, distance to a light horizon), d_t, by multiplying by the speed of light, c, in (10):

$d_{tsys} = ct_{hsys}$ (10)

Now for systems within spacetime (with $v_{sys} < c$), we can combine (9) and (10) with the understanding that $t_h = \tau$ in (11):

$d_{tsys} = c\tau_{sys} = ct^{o}\sqrt{[1 - (v^2/c^2)]} = ct^{o}\gamma = S_{tsys}\gamma$ (11)

Note that S_{tsys} is the sub lightspeed velocity independent aspect of the time spatial dimension reflecting the distance to a light horizon of an object at rest in spacetime (but as we will learn later, orbiting at light speed in timespace), thus does not dilate as spacetime velocity reaches light speed. The term, γ, is a convenient shorthand for the relativistic speed portion of time dilation.

Next, if we consider the time it takes light to reach the light horizon from a system accelerating away from it, we get (12):

$t^{o}_{sys} = c/a_{sys}$ (12)

Note that normal time is used here because acceleration does not dilate as velocity approaches light speed. Combining (11) and (12) yields an acceleration equation in terms of the system's velocity independent distance to a light horizon (13):

$a_{sys} = c^2/S_{tsys}$ (13)

Time Spatial Dimension Relationship to E=mc²:

As we will explore more within this paper, light horizons (and the time spatial dimensions) are intimately connected to the concept of mass. Combining (1), (4) and (13) gives us a relationship of mass and the time spatial dimension to energy in (14):

$$E_{orb} = m_{sys}{}^{i}c^2r/S_{tsys} \qquad (14)$$

Now to further simplify the above into its recognized form, we must set up the proper conditions. First, by combining (7) and (13) we get the relationship of S_{tsys} and r_{sys} in (15):

$$S_{tsys} = r_{sys}c^2/v_{sys}{}^2 \qquad (15)$$

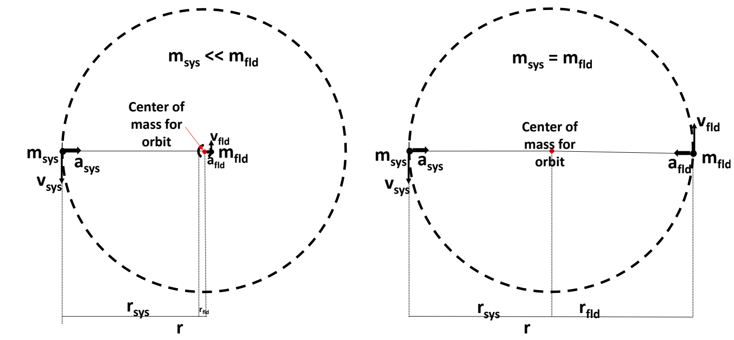

Figure 2: The two most common forms of orbits. The more commonly seen case is the left-hand side where $m_{sys} << m_{fld}$ and $r_{sys} \approx r$. The right-hand case where $m_{sys} = m_{fld}$ occurs in previous publications on the universal level and occasionally in spacetime.

Next, note that when $v_{sys} = c$, $S_{tsys} = r_{sys}$. We can now recognize the relationship of r_{sys} and r in the two most common orbit cases of associated masses. As is depicted in Figure 2, if $m_{sys} = m_{fld}$, $r = 2r_{sys} = 2r_{fld}$; If $m_{sys} << m_{fld}$, $r_{sys} >> r_{fld}$, and $r \approx r_{sys}$. For this case, we will assume that baryon mass is generated by a light speed orbit where $m_{sys} << m_{fld}$ and therefore $r \approx r_{sys}$. This being the case for all mass generation in our universe as determined previously by the universal orbit.[1] With these specifications in mind combining (14) and (15) gives us the familiar equation[4] (16):

$$E_{orb} = m_{sys}{}^{i}c^2 \qquad (16)$$

Thus, the origin of the mass-energy equation appears to be resulting from a light speed orbit giving rise to mass. Now a natural question that arises from these assumptions and this equation is where is this orbit taking place that gives rise to baryon mass? If we take our acceleration term as H_o(CMB) = 66 m/s^2 (the minimum acceleration possible in spacetime[3]) in (13), we find that $S_{tsys} = r = 1.402\text{x}10^{26}$ m $= R_h$, the distance to our universe's light horizon for an object with no velocity in spacetime from our previous publication.[1] Thus, baryon mass in this case would be the result of an orbit taking place at the light barrier of our universe (edge of spacetime) with orbital velocity of c in timespace and orbital acceleration of Hubble constant, H_o.

Orbital Curvature and Light Horizons:

Consider the aspects of light barriers which are depicted in Figure 3. One we will call the acceleration horizon and is a plane behind and perpendicular to the accelerating observer (existing for any accelerating body) where the closest point is directly behind the acceleration direction at S_t. Next, the light horizon, L_h, is formed within the orbit as a circle or ellipse in plane with the orbit and is formed from the moving acceleration horizon at its closest point. Note that light is perceived as moving within the acceleration horizon plane at each point along the light horizon.

