

# On the Absolute Meaning of Motion

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## Abstract

The present manuscript aims to clarify why motion causes matter to age slower in a comparable sense, and how this relates to relativistic effects caused by motion. A fresh analysis of motion, build on first axiom, delivers proof with its result, from which significant new understanding and computational power is gained.

A review of experimental results demonstrates, that unaccelerated motion causes matter to age slower in a comparable, observer independent sense. Whilst focusing on this absolute effect, the present manuscript clarifies its context to relativistic effects, detailing their relationship and incorporating both into one consistent picture. The presented theoretical results make new predictions and are testable through suggested experiment of a novel nature. The manuscript finally arrives at an experimental tool and methodology, which as far as motion in ungravitated space is concerned or gravity appreciated, enables us to find the absolute observer independent picture of reality, which is reflected in the comparable display of atomic clocks.

The discussion of the theoretical results, derives a physical causal understanding of gravity, a mathematical formulation of which, will be presented.

## Review and Introduction

The question whether motion causes matter to age slower in a comparable sense, resulting in one twin dying before the other, has been answered positively in numerous experiments involving space-stations, satellites and particle accelerators (*Ashby 2003, Bailey et al. 1978*).

Atmospheric particles travelling towards earth at almost the speed of light, live longer than their twins at rest on earth (*Rossi and Hall 1941, Rossi et al. 1942*). The average muon in our laboratory has a lifespan of  $2.21 \pm .003 \mu\text{sec}$  (*David H. Frisch and James H. Smith 1963*). However incoming muons are observed to live longer by a factor of  $8.8 \pm .8$  (*David H. Frisch and James H. Smith 1963*) to explain the detected quantity. These results coincide with the time dilation factor from special relativity (SR), with the factor calculated being  $8.4$  after averaging (*David H. Frisch and James H. Smith 1963, Einstein 1905*). The time dilation effect described in SR to generally be a real comparable effect, would imply one inertial reference frame special over the other, contradicting the premise of SR (*Einstein 1905, p. 1 and 7*). Experimental results are commonly explained by considering the time dilation effect of SR from the perspective of the twin muon at rest on earth only, and the length contraction effect of SR from the perspective of the incoming muon only. To do so however contradicts the premise of SR, which states the equivalence of both frames of reference, if this problem is considered in the sense of SR which applies to inertial frames

of reference only, whilst our twin muon resting on earth is under the influence of gravity. General relativity (GR) even predicts that the muon on the ground should age slower than the one in free fall, as those in free fall according to GR are not affected by any forces during the relevant duration of the experiment unlike those resting on earth (*Einstein 1916*). In reality, when the incoming muons arrive well alive, they find their twin muons long dead.

If we express frequency in  $f = \text{cycles}/\text{time}$ , then the longer an experiment takes, the greater will be the difference in cycles ( $\Delta\text{cycles}$ ) between two different clocks by

$$\Delta\text{cycles} = \Delta f * \Delta t \quad [1]$$

, where  $\Delta f$  symbolizes the difference in frequencies between the two clocks and  $\Delta t$  the duration of the experiment. But if a particle only experiences an instant of acceleration at the start of an experiment and the duration of an experiment matters, this demonstrates that unaccelerated motion causes matter to age slower.

In the introduction to their paper from 1972, Hafele and Keating write that flying clocks around the world, should lose cycles during the eastward trip and gain cycles during the westward trip in a comparable fashion, as predicted by Einstein's equations. The calculation of the gain and loss of cycles (*Hafele and Keating 1972a– equation (1)*) demonstrates, that what was considered to differ on either trip was the velocities of the clocks. A westward trip counteracts the earth rotation, and thus Hafele and Keating predicted an absolute gain of cycles of  $275 \mp 21 \text{ nsec}$  as compared to a clock stationary on earth, whereas an eastward trip is going along the earth rotation and thus a loss of cycles was predicted at  $40 \mp 23 \text{ nsec}$  (*Hafele and Keating 1972a*). A gain of  $273 \mp 7 \text{ nsec}$  during the westward- and loss of  $59 \mp 10 \text{ nsec}$  during the eastward trip was recorded (*Hafele and Keating 1972b*). The clock stationary on earth can be removed from the experiment, when we realize that the two clocks flown into different directions around earth, had gained a different amount of cycles when compared next to each other after the experiment. But the relative motion to each other was the same for both. And if going into one direction even gains cycles relative to a clock stationary on earth, whereas going into the other direction loses cycles, this implies the motion of planet earth to have meaning. Direction can only then matter if motion has absolute meaning.

In a recent experiment by *Chou et al., 2010*, two atomic clocks were located in different laboratories. One at rest, and the other in harmonic motion. In personal communication Dr. Chou confirmed: "You are correct that with the 75-m fiber link and the way it is done in the experiment, it is equivalent to have the clocks next to each other." Acceleration was integrated to find the average speed to be used in equations of SR (*Chou et al., 2010 – equation 1*). The two clocks showed absolute differences in frequency, coinciding with calculations from SR as shown in figure 2 of Chou's paper, with the clock that exhibited motion in the laboratory, recording less cycles. Dr. Chou ensured: "When we compared the clocks at different height and/or in relative motion, we found that the two clocks produced different frequencies. So you are correct in saying that "during the duration of the experiment one clock recorded 'absolutely' more cycles than the other." ". Therefore, the present manuscript does not speak about different passages of time, but asks us to detach our understanding of time from what is measured by clocks. Clocks tick at different rates, such that the difference in cycles they recorded during the duration of the experiment (a definition for which will be developed in theoretical part 3) can be determined by direct comparison.

We therefore sense that direct comparison is the key, to deduce the absolute, observer independent picture of reality. Let us now consider an observer B to stand in the middle of a rod which connects two spaceships, travelling past an observer A at a given relative speed. In the theory of special relativity, if observer B would start the engines of both ships via a signal, observer B is said to conclude the engines to start simultaneously in his reference frame for the same logic that SR would state him to conclude his clocks to be synchronized, concluding the rod to hold. Observer A however is said to conclude the front engine to start after the back engine in her reference frame for the same logic that SR would state her to conclude observer B's clocks unsynchronized, concluding the rod to snap. However in reality, the rod either snaps or it doesn't (depending on which engine 'really' starts first – a concept which special relativity denies to have meaning), because reality does not care what different observers conclude in their respective reference frames. But if this one true picture of reality exists, which of course it does as a rod cannot both survive and not survive an event, then we can technically work it out and mathematically formulate it. To do so, is the scope of the following theoretical work.

## **Table**

dotted arrow : path of signal

$d$  : distance

$d_p$  : distance measured in the observer's reference frame

$f$  : frequency

$t$  : temporal coordinate

$t_p$  : temporal coordinate measured in the observer's reference frame

$v$  : a particle's absolute velocity through space

$v'$  : real relative velocity between 2 objects

$v_p'$  : relative velocity measured in the observer's reference frame

$x, y, z$  : spatial coordinates

$x_p$  : spatial coordinate measured in the observer's reference frame

## Theoretical Part

### 1. Simultaneity of Events with and without Motion

Whether motion has meaning in an absolute sense, is tied to the question whether the location and timepoint of an event, and hence simultaneity of events, has absolute, observer independent meaning. The aim of the present chapter is to examine this question.

Without the need of asserting the existence of a light-medium, let us start on a first self-evident axiom, that a signal travels a given distance in a given time. Then according to the definition  $s = v * t$ , a signal takes longer to travel further.

By our axiom, if an observer moves away from an approaching signal, which an observer is free to do, the signal will take longer to reach the observer, because it has to travel further as only the location of the observer at the timepoint the signal meets the observer is relevant. We realize that the motion of the source after the signal has been emitted is irrelevant to this problem, as we did not even assume the existence of a source. But if this is so, then moving a constellation of source and observer, is equivalent to only moving the observer. This implies a different relative motion between source and observer to obtain the same result. But if the speed of light would be constant in every inertial reference frame and hence in relative terms, then the relative velocity between source and observer should determine when the signal reaches the observer. But as we have proven that this is not the case as only the motion of the observer matters, therefore the speed of light must be constant not in relative, but in absolute terms. This implies there to exist a frame in which the speed of light is  $c$ . Therefore, coordinate systems in the present manuscript represent frames of absolute rest, relative to which the speed of light measures  $c$  under invariant conditions.

