Universal Specificity Investigation 5: A Time Dilation Gradient Implies an Energy Gradient

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Prior investigations into universal specificity (or specificity for short) found that time properly conceptualized is the interval over which change occurs, and is not a property of the Universe apart from physical changes to things in the Universe; which led to the proper conception of time dilation as a common change in the interval over which change occurs to things. In addition, it was found that a universally stationary frame (USF) must exist; which led to discovering the cause of kinetic time dilation, shown in Equation (1); which led to deriving a relativistic specific energy model, shown in Equation (2).

$$\frac{dt'}{dt} = \frac{c_0}{c} = \sqrt{1 - \frac{\Delta e_K}{e_T}} = \sqrt{1 - \frac{w}{e_T}} = \frac{1}{\gamma_K} \tag{1}$$

$$e_T = \frac{1}{2}c^2 = e_I + \Delta e_K = \frac{1}{2}c_0^2 + \frac{1}{2}v^2 \tag{2}$$

dt' is the time rate of change measured by a clock traveling with an object in an inertial frame; dt represents the time rate of change measured by an identical clock stationary in the USF; c_0 is the average effective speed of light in the objects reference frame in motion relative to the USF; c is the speed of light in the USF in a vacuum not under any gravity potential; Δe_K is the traveling object's change in specific kinetic energy in the USF; w is the specific work done to the object in the USF; and e_T is the traveling object's total specific energy, $\frac{1}{2}c^2$. The ratio of time derivatives is termed *inertial time differential* (ITD), which remains constant for any object until specific work, w, is done.

Given this basis, we now investigate the implications of a time dilation gradient.

1. Gravitational Time Dilation

According to the Schwarzschild Metric, which is a good description of how time dilation is measured within a gravitational field, the ITD measured within a gravitational field at zero velocity in the USF is given by Equation (3).

$$\frac{dt'}{dt} = \sqrt{1 - \frac{GM/r}{e_T}} \tag{3}$$

Where :

GM/r is the Newtonian gravitational potential

The relationship between ITDs and specific work done continue past kinetic ITDs given in Equation (1) and into gravitational ITDs shown in Equation (3). GM/r is the specific work done by the gravitational field to the object as it travels infinitely far away to a distance r from center of mass given by: $\int_\infty^r g(r)dr$. If one replaces this specific work in Equation (3), you get:

$$\begin{aligned}\frac{dt'}{dt} &= \sqrt{1 - \frac{\int_\infty^r g(r)dr}{e_T}} = \sqrt{1 - \frac{w}{e_T}} \\ &= \sqrt{1 - \frac{\Delta e_P}{e_T}} = \frac{1}{\gamma_P}\end{aligned} \tag{4}$$

Given that this relationship between gravitational ITDs and specific work done, and the cause of kinetic time dilation fundamentally being the reduction of the average effective speed of light, c_0, it stands to reason that gravitational time dilation might be fundamentally caused by the same mechanism—a reduction in c_0.

The proof is relatively straight forward. Suppose you wanted to estimate the total time dilation given a velocity within a gravitational field, as shown in Figure 1.

Ultimately, we want to calculate the overall ITD, $\frac{dt'_2}{dt}$, for the moving object within the gravitational field. What we know from relativity is that $\frac{dt'_1}{dt}$ and $\frac{dt'_2}{dt'_1}$ can be measured by comparing local frame clocks to universally stationary clocks. Both ITDs are relatable to the total effective ITD, $\frac{dt'_2}{dt}$, via the chain rule, as shown in Equation (5).

$$\frac{dt'_2}{dt} = \frac{dt'_2}{dt'_1}\frac{dt'_1}{dt} = \sqrt{1 - \frac{\Delta e_{K2|P1}}{e_T}}\sqrt{1 - \frac{\Delta e_{P1}}{e_T}} \tag{5}$$

$\Delta e_{K2|P1}$ is the proper change of specific kinetic energy, as measured in the gravitation field, and will be different than the absolute change in specific kinetic energy, $e_K 2$, as measured at a point in the USF infantly far from any gravitational potential. This fact becomes evident when we simplify Equation (5) in the following way:

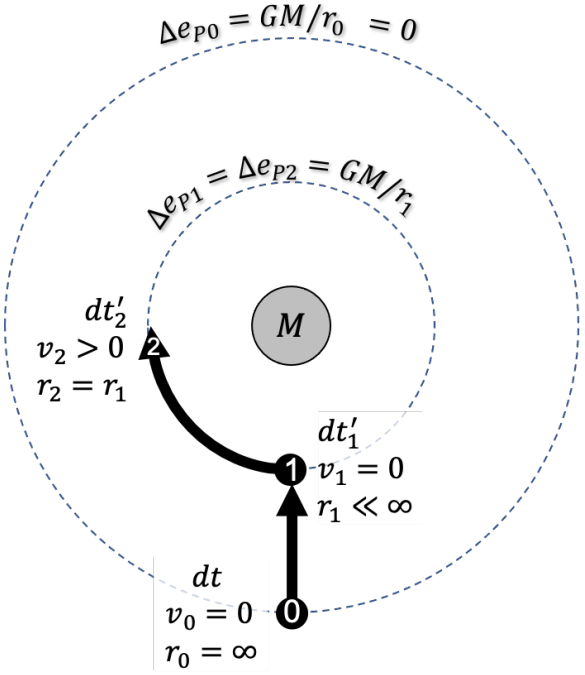

Figure 1. Total effective time differential example.

$$\frac{1}{\gamma_T} = \sqrt{1 - \frac{\gamma_{P1}^{-2}\Delta e_{K2|P1} + \Delta e_{P2}}{e_T}} = \sqrt{1 - \frac{\Delta e_{K2} + \Delta e_{P1}}{e_T}} = \sqrt{1 - \frac{\Delta e_t}{e_T}} \tag{6}$$

The full term, $\gamma_{P1}^{-2}\Delta e_{K2|P1} + \Delta e_{P2}$, is properly interpreted as the change in total specific energy, Δe_t. The $\gamma_{P1}^{-2}\Delta e_{K2|P1}$ term is properly interpreted as the absolution change in specific kinetic energy, Δe_{K2}. Notice that $\Delta e_{K2} < \Delta e_{K2|P1}$ by a factor of γ_{P1}^{-2}, which can be generalized to the following: velocities of entities slow down within a gravitational field by a factor of γ_{P1}^{-1}, including light. QED.

This fact implies refraction governs gravitational effects and prior work in this area demonstrated "the equations of motion for [refracted] light are formally identical to those predicted by general relativity" [1]. Additionally, time dilation gradients being a gradient in the average effective speed of light, c_0, implies a specific energy gradient is the cause of gravity as is shown in the next section.

2. Time Dilation Gradient

Given that observations for gravitational ITDs match that of Equation (3), it means that a TDG exists around physical objects, and is defined by Equation (7).

$$\nabla\frac{dt'}{dt} \triangleq \frac{d\left(\frac{dt'}{dt}\right)}{dr} = \frac{\gamma_g}{2e_T}\frac{GM}{r^2} \tag{7}$$

Where :

$\nabla\frac{dt'}{dt}$ is the time dilation gradient

$\frac{dt'}{dt}$ is the ITD in the gravitational field.

We can immediately see the connection between TDG and the specific force of gravity, since $-\frac{GM}{r^2} = g(r)$; however, this relationship is only correlated, not causal. To establish the causal relationship we need a specific energy gradient (SEG), which the time dilation gradient implies. This is derived as follows:

$$\text{since } \frac{\mathrm{dt}'}{\mathrm{dt}} = \frac{c_0}{c} \tag{8}$$

$$\text{and since } \frac{\mathrm{c}_0^2}{\mathrm{c}^2} = \frac{\frac{1}{2}c_0^2}{\frac{1}{2}c^2} = \frac{e_I}{e_T} \tag{9}$$

$$\therefore \nabla\frac{e_I}{e_T} = \nabla\frac{dt'^2}{dt^2} = \frac{d\left(\frac{dt'^2}{dt^2}\right)}{dr} = \frac{GM}{r^2 e_T} \tag{10}$$

$$\therefore g(r) = -e_T\nabla\frac{e_I}{e_T} = -\nabla e_I \blacksquare \tag{11}$$

Equation (3) and Equation (10) for any generic gravitational field is shown in Figure 2, where r is in units of the Schwarzschild Radius, r_s, and $\nabla\frac{e_I}{e_T}$ in units of $\frac{1}{r_s}$.