The light horizon circumference, L_h, is related to the distance to the light horizon, S_t, by (17):

$$L_{hsys} = 2\pi S_{tsys} \qquad (17)$$

Note that S_t is used here rather than d_t because although L_h scales with orbital acceleration, it does not dilate as v approaches c.

Returning to our acceleration terms, if we want to derive relativistic field equations akin to that of Einstein's,[5] we can convert to a principal 1D curvature term, k_{sys}, which describes the principal curvature at the light horizon. Curvature is related to the speed of light squared by (18):

$$k_{sys}^{ac} = a_{sys}^{ac}/c_h^{bc}c_h^{ab} \qquad (18)$$

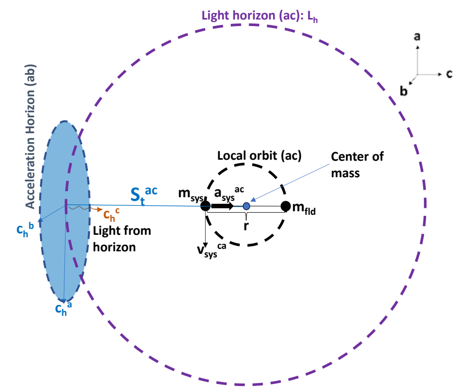

Figure 3: Visualization of acceleration horizon and light horizon generated from the acceleration of orbiting bodies.

By applying (18) to equations (7), (8) and (13) we get 1D spacetime curvature equations (19), (20) and (21), respectively:

$$k_{sys}^{ac} = v_{sys}^{ca2}/c_h^{ab}c_h^{bc}r_{sys}^{ac} \qquad (19)$$

$$k_{sys}^{ac} = \Phi_{sys}^{ac}m_{fld}^{g}G/c_h^{bc}c_h^{ab}(r^{STac})^2 \qquad (20)$$

$$k_{sys}^{ac} = 1/S_{tsys}^{ac} \qquad (21)$$

The superscripts "a", "b" and "c" represent arbitrary relative directions (such as x, y, z) in a 3D space. Here we assume the orbit is arbitrarily taking place in the "ac" plane (as in Figure 3). Note that within these terms, the Gaussian curvature, orbital acceleration, and orbital distance are always orthogonal to orbital velocity at any given position while remaining in the "ac" plane. As discussed earlier, the acceleration horizon surface is in the plane orthogonal to the acceleration direction ("ab" in this example) and thus the direction of light speed travel at the horizon reflects this in the denominator.

Gravity generating orbits via Timespace Orbital Gaussian Curvature:

Now we consider how to generate the 2D manifold curvature term, resulting from a 3D probability orbit which is related to mass generation. The 2D Gaussian curvature which can be thought of as the degree an orbit gains the timespace character of the light horizon (which gives the orbit a probabilistic 3D spherical quality rather than a 2D circular spacetime quality), K^{abc}, for an approximately circular orbit is (22):

$$K^{abc}(\text{spherical}) = k_{sys}^{ac}k_{sys}^{bc} = k_{sys}^{2} \qquad (22)$$

Taking the simple 1D curvature relationship of (19) we get (23):

$$K^{abc}(\text{spherical}) = v_{sys}^{4}/c^4r_{sys}^{2} \qquad (23)$$

Note that 2D curvature, K^{abc} (spherical), grows very slowly until orbital velocity approach light speed where the orbit approaches the acceleration horizon and takes on more of its timespace character becoming a probabilistic spherical orbit rather than circular as depicted graphically and pictorially in Figure 4.

This relationship gives rise to the spacetime and timespace orbitals described in our previous publication on the Geometry of Time and Space when v_{sys} = c.[1]

Deriving Einstein's Field Equations using Timespace Orbital Gaussian curvature:

Now we will substitute forms of k_{sys} into (22) to yield an equation similar to Einstein's field equations. Taking (19) and (20) as k_{sys} terms and substituting them to (22) yielding (24):

$$K^{abc}(\text{spherical}) = [v_{sys}^2/r_{sys}c^2][\Phi_{sys}m_{fld}^gG/c^2r^2] \quad (24)$$