This result agrees with the understanding of Michelson and Morley who envisioned a signal of EM radiation, to have existence not only as of our experience, but as a propagating disturbance of a medium. To be able to understand yet undescribed factors on which the Michelson-Morley experiment has failed and design an experiment which avoids this failure, let us start heading towards a practical mathematical description.

Let us start by examining stationary and moving sources and observers, as depicted in diagram 1 with the letters S and O. A source and observer which are at absolute rest, are separated by

$$\Delta x = x - x_o \quad [2]$$

meters, which is equals the distance the signal bridges from when it leaves the source to when it reaches the observer. At time  $t_o$  the source sends out light, which will reach the observer after

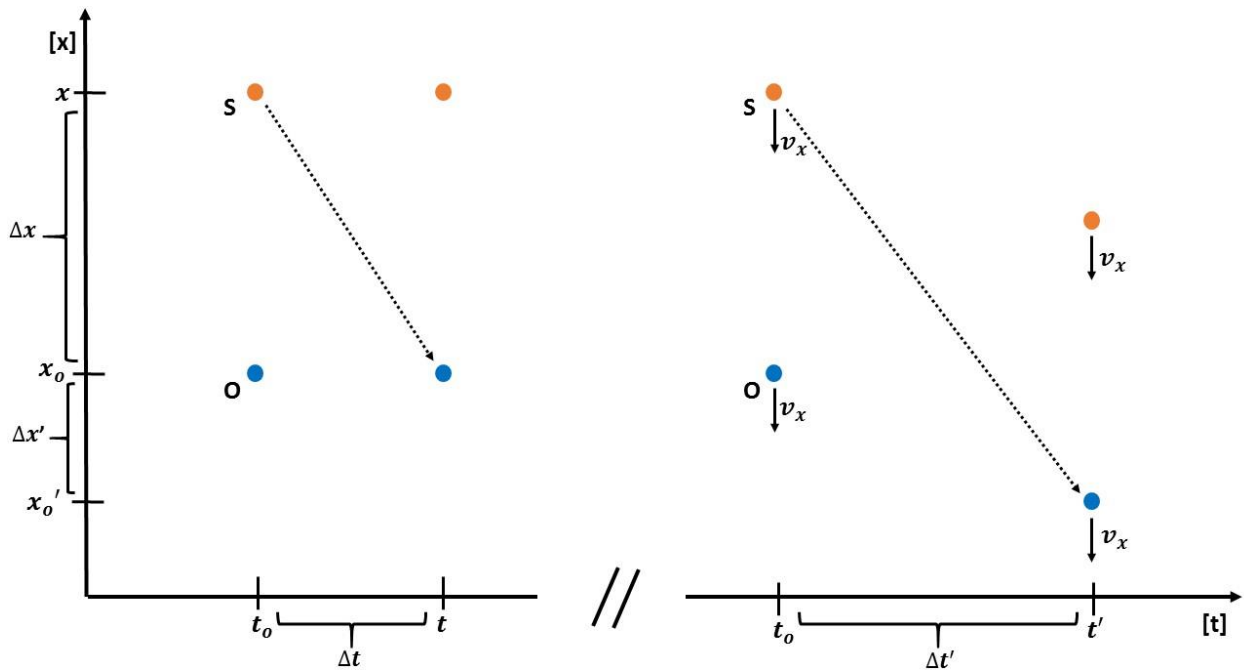
$$\Delta t = t - t_o = \frac{\Delta x}{c} \quad [3]$$

seconds at time  $t$ . Therefore by

$$t_o = t - \frac{\Delta x}{c} \quad [4]$$

, the observer must conclude  $t_o$  at which the source sent out the photon. Hence the observer perceives the event shifted in time, because the signal takes a finite time to reach him.

Diagram 1: Stationary and Moving Sources and Observers



If the observer and source are only at relative rest, the absolute motion of the observer relative to the approaching information needs to be considered. Let us define a positive velocity of either signal or observer to describe motion into the negative x-direction of diagram 1. If the observer moves into the negative x-direction, the distance the information has to travel changes to

$$x - x'_o = \Delta x + \Delta x' \quad [5]$$

where  $\Delta x'$  denotes the distance that the observer moves away from the source with velocity  $v_x$  during  $\Delta t'$  which is the time the signal takes to reach him. So

$$\Delta x' = v_x * \Delta t' \quad [6]$$

where  $v_x$  is the absolute velocity of the observer, and where

$$\Delta t' = t' - t_o = \frac{\Delta x + \Delta x'}{c} \quad [7]$$

When substituting [6] into [7] it now holds that

$$t' - t_o = \Delta t' = \frac{\frac{\Delta x}{c}}{1 - \frac{v_x}{c}} \quad [8]$$

Through [3] and [8], we recognize a factor by which the time interval the signal takes to reach the observer changes due to the absolute motion of the observer. If we call this factor  $\alpha$ , we find that

$$\Delta t' = \Delta t * \alpha \quad [9]$$

where

$$\alpha = \frac{1}{1 - \frac{v_x}{c}} \quad [10]$$

Following from this, the observer needs to conclude the time at which the signal was emitted as

$$t_o = t' - \alpha * \frac{\Delta x}{c} \quad [11]$$

The concept here developed does not yet consider that motion slows the ticking of clocks, but together with such, which requires finding our absolute motion through space, will come to practical use in theoretical part 3, to i.e. reverse engineer distances at the time a signal was emitted.

Considering  $\alpha$  and remembering that  $v_x$  is a vectorial quantity defined into the same direction as the velocity of the signal, we realize that if the observer moves towards the signal at the same speed as the signal, the signal only has to bridge half the distances to reach him – but if the observer moves away from the signal at the same speed as the signal, the signal cannot reach him. This implies a possible relative velocity between two signals in the range of  $-2c < v' < 2c$ .

The implication of the present chapter becomes practically testable at this point. If source and observer are kept at relative rest to each other in a laboratory, but the constellation is moved along its axis into the direction of the observer, then the observer should record the signal to arrive later on an atomic clock, than when the constellation is moved into the direction of the source. If motion only had relative meaning, no difference should be detected.

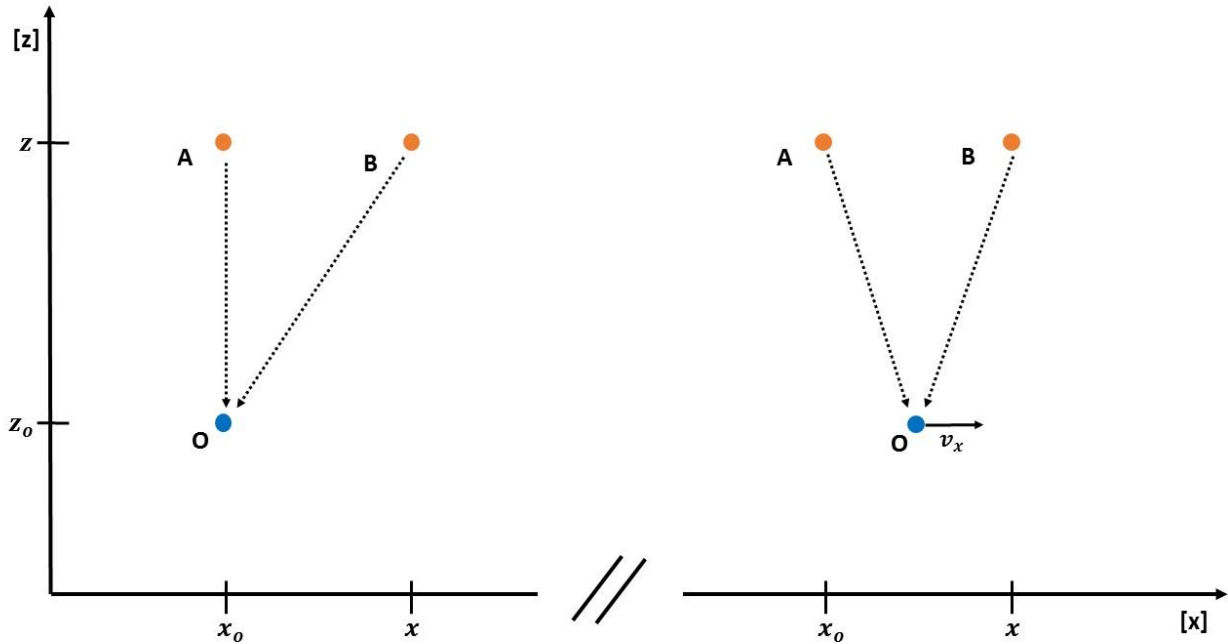
The experimental results will only be able to answer whether motion has absolute or only relative meaning, but with the knowledge delivered in theoretical part 2 and 3, we will revisit this experiment in theoretical part 3 and be able to determine and accommodate the laboratory velocity to make precise predictions.