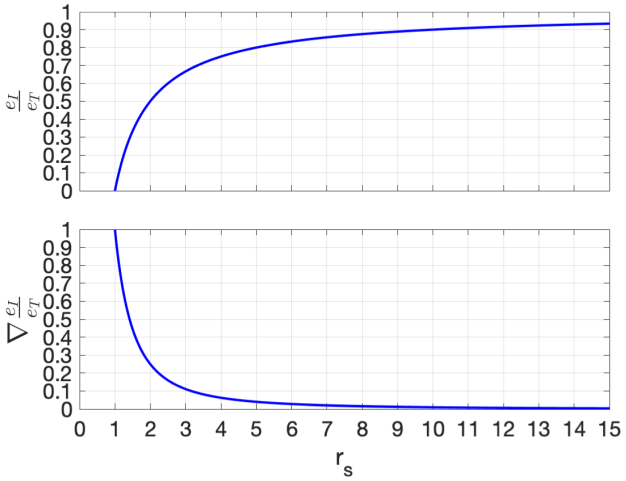

Figure 2. ITD and SEG in units of r_s.

Given that TDGs implies SEGs, then it is easy to show that the equivalence principle is falsifiable. As in, free falling is not equivalent to floating in empty space, and sitting on earth is not equivalent to accelerating in empty space.

The difference is that SEGs exist around earth, but not in empty space. The same was said about tidal force existing around earth and not in empty space, but the response to tidal

forces has been that the equivalence principle is accepted as *approximately* true since for infinitesimally points tidal forces vanish [2]. The argument has been that tidal forces approaches zero for infinitesimal points near earth, just like they are zero in empty space; however, this argument does not apply to SEGs because, as we can see in Figure 2, SEGs do converge to a non-zero value for infinitesimal points. Therefore, the equivalence principle must be rejected on the grounds that non-zero SEGs have significant consequences– they cause a specific force to be applied to objects within them.

To summarize, TDGs around massed objects are due to the slowing of the average effective speed of light. This means for objects wihtin a TDG, the specific internal energy within them forms a gradient, where the specific internal energy of the object is lower on the end closer to the massed object, and higher on the end farther away from the massed object. This unbalance of specific internal energy within the object causes a specific force we call gravity.

This is the next step after Newton in understanding a more fundamental cause of gravity. To Newton, gravity was an action at a distance, where one object affected another without physical contact (or rather contact through a distant invisible field); however, according to specificity it is a local action caused by an object's specific internal energy gradient. This gradient is caused by the speed of light being slower on one end of the object vs the other.

While this is one step closer to understanding gravity as a local phenomena, the question directing to the next step after this one becomes: what about objects causes the permittivity and/or permeability of free space around them to increase?

Answering this question will have to wait for a different investigation, but it is interesting that gravity, which is thought to be a fundamental force, involves light, which is responsible for the electromagnetic force. Equally interesting, electromagnetism is a force orthogonal to light's velocity, while gravity is parallel to its velocity; in other words, in all three dimensions of light, a different force exists—electrical, magnetic, and gravitational—one force for each dimension. It may turn out that gravity needs to be coupled with electromagnetism to form *electromagnetgravitism* (EMG).

If EMGs are a true coupling, then one really needs to consider the possibility that the other known forces—the week and strong nuclear forces—might really be just an aspect of EMG. Meaning EMG might be the only force in existence, where the strong/week nuclear forces are simply a manifestation of the never before considered couplings of electrogravitism and magnetgravitism? That is electrogravitism would be a form of EMG with the magnitic component neutralized, and magneticgravitism is a form of EMG with the electric component neutralized, just like electromagnitism is a form of EMG with the gravitational component neutralized. The possibility of EMG being the only force in existence would be an interesting question to look into for a different investigation.

3. CONCLUSION

In conclusion, it was discovered that gravitational ITDs follow the same relationship to specific work done in the USF as does kinetic ITDs. Additionally, it was shown through studying total ITDs, the speed of light slows down within a gravitational field, and this is responsible for time dilation within a gravitational field. This means that the existence of TDGs implies the existence of SEGs internal to objects within TDGs, which causes a specific force to be applied to those objects, which we call gravity.

The next investigation will look to integrate gravitational and kinetic ITDs fully into total ITD. In addition, the next investigation will integrate changes in specific potential energy into the total specific energy model, which tacitly assumed that no specific work was done by specific internal energy gradients.

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