Now because of the parameters we set with relative masses ($m_{sys} << m_{fld}$), we can simplify and estimate $r_{sys} \approx r$. Substitution and distribution yields (25):

$$K^{abc} = \Phi_{sys}m_{fld}^gv_{sys}^2G/r^3c^4 \quad (25)$$

Now if we assume an acceleration field generated with volume from the center of orbit 2 with diameter r, we can imagine a sphere of Volume, V, equal to $(4/3)\pi r^3$. If we substitute this into our equation, we get (26):

$$K^{abc} = (4/3)\pi\Phi_{sys}m_{fld}^gv_{sys}^2G/Vc^4 \quad (26)$$

Now if we convert mass to energy using $E=mc^2$, we can get (27):

$$K^{abc} = (4/3)\pi\Phi_{sys}E_{fld}^{abc}Gv_{sys}/c^6V \quad (27)$$

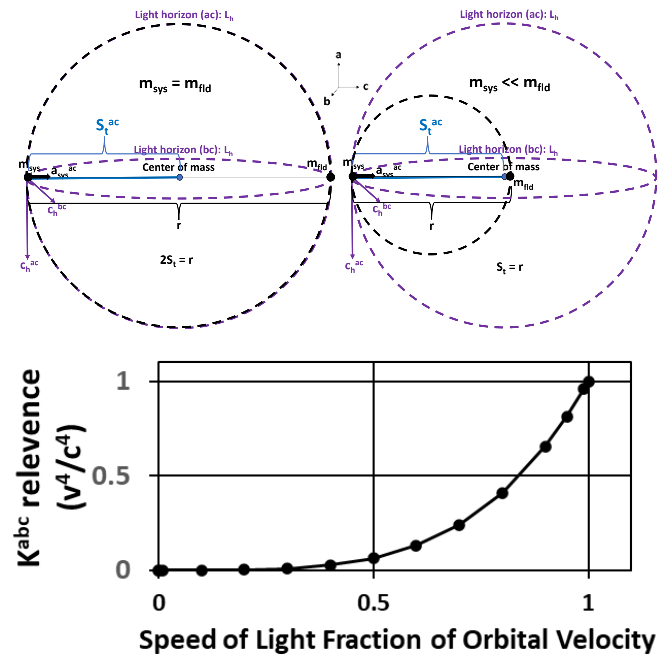

Figure 4: **Top:** Two cases of light speed orbit approaching the light horizon. Left-hand-side: $m_{sys} = m_{fld}$, thus overlapping the orbit with the light horizon, making $2S_t = r$. Right-hand-side: $m_{sys} << m_{fld}$, this orbit is still within spacetime with $S_t = r$. **Bottom:** Graph showing relationship between system orbital speed (as a fraction of light speed) and 2D curvature Gaussian relevance (aka mass generating curvature).

Note that here I replaced the gravitational mass, m^g, in the mass-energy equation even though technically, as we derived earlier in (16), inertial mass, m^i, should be replaced and thus would consume the Φ_{sys} term via (5). The reason for this is that inertial mass and gravitational mass are historically believed to be equal according to the 'equivalence principle' and thus historically the acceleration adjustment term, Φ_{sys}, would have been incorporated into the equation in a different way. Because we are aware of quantized inertia, we will keep this term in to show where the historical terms in Einstein's field equation originated.

Now if we will introduce an energy per volume term, $T_{fld} = E_{fld}/V$, and substitute this into (27) we get (28):

$$K^{abc} = (4/3)\pi\Phi_{sys}T_{fld}^{abc}Gv_{sys2}/c^6 \quad (28)$$

From here, if we can substitute for Φ_{sys} as in (5) to yield (29):

$$K^{abc} = (4/3)\pi(1 + H_o'/a_{sys})T_{fld}^{abc}Gv_{sys}/c^6 \quad (29)$$

Now let's return to our hypothesis about baryon mass and time being generated by a universal orbit between any arbitrary center of the universe and the light barrier. In this condition, baryon matter orbits the light horizon of our universe at the speed of light, c, and with orbital acceleration of H_o' (CMB Hubble's constant as discussed in a previous publication[1]). Thus $v_{sys} = c$ and $a_{sys} = H_o'$. By substituting this case for baryon matter into (29) we get the much simplified (30):

$$K^{abc} = (8/3)\pi T_{fld}^{abc}G/c^4 \quad (30)$$

If we consider the sum of all 3 spatial variations in spacetime for the full field curvature we get (31):

$$K = K^{abc} + K^{bca} + K^{cab} = (8/3)\pi T_{fld}^{abc}G/c^4 + (8/3)\pi T_{fld}^{bca}G/c^4 + (8/3)\pi T_{fld}^{cab}G/c^4 = 8\pi G T_{fld}/c^4 \quad (31)$$

Note that (31) is in fact the familiar equation on the right side of Einstein Field equations often with the symbol $\kappa = 8\pi G/c^4$.[5]

Conclusion: By looking at the basic physics of orbital motion and how orbital acceleration generates light barriers, we can make a mathematical and conceptual link between the motion of light, spacetime curvature, time and their relation to gravity geometrically. By applying the time spatial dimension to orbital energy, we were able to derive the mass-energy equation.

Mass generation via spacetime curvature for basic orbitals that became more potent closer to light speed. Through utilizing certain equations for orbits and the Gaussian curvature equation, we have a comprehensive alternate route to the right-hand side of Einstein's field equations as relating to the timespace orbital Gaussian curvature derived here from purely algebraic and geometric means.

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