Our examination thus far implies that there is an absolute meaning to when an event occurs and thus the simultaneity of events. If we let a lightning be sent out from a source and be split at the same angle to the left and right along an axis perpendicular to our xz-plane, then by default two lightnings strike simultaneously within our frame, causing event A and B in diagram 2, which could be considered as two sources A and B. Being at rest relative to an event means being at absolute rest, because an event occurs

where it occurs. A stationary observer located closer to event A than B, as illustrated in diagram 2, will see lightning A first, because the information of the lightning strike A takes a shorter time to reach him. Observers who know their distances to location A and B as of their location on a grid that has been painted on the plane where the lightnings hit at known locations A and B, can conclude when events A and B really occurred in a comparable sense – such that each observer would calculate that they occurred simultaneously at time  $t_o$ , where

$$t_o = t_1 - \frac{\Delta z}{c} = t_2 - \frac{\sqrt{\Delta z^2 + \Delta x^2}}{c} \quad [12]$$

Diagram 2: Simultaneity of Events with and without Motion



Once both sources in the above diagram emit their photons, they become irrelevant to the problem. However, if the observer moves relative to the emitted signal and thus in an absolute sense, such has to be considered. In this case, if respective observers now additionally knew their velocity  $v_x$  over the grid on which the lightnings strike, they would again agree on them having occurred simultaneously at time

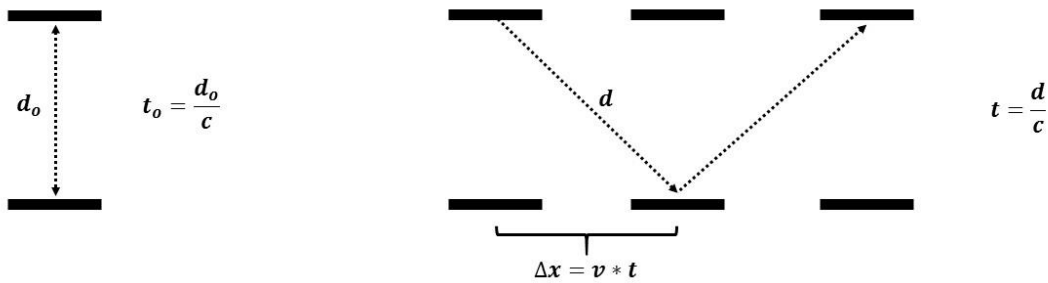
$$t_o = t_1 - \frac{\sqrt{\Delta z^2 + (v_x * (t_1 - t_0))^2}}{c} = t_2 - \frac{\sqrt{\Delta z^2 + (\Delta x - (v_x * (t_2 - t_0)))^2}}{c} \quad [13]$$

## 2. The Absolute Effect on the Ageing of Matter and its Relation to Relativistic Effects

Matter in motion ages slower in an absolute comparable sense. The present chapter aims to gain insight into this phenomenon and its relation to relativistic perceptive effects. Let us first examine the effect, that the absolute motion described in theoretical part 1, has onto a lightclock.

### 2.1. The Absolute Effect

Diagram 3: A Lightclock at Rest and Absolute Motion



We already realized in part 1, that absolute motion can be defined as motion relative to a signal. But therefore, lightclocks are an indicator of absolute motion. In a resting lightclock, a signal bridges a distance  $d_o$  in  $t_o$  seconds. Following the logic from theoretical part 1, when as depicted in diagram 3, the same lightclock moves with absolute speed  $v$  into a given direction, and the signal travels within the clock perpendicular to this direction, then the signal needs to cover a larger distance by

$$d = \frac{d_o}{\sqrt{1 - \frac{v^2}{c^2}}} \quad [14]$$

One cycle thus takes longer to complete by

$$t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}} \quad [15]$$

such that the clock will encounter a frequencyshift by

$$f = f_o * \sqrt{1 - \frac{v^2}{c^2}} \quad [16]$$

The formula implies a maximum absolute velocity  $c$  for any matter and hence a possible relative velocity in the range of  $-2c < v' < 2c$  following from the logic of theoretical part 1.



The model of our lightclock, describes rest matter to in a meaningful way oscillate at speed  $c$  perpendicular to the direction of its motion, whilst its lifetime is decided by how many cycles it can last. This agrees with experimental results of the lifespan of high speed particles being increased by the above factor known as gamma (see introduction) – however must be understood as an untested assertion, born from observational agreement with experiment.

If matter and therefore clocks experience an absolute frequencyshift, mathematically described by the above model of a lightclock, then if we compare two clocks against each other, the times that it takes for a cycle to complete in either clock will however relate according to

$$t_2 = \frac{t_1 * \sqrt{1 - \frac{\|v_1\|^2}{c^2}}}{\sqrt{1 - \frac{\|v_2\|^2}{c^2}}} \quad [17]$$

The clocks relative motion to each other does not matter, but  $v_1$  and  $v_2$  describe their absolute velocities, as each clock relates to a clock at rest in space by a cycle taking

$$t_1 = \frac{t_o}{\sqrt{1 - \frac{\|v_1\|^2}{c^2}}} \quad \text{and} \quad t_2 = \frac{t_o}{\sqrt{1 - \frac{\|v_2\|^2}{c^2}}} \quad [18]$$

If we compare two clocks within a laboratory, where i.e.

$$\|v_2\| = \sqrt{(v_{2x}' + v_{Lx})^2 + (v_{2y}' + v_{Ly})^2 + (v_{2z}' + v_{Lz})^2} \quad [19]$$

whilst the laboratory itself is in motion through space, they relate according to

$$t_2 = \frac{t_1 * \sqrt{1 - \frac{\|v_1' + v_L\|^2}{c^2}}}{\sqrt{1 - \frac{\|v_2' + v_L\|^2}{c^2}}} \quad [20]$$

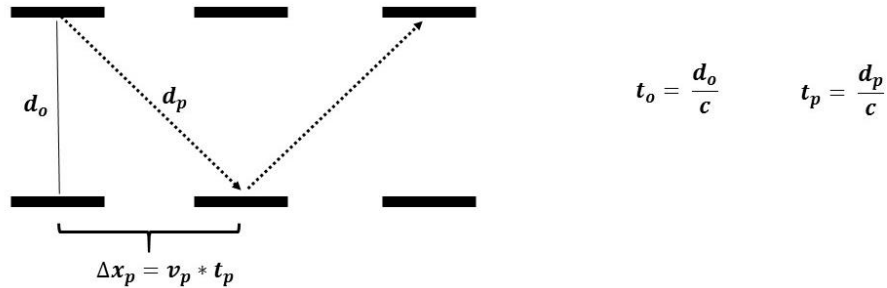
where i.e.  $v_2'$  describes the velocity of clock 2 relative to the laboratory which has to be added vectorially to the laboratory velocity  $v_L$ , such that when minding the absolute speed limit  $-c < v_2 = v' + v_L < c$ . The laboratory velocity may be determined from equation 20, by flying two atomic clocks in and out of the direction of star-sign Leo which may coincide with the direction of our motion through space as it signals our motion relative to the cosmic microwave background (*Lineweaver, 1996*). By reading both clocks whilst knowing their average velocities relative to our laboratory, we can solve the below equation 21 for  $v_{Lab}$ . Mind that in our equations,  $t$  relates the duration of a cycle inside clocks, whilst the clock with the longer cycle will display less cycles so that for a practical reason we may reverse the  $t$ 's.

$$t_{in} = \frac{t_{out} * \sqrt{1 - \frac{(|v_{lab}| - |\langle v_{out} \rangle|)^2}{c^2}}}{\sqrt{1 - \frac{(|v_{lab}| + |\langle v_{in} \rangle|)^2}{c^2}}} \quad [21]$$

## 2.2. Understanding Relativistic Perception amongst Absolute Effects - The Common Cause

If there is a clock at rest in space and an observer moves past the clock, he would measure the signal to bridge a longer distance inside his own reference frame, by the same amount as if the lightclock moved past him.

Diagram 4: Inside the Reference Frame of an Observer moving Relative to a Lightclock



The above diagram 4 shows the reference frame of an observer moving to the left or a lightclock moving to the right.  $v_p$  stands for the velocity of the observed object as measured in the reference frame of the observer,  $d_p$  for the distance a signal bridges as measured in the reference frame of the observer, and  $t_p$  for how long he miscalculates the signal to take. If either a lightclock moved to the right, or we moved to the left, in our own frame we measure the light to have covered a larger distance than the rest-distance  $d_o$ , namely

$$d_p = \frac{d_o}{\sqrt{1 - \frac{v_p^2}{c^2}}} \quad [22]$$

for which we miscalculate the tick of a clock to take longer by

$$t_p = \frac{t_o}{\sqrt{1 - \frac{v_p^2}{c^2}}} \quad [23]$$

These formulas resemble equations [14] and [15], however are of a hypothetical nature with no characteristics of appearance attached to them. Let us examine this by starting with the assertion of SR (the nature of which we here described) that motion only has relative meaning (*Einstein 1905*), such that the first observer sees the clock of the second observer tick slower, alike the second observer sees the clock of the first observer tick slower. SR hence states that muons traveling at almost the speed of light, should see muons at rest on earth age slower by

$$f_{other} = f_{own} * \sqrt{1 - \frac{v^2}{c^2}} \quad [24]$$

However muons traveling at almost the speed of light age slower in an absolute, comparable sense to find their twin dead, when they arrive nice and alive. Hence the traveling muons experience their twins to age faster, not slower. But if this is so which it is, SR neither describes these absolute comparable effects, nor even the relativistic perceptive effects.

The frequency of the traveling muons is slowed down in an absolute sense by

$$f_{traveler} = f_o * \sqrt{1 - \frac{v^2}{c^2}} \quad [25]$$

in comparison to a clock at rest with frequency  $f_o$  - which is not that of the muon at rest on earth but must be experimentally determined as suggested in theoretical part 3. Therefore, the traveling muons will perceive the outer world to rush past because their own biological clocks are slowed down. But then the traveling muon would perceive the clock of the resting muon to tick extremely fast, yet in a shifted fashion due to the relativistic perceptive effects of a moving body being in different locations when the light sent from its various parts reaches us to form our picture at any one time. According to the understanding of this manuscript, the traveling muon will perceive a shifted distance in the resting muon's lightclock to be bridged in

$$t_{earth} = \frac{t_{traveler} * \sqrt{1 - \frac{\|v_{traveler}\|^2}{c^2}}}{\sqrt{1 - \frac{\|v_{earth}\|^2}{c^2}}} \approx t_{traveler} * \sqrt{1 - \frac{\|v_{traveler}\|^2}{c^2}} \quad [26]$$

seconds. This matches experimental results.

Relativistic perceptive effects and the absolute effects described in this chapter are both dictated by the speed of propagation of a disturbance through the fabric of space. Thus, relativistic effects cause no absolute comparable effects, but share this common cause.

### 2.3. Acceleration

Experiments reviewed in the introduction demonstrated that unaccelerated motion through the fabric of space causes absolute changes to matter. Thus, if slower ageing is due to motion rather than acceleration, we can calculate how much longer an accelerated particle will live by calculating its average velocity

$$\langle v \rangle = \frac{1}{T} \int_{t=0}^T a(t) dt \quad [27]$$

to use this velocity in

$$t = \frac{t_o}{\sqrt{1 - \frac{\langle v \rangle^2}{c^2}}} \quad [28]$$

This understanding is in accordance with the work and calculations by *Chou et al. 2010*, and to be distinguished from the influence of gravity which will be dealt with later.

#### 2.4. Energy of Inertial Matter

In contrast to light, rest matter experiences what is called inertia (for which mass is but another word), which is a measure of resistance to motion - in our case through the fabric of space. As already mentioned in the above, experimental results suggest the phenomenon of a particle's increase in inertia/mass with increased motion, to be mathematically modeled by the signal in our hypothetical lightclock having to bridge an ever larger distance the faster the lightclock travels. But its inertia is proportional to its energy content. And considering various areas of physics including thermodynamics, mechanics and optics, it appears sensible to define energy as quantifying the amount of change over space and time.

When we do work, we bring up an amount of energy  $E$  to for example move a particle from here to there. The amount of work that we do which is described as

$$W = \int F \cdot dr \quad [29]$$

which if we apply a constant force, does not reflect into a change of energy of the particle, but reflects in the change of the particle's location. So in this sense, the energy we brought up is a measure of the change we caused. Now let us remember that experiments suggest a particle itself to be modelled by a lightclock ticking perpendicular to its direction of motion as shown in diagram 3. If the particle is at rest, let us describe its energy by

$$E_o = \int F \cdot dr \quad [30]$$

where

$$F = \frac{dp}{dt} = \text{constant} \quad [31]$$

because the speed of light is constant under invariable conditions. Thus we describe the energy of the particle modeled by our lightclock as

$$E_o = \int_{r=0}^{d_o} F \cdot dr = F * d_o \quad [32]$$

Then, if motion through space increases  $d$  which can be expressed as

$$d = \frac{d_o}{\sqrt{1 - \frac{v^2}{c^2}}} \quad [33]$$

it therefore increases the particle's energy by

$$E = \int_{r=0}^d F \cdot dr = F * d \quad [34]$$

because in consideration of the dot product, the direction of motion of the signal coupled to the direction of force, changes with the direction of dr, to remain parallel to dr. Here

$$\frac{E}{E_o} = \frac{F * d}{F * d_o} \quad [35]$$

such that following from previous algebra i.e. using equation [33] to express  $d$  in terms of  $d_o$

$$E = \frac{E_o * d_o}{d_o * \sqrt{1 - \frac{v^2}{c^2}}} \quad [36]$$

$$E = \frac{E_o}{\sqrt{1 - \frac{v^2}{c^2}}} \quad [37]$$

Hence, motion causes an absolute change in a particle's energy by the above equation, through increasing its value of change over space and thus its inertia. I wish to refrain from talking about kinetic or later potential energy, but instead try to understand energy as what it describes: the amount of change over space and time which for the case of a particle, defines a particle. The influence of gravity onto the total absolute energy of a particle will be considered in the discussion, where we will find that the influence of gravity decreases a particle's amount of change over time by lowering the speed of induction.

In summary, absolute motion through space changes the energy of a particle in an absolute comparable sense, rather than in a relative sense as postulated by *Einstein 1907*.

### 3. Finding the Absolute Picture

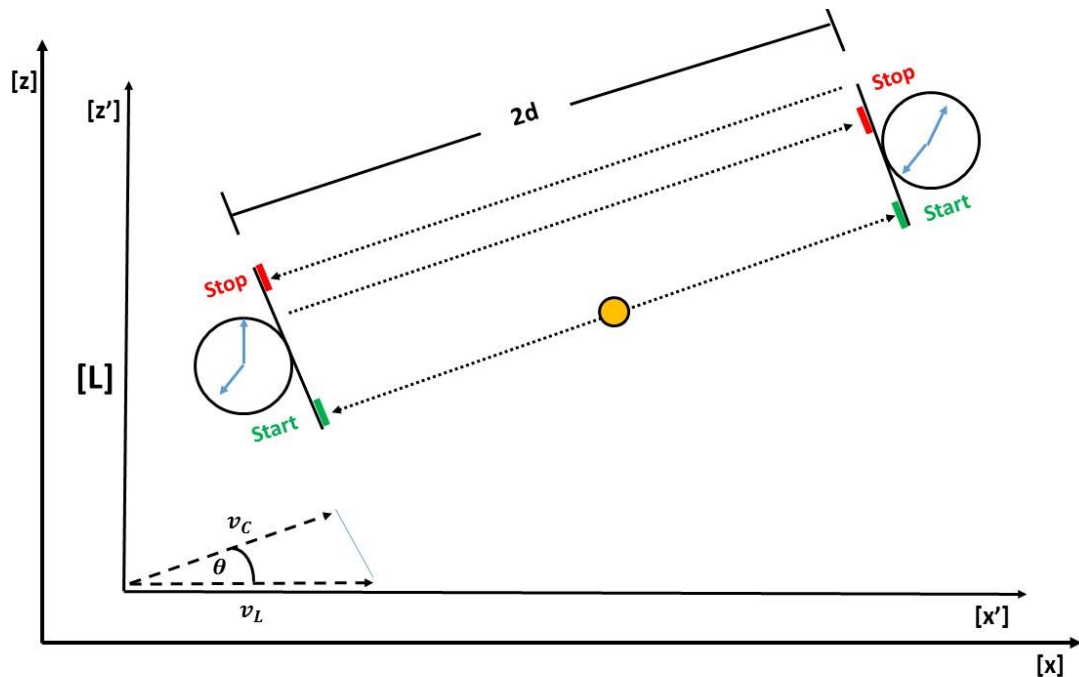
The present chapter combines the knowledge gained from theoretical part 1 and part 2, by combining absolute and relative effects, to find the absolute picture of nature to enable a meaningful comparison between different observers. However for the equations which will be derived in this chapter to work in practice, we need to know our own absolute velocity through space.

#### 3.1. The Experiment to find the Rest Frame

The understanding gained in the presented manuscript agrees with Michelson's and Morley's understanding of light being the propagation of a disturbance in a medium. Hence, we make the prediction that within a laboratory stationary on earth, a signal will take longer to travel one way than the other along the same axis as detectable by atomic clocks to overcome the shortcomings of the Michelson Morley experiments.

For this purpose, let us set up 2 atomic clocks a distance  $2d$  apart. Let both clocks be set to zero until they get started. We start both clocks with a signal sent from the center between both of the clocks as shown in the below diagram 5. When a signal reaches a clock and starts it, this clock sends a signal to the opposite clock to stop it.

Diagram 5: The Experiment to find the Rest Frame - Concept



Note that the above diagram 5 of the lightclock is drawn from the perspective of the laboratory frame L, which moves at velocity  $v_L$  within the rest frame which we want to find with this experiment. Of course, when the initial signal moves out from the center to both clocks, according to our prediction, it will start the right clock a bit later than the left clock, due to the motion of earth. However on the return journey, both signals will cross exactly in the center. This is so because on the first journey to start the clocks, the

signal has a longer distance by  $\Delta d_{Front}$  towards the clock at the front of the constellation, but a shorter distance by  $\Delta d_{Back}$  towards the clock at the back. But on the return journey towards the center, the signal reflecting from the clock at the back now has a longer distance by  $\Delta d_{Front}$ , whilst the signal reflecting from the clock at the front now has a shorter distance by  $\Delta d_{Back}$ . So in total, both signal have to bridge the same distance until they cross over at the center of the lightclock. But for the second half of the return journey, the right clock still moves slightly away and the left moves slightly towards the signal, and thus both clocks will display a different amount of cycles when they stop. Thus the mathematically relevant distance is half the distance between the two clocks  $d$ . This distance needs to be large enough to yield a significant difference in cycles between the two clocks. Let us call the time it takes the signal to reach the clock moving away from the signal  $t_F$ , and the time it takes the signal to reach the clock moving towards the signal  $t_B$ . And let the component of the earth's velocity  $v_L$  through space, along the direction of our constellation, be  $v_C$ . If we consider a cesium clock with 9,192,631,770 *cycles/sec*, then to detect a cycle difference for i.e.  $\|v_C\| = 300,000 \text{ m/sec}$  away from or towards the signal, we need a separation of  $\sim 300$  meters between the 2 clocks to obtain a difference of 10 cycles.

This is so because we chose

$$|t_F - t_B| > \frac{10 \text{ cycles}}{9,192,631,770 \text{ cycles/sec}} \approx 10^{-9} \text{ sec} \quad [38]$$

Where after the signal crosses in the middle the right clock records another

$$\Delta t_F = \frac{d}{c} \left( \frac{1}{1 - \frac{|v_C|}{c}} \right) \quad [39]$$

and the left clock another

$$\Delta t_B = \frac{d}{c} \left( \frac{1}{1 + \frac{|v_C|}{c}} \right) \quad [40]$$

These equations follow from the logic developed in part 1. Thus

$$|\Delta t_F - \Delta t_B| = \frac{d}{c} \left( \frac{1}{1 - \frac{|v_C|}{c}} \right) - \frac{d}{c} \left( \frac{1}{1 + \frac{|v_C|}{c}} \right) \quad [41]$$

So for an assumed speed  $\|v_C\|=300,000 \text{ m/sec}$  to obtain  $|\Delta t_F - \Delta t_B| = 10^{-9} \text{ sec} \approx 10$  cycles we need

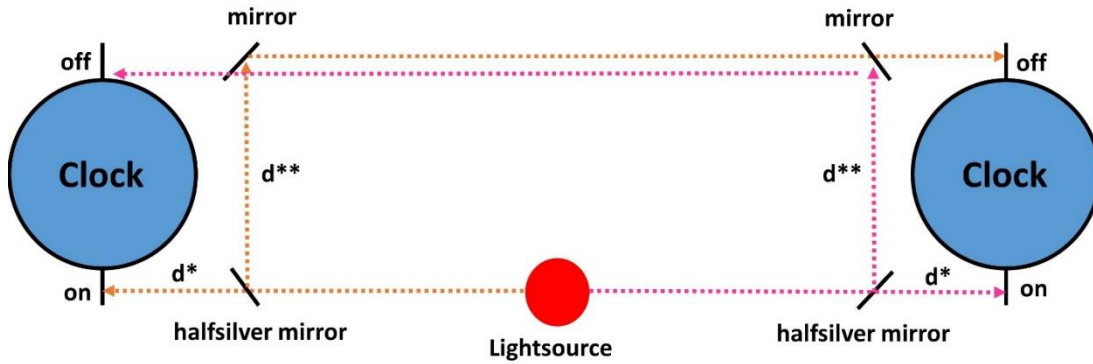
$$10^{-9} \text{ sec} = \frac{d}{c} \left( \frac{1}{1 - \frac{|v_C|}{c}} - \frac{1}{1 + \frac{|v_C|}{c}} \right) \quad [42]$$

$$d = \frac{10^{-9} \text{sec} * 300,000,000 \text{ m/sec}}{\frac{1}{1 - \left| \frac{0.001c}{c} \right|} - \frac{1}{1 + \left| \frac{0.001c}{c} \right|}} \approx 150 \text{ m} \quad [43]$$

at least a distance of  $2d = 300 \text{ meters}$  between our two clocks.

The experiment could be built as explained in the diagram 6 in the below, where either optical fibers could be employed, or the apparatus could be aligned precisely. The lightsource must serve the purpose of simultaneously sending a signal to the right and to the left onto photosensitive on an off switches. The distances  $d^{**}$  are invariant and thus do not cause changes to the measured difference in cycles. However the distances  $d^*$  must be kept as small as just possible.

Diagram 6: The Experiment to find the Rest Frame - Design



It is possible that the absolute motion of earth coincides with the relative motion of earth to the CMB as experimentally determined by i.e. *Lineweaver, 1996*. Therefore let us align the axis of our constellation with our velocity relative to the CMB for the first attempt of the experiment. But I would even after success alter the angle of the constellation by 10 degree along each axis to see whether a larger cycle difference is picked up.

Our final goal is to determine the velocity  $v_L$  (magnitude and direction) of ourselves through the fabric, where

$$\|v_L\| = \|v_C\|/\cos(\theta) \quad [44]$$

The largest difference in cycles, signals the direction of motion through the fabric at which  $v_L = v_C$ . From here we can calculate the magnitude by solving

$$|\Delta t_F - \Delta t_B| = \frac{d}{c} \left( \frac{1}{1 - \left| \frac{v_L}{c} \right|} - \frac{1}{1 + \left| \frac{v_L}{c} \right|} \right) \quad [45]$$



for  $v_L$ , where we put the largest difference in cycles we managed to record in place for  $|\Delta t_F - \Delta t_B|$ . Noting the geographical location, time and direction would enable us to determine the velocity through space for other geographical locations and for a long time to come.

Our motion through the fabric of space may or may not coincide with our motion relative to the CMB in direction and/or magnitude. But let us for the sake of making an illustrative prediction, assume that our constellation will be arranged such that at least  $\|v_c\| = 300,000 \text{ m/sec}$  - which our motion relative to the CMB suggests is possible (Lineweaver, 1996). Let us assume we use 2 cesium clocks and a distance of  $2d = 400 \text{ meters}$ . Then, we would expect a cycle difference of at least

$$|\Delta t_F - \Delta t_B| = \frac{200}{c} \left( \frac{1}{1 - \left| \frac{0.001c}{c} \right|} - \frac{1}{1 + \left| \frac{0.001c}{c} \right|} \right) \approx 1.33 * 10^{-9} \text{ sec} \quad [46]$$

which corresponds to a difference of at least 12 cycles.

Let us envision this with a more intuitive approximate equation which can only then be used when  $v \ll c$ . If earth moves at a speed of 0.001 times the speed of light along our axis, then earth moves a distance  $0.001 * d$  during the same time that light covers a distance  $d$ . So if light approximately covers a 200 meter distance, then the motion of earth approximately increases or decreases the signal path by 0.2 meters into either direction. When we formulate this approximation as

$$|\Delta t_F - \Delta t_B| \approx \frac{2 * \left( d * \frac{v}{c} \right)}{c} = \frac{0.4m}{c} = 1.3 * 10^{-9} \text{ sec} \quad [47]$$

equation [47] leads us to the same approximate cycle difference of at least 12 cycles.

According to the understanding of the present manuscript, the Michelson-Morley experiment should have succeeded if it wasn't for hitherto unknown factors which may include absolute changes to matter. The proposed experiment is designed to avoid these factors by employing a single axis, a one way path and avoid the use of interference such that changes to any form of matter should not impact on the experiment. Atomic clocks however have already been proven to serve a reliable tool to detect a difference in motion. The results of this experiment will be unquestionably due to absolute motion, as rotation plays no role unlike it does for the Sagnac effect.

If our 2 clocks are located at different heights, for mathematical correctness, we should consider this effect onto the clockrates. However, as the experiment happens during such a short time, the effect from gravity will be negligible because the cycle difference due to gravity is determined by

$$\Delta \text{cycles} = \Delta f * \Delta t \quad [48]$$

where however the duration of the experiment  $\Delta t$  is as short as approximately

$$\Delta t = \frac{300m}{c} = 1.0 * 10^{-6} \text{ sec} \quad [49]$$

If light had to travel a distance of for example 300 meters. Such that for a height difference of even 100 meters by equation 2 from *Chou et al., 2010*, we would get a frequency difference of approximately

$$\Delta f = f_o * \frac{g\Delta h}{c^2} \quad [50]$$

$$\Delta f = 9,192,631,770 * \frac{9.81 * 100}{300,000,000^2} = 1 * 10^{-4} \frac{\text{cycles}}{\text{sec}} \quad [51]$$

Gravity thus contributes a cycle difference of

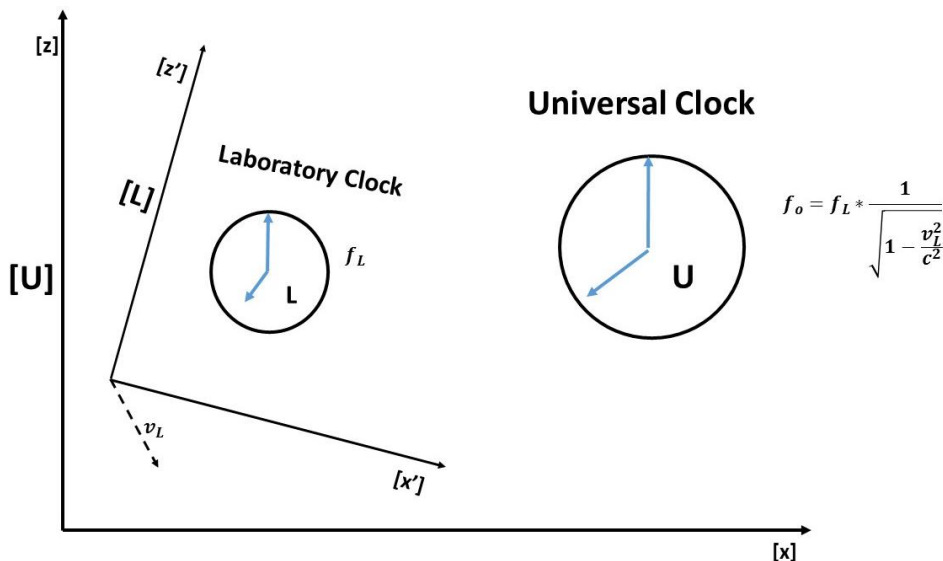
$$\Delta \text{cycles} = 1 * 10^{-4} \frac{\text{cycles}}{\text{sec}} * 1.0 * 10^{-6} \text{ sec} = 1.0 * 10^{-10} \text{ cycles} \quad [52]$$

to be subtracted from the total cycle difference to yield the cycle difference caused by motion only. This contribution due to gravity can really be neglected for the present experiment.

### 3.2. The Universal Clock

As discussed in the introduction, experiments by Hafele and Keating have shown that moving a clock along the rotation of earth loses cycles because it increases the absolute motion of the clock, whereas moving a clock against the rotation of earth gains cycles because it reduces the absolute motion of the clock. Hence, moving a clock against the direction of our total motion through space yields the rest clock. Let us call this clock "universal clock" (for gravity still to be incorporated) at rest in a universal frame U.

Diagram 7: Defining the Rest Clock



We can define the rest clock as we know our own (laboratory L) velocity  $v_L$  through space. The frequency  $f_o$  of the rest clock can hence be determined from the frequency  $f_L$  of our own clock via

$$f_o = f_L * \frac{1}{\sqrt{1 - \frac{\|v_L\|^2}{c^2}}} \quad [53]$$

Thus we can define a universal time, which will be an essential tool to derive the absolute picture of reality in a meaningful comparable way – as will be done in the next parts of the manuscript.

### 3.3. Revisiting Theoretical Part 1

Equipped with the now experimentally determined absolute motion of our laboratory at velocity  $v_L$ , we can perform the experiment suggested in theoretical part 1, by aligning a source and observer along the velocity of our laboratory along a hypothetical x-axis, and substituting  $v_L$  (which then only has x-component) with the magnitude of the laboratory's velocity in the equation, such that for the case of a hypothetical observer whose clock is not slowed down, the time  $t_o$  at which the signal was emitted must be calculated from time  $t$  at which he received the signal via

$$t_o = t - \frac{\Delta x}{c} \left( \frac{1}{1 - \frac{v_L}{c}} \right) \quad [54]$$

To, move the source along the designated axis away from the observer at a given velocity, will according to theoretical part 1 cause no changes to the results. However moving the observer away from or toward the source along the x-axis, will according to theoretical part 1 cause changes to the result in the form of

$$t_o = t - \frac{\Delta x}{c} \left( \frac{1}{1 - \frac{v_L + v'_o}{c}} \right) \quad [55]$$

Where  $v'_o$  is the velocity of the observer along the designated axis relative to the laboratory. Let us therefore express the absolute velocity of the observer  $v_x$  as

$$-c < v_x = v_L + v'_o < c \quad [56]$$

such that

$$t_o = t - \frac{\Delta x}{c} \left( \frac{1}{1 - \frac{v_x}{c}} \right) \quad [57]$$

which is the same as equation [12] in chapter 1, whilst we are now able to correctly determine  $v_x$ .

However we still failed to consider that motion slows down the ageing of matter as explained in part 2. The term, let us call it  $\beta$ , by which the observer needs to correct for, depends on the frequencyshift the observer experience and the duration he experiences it for. To explain this concept, let all clocks be synchronized at time  $t_o$ . Whatever time or amount of cycles the observer loses by his clock being slowed down through his motion during the duration of the experiment as compared to the universal clock, will need to be added to the right site of equation [57] in form of  $\beta$

$$t_o = t - \frac{\Delta x}{c} * \alpha + \beta \quad [58]$$

such that  $\Delta t$  which it took for the signal to reach the observer according to the rest clock is

$$\Delta t = \frac{\Delta x}{c} * \alpha = t + \beta - t_o \quad [59]$$

Considering equation [59], different observers can when knowing their absolute velocity, calculate the duration that the signal took to reach them according to the rest clock, and with the help of this calculate  $t_o$  when defining

$$\beta = \Delta f * \Delta t \quad [60]$$

where  $\Delta f$  is the frequencyshift of the observer's clock as compared to the universal clock, and  $\Delta t$  the duration of the experiment as measured by the universal clock and calculated by [59]. We remember from chapter 2, that the observer's frequency  $f$  as compared to the frequency  $f_o$  of the universal clock, reduces by

$$f = f_o * \sqrt{1 - \frac{v_x^2}{c^2}} \quad [61]$$

Thus the frequency difference  $\Delta f$  will be

$$\Delta f = f_o - f_o * \sqrt{1 - \frac{v_x^2}{c^2}} = f_o \left( 1 - \sqrt{1 - \frac{v_x^2}{c^2}} \right) \quad [62]$$

Therefore to calculate  $t_o$  in cycles, an observer will have to solve

$$t_o = t - \frac{\Delta x}{c} * \left( \frac{1}{1 - \frac{v_x}{c}} \right) + f_o \left( 1 - \sqrt{1 - \frac{v_x^2}{c^2}} \right) * \Delta t \quad [63]$$

$$t_o = t - \frac{\Delta x}{c} * \left( \frac{1}{1 - \frac{v_x}{c}} \right) + f_o \left( 1 - \sqrt{1 - \frac{v_x^2}{c^2}} \right) * \frac{\Delta x}{c} * \left( \frac{1}{1 - \frac{v_x}{c}} \right) \quad [64]$$

$$t_o = t - \frac{\Delta x}{c} * \left( \frac{1}{1 - \frac{v_x}{c}} \right) \left( 1 + f_o \left( 1 - \sqrt{1 - \frac{v_x^2}{c^2}} \right) \right) \quad [65]$$

for which we need to describe the speed of light in meters/cycle (as of the universal clock) and meters/seconds respectively within the same equation, to work in consistent units, because frequency is currently defined as cycles per seconds. I.e. the units in equation [64] would look like

$$cycles(t_o) = cycles(t) - \frac{m}{m/cycles} + \frac{cycles}{sec} * \frac{m}{m/sec} \quad [66]$$

If however we would want to calculate  $t_o$  in seconds, we would need to define frequency as of second/cycles of the universal clock. I.e. the units would look like

$$sec(t_o) = sec(t) - \frac{m}{m/sec} + \frac{sec}{cycles} * \frac{m}{m/cycles} \quad [67]$$

It may in future be sensible to let time be measured by cycles of the universal clock, let frequency be a unitless measure expressing the amount of cycles a clock describes during one cycle of the universal clock the frequency of which is 1, let a distance unit be defined through the distance light covers during a cycle of the universal clock and let the speed of light be given in units of distance per cycle.

### 3.4. Doppler Shift

Doppler shift serves as a practical tool for experiments that can be conducted in the sense of this manuscript. Therefore we need to derive formulas for Doppler shift in the sense of this manuscript, considering the absolute velocity of source and observer. Let us for this purpose examine the two scenarios of either the observer or the source moving, to then combine their effects.

Let us start by acknowledging the definition

$$\lambda = c * T = c * 1/f \quad [68]$$

which is nothing but the definition

$$s = v * t \quad [69]$$

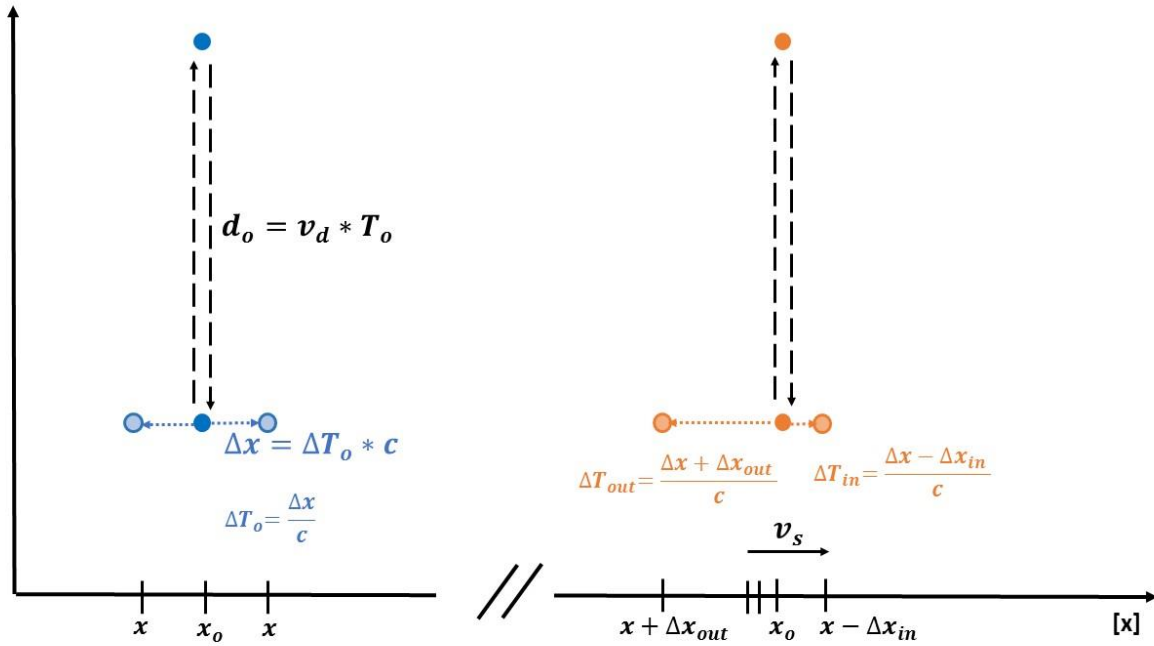
applied to the distance  $\lambda$  covered at a speed of propagation  $c$  during one period  $T$ . Let us first consider what changes absolute motion of the source will cause to  $\lambda$ .

Let us consider the most simple of all sources of EM radiation, namely a charge moving up and down a cycle of distance  $d$  at speed  $v_d$ , in period  $T$ . When the charge moves up and down, the electric field that surrounds it moves up and down with it. But the information of this motion only propagates outwards at speed  $c$ , causing the appearance of the wave. When the source containing the charge is at absolute rest, it hence emits a wave according to the relation

$$\lambda_o = c * T_o \quad [70]$$

into all directions perpendicular to the charge's direction of motion.

Diagram 8: EM-wavesource at Absolute Rest and in Motion



But if the same source moves along the positive x-axis, the speed  $c$  of propagation of the information that the field moves, does not change. Yet, the distance towards a *next* x-coordinate is either increased or decreased, for the induced information of the field to move up or down, to take a longer or shorter time to reach this x-coordinate, leading to a shift of the apparent wave. At rest, the amount of time it takes to induce a certain x-coordinate is

$$\Delta T_o = \frac{\Delta x}{c} \quad [71]$$

Out of the direction of the motion of the source, the amount to induce the same location is

$$\Delta T_{out} = \frac{\Delta x + \Delta x_{out}}{c} \quad [72]$$

$$\Delta T_{out} = \frac{\Delta x + |v_s| \Delta T_o}{c} \quad [73]$$

$$\Delta T_{out} = \Delta T_o * \left(1 + \left|\frac{v_s}{c}\right|\right) \quad [74]$$

where  $|v_s|\Delta T_o$  describes how far the source has moved in x-direction whilst the charge moved up during the fraction of a period  $\Delta T_o$ . Therefore after a same amount of time the induction signal would not get as far, and as wavelength and period are proportional, the wave would get stretched by

$$\Delta\lambda_{out} = \Delta\lambda_o * \left(1 + \left|\frac{v_s}{c}\right|\right) \quad [75]$$

Into the direction of the motion of the source, with similar reasoning we derive that the apparent wave would get pushed by

$$\Delta\lambda_{in} = \Delta\lambda_o * \left(1 - \left|\frac{v_s}{c}\right|\right) \quad [76]$$

The motion of the source hence shifts the wavelength of the emitted EM wave in an absolute sense, by the above relations.

If however the observer moves with velocity  $v_o$  along the x-direction, he moves towards or away from the him approaching signal to perceive a field value to drop or rise later (direction out) or sooner (direction in). However his motion is affecting the final wavelength that the observer will measure in a different way than the motion of the source. Let us first consider the observer moving away from the signal. At rest, the amount of time it takes for an induced signal to reach him is

$$\Delta T_o = \frac{\Delta x}{c} \quad [77]$$

However if he moves away from this signal he increases the distance this signal has to travel by

$$\Delta T_{out} = \frac{\Delta x + \Delta x_{out}}{c} \quad [78]$$

where however

$$\Delta T_{out} = \frac{\Delta x + |v_o|\Delta T_{out}}{c} \quad [79]$$

$$\Delta T_{out} = \Delta T_o * \frac{1}{1 - \left|\frac{v_o}{c}\right|} \quad [80]$$

because  $|v_o|\Delta T_{out}$  describes how far he traveled in the time the signal took to reach him. As the wavelength and period are proportional we get

$$\Delta\lambda_{out} = \Delta\lambda_o * \frac{1}{1 - \left|\frac{v_o}{c}\right|} \quad [81]$$

Likewise if the observer moves towards the signal we get

$$\Delta\lambda_{in} = \Delta\lambda_o * \frac{1}{1 + \left|\frac{v_o}{c}\right|} \quad [82]$$

Taken together, we can state the following 4 equations: If the source moves away from the observer at absolute rest, and the observer now moves away from the approaching signal, he will record a wavelength shift of

$$\lambda_{out/out} = \lambda_o * \frac{1 + \left|\frac{v_s}{c}\right|}{1 - \left|\frac{v_o}{c}\right|} \quad [83]$$

If the source moves away from the observer at absolute rest, and the observer now moves towards the approaching signal, he will record a wavelength shift of

$$\lambda_{out/in} = \lambda_o * \frac{1 + \left|\frac{v_s}{c}\right|}{1 + \left|\frac{v_o}{c}\right|} \quad [84]$$

If the source moves towards the observer at absolute rest, and the observer now moves away from the approaching signal, he will record a wavelength shift of

$$\lambda_{in/out} = \lambda_o * \frac{1 - \left|\frac{v_s}{c}\right|}{1 - \left|\frac{v_o}{c}\right|} \quad [85]$$

If the source moves towards the observer at absolute rest, and the observer now moves towards the approaching signal, he will record a wavelength shift of

$$\lambda_{in/in} = \lambda_o * \frac{1 - \left|\frac{v_s}{c}\right|}{1 + \left|\frac{v_o}{c}\right|} \quad [86]$$

Let us remember that the first contribution to the shift of the measured wavelength is absolute, and the second is relative. But when noting the vectorial property of the velocity and doing some algebra, we arrive at the classical Doppler formula

$$\lambda = \lambda_o * \frac{c + v_s}{c + v_o} \quad [87]$$

In the worldview of special relativity the motion of the observer or the source should have the same effect. If it however matters to the extent of Doppler shift whether the source or whether the observer moves, then motion must have meaning in an absolute sense. This can be tested in a laboratory by moving source or observer respectively and comparing the results.



### 3.5. Finding the Absolute Picture - Astronomical Observation

Let there be an observer on earth who is observing a comet passing by a star. When the comet is close to the star, the star flares and the comet explodes. The observer questions: "Which event caused the other – i.e. which occurred first and how much earlier? How far were the two bodies apart when the events occurred? What were their velocities and energy contents?" He wants to find these answers in a meaningful way, to be in agreement with other observers observing the same event. He therefore sets out to perform the following steps.

#### 3.5.1. Finding the Absolute Velocities of Sources

As a first step the observer uses the information from the previously established universal frame, and reads his own absolute velocity as  $v_o$ . Knowing his own absolute velocity  $v_o$ , he knows the components of this velocity into the direction of the sources. Let us call these components  $v_{o1c}$  and  $v_{o2c}$ , such that

$$\|v_{o1c}\| = \|v_o\| * \cos(\theta_1) \quad [88]$$

and

$$\|v_{o2c}\| = \|v_o\| * \cos(\theta_2) \quad [89]$$

where  $\theta_1$  and  $\theta_2$  denote the respective angles between the axis of the observer's absolute motion through space and the axes towards the sources. But knowing his velocity along the axes to the sources, and also having observed their motion relative to these axes, he can now conclude the velocities  $v_{s1c}$  and  $v_{s2c}$  of the sources along these axes, via the previously established Doppler formulas. Say, that when reading  $v_o$ , the observer found that he moves in absolute terms towards the sources, but as the sources are receding from him, he will choose the equation

Source 1

$$\lambda_{out/in} = \lambda_o * \frac{1 + \left| \frac{v_{s1c}}{c} \right|}{1 + \left| \frac{v_{o1c}}{c} \right|} \quad [90]$$

Source 2

$$\lambda_{out/in} = \lambda_o * \frac{1 + \left| \frac{v_{s2c}}{c} \right|}{1 + \left| \frac{v_{o2c}}{c} \right|} \quad [91]$$

where  $\lambda_{out/in}$ , is measured by the observer,  $\lambda_o$  known,  $v_{o2c}$  and  $v_{o1c}$  determined from the known  $v_o$ , such that he can solve for  $v_{s1c}$  and  $v_{s2c}$  from the above equations. But observing the angle of the motion of the sources with the axes that connects him and the sources, he can conclude the absolute source velocities  $v_{s1}$  and  $v_{s2}$  as

$$\|v_{s1}\| = \|v_{s1c}\| / \cos(\theta_1) \quad [92]$$

and

$$\|v_{S2}\| = \|v_{S2C}\|/\cos(\theta_2) \quad [93]$$

from where he can describe  $v_{S1}$  and  $v_{S2}$  in magnitude and direction.

### 3.5.2. Finding the Absolute Energy of observed Objects

But with this knowledge, the observer can now determine the absolute energy content of the sources and the frequency of a clock located on them via

$$E_{S1} = \frac{E_o}{\sqrt{1 - \frac{\|v_{S1}\|^2}{c^2}}} \quad [94]$$

$$E_{S2} = \frac{E_o}{\sqrt{1 - \frac{\|v_{S2}\|^2}{c^2}}} \quad [95]$$

$$f_{S1} = f_o * \sqrt{1 - \frac{\|v_{S1}\|^2}{c^2}} \quad [96]$$

$$f_{S2} = f_o * \sqrt{1 - \frac{\|v_{S2}\|^2}{c^2}} \quad [97]$$

### 3.5.3. Distances between 2 Events in Space and Time

Let it be that the observer records the solar flare from source 1 at time  $t_1$  and the explosion of the comet from source 2 at time  $t_2$  on his own clock. Let him determine the distances to the sources as  $d_1$  and  $d_2$  at these times as these are the distances the signal had to travel. But we know from theoretical part 1, that the distances  $d_{o1}$  and  $d_{o2}$  at the times  $t_{o1}$  and  $t_{o2}$  the signals were emitted, were shorter or longer depending on the direction of the components  $v_{O1C}$  and  $v_{O2C}$  of the observer's velocity, where a positive observer velocity implies motion away from the signal. Hence

$$d_{o1} = d_1 - v_{O1C} * \Delta t_1 \quad [98]$$

$$d_{o2} = d_2 - v_{O2C} * \Delta t_2 \quad [99]$$

where the signals travelled for

$$\Delta t_1 = \frac{d_1}{c} \quad [100]$$

$$\Delta t_2 = \frac{d_2}{c} \quad [101]$$

such that

$$d_{o1} = d_1 * \left(1 - \frac{v_{o1c}}{c}\right) \quad [102]$$

$$d_{o2} = d_2 * \left(1 - \frac{v_{o2c}}{c}\right) \quad [103]$$

The observer can determine when the signals were sent via previously developed formulas in either of the two ways

$$t_{o1} = t_1 - \frac{d_{o1}}{c} * \left(\frac{1}{1 - \frac{v_{o1c}}{c}}\right) \left(1 + f_o \left(1 - \sqrt{1 - \frac{v_o^2}{c^2}}\right)\right) \quad [104]$$

$$t_{o2} = t_2 - \frac{d_2}{c} * \left(1 + f_o \left(1 - \sqrt{1 - \frac{v_o^2}{c^2}}\right)\right) \quad [105]$$

which considers how much longer or shorter the signal has to travel due to the observer's motion away from or towards the signal (hence the vectorial quantity  $v_{o1c}$ ), as well as how much the frequency of his own clock is slowed down by his own absolute motion  $v_o$ .

## Discussion and Future work

### Lead over to Gravity

The apparent contradiction of a clock at low altitude having a lower frequency and less (potential) energy, whilst a clock at motion through space also has a lower frequency yet more (kinetic) energy, needs explanation. The present manuscript has shown that moving clocks tick slower as the signal has to traverse a longer distance of same density – describing more change over space and thus an increase in their energy content. But the signal takes longer because it has to propagate through more fabric. It can be concluded that clocks at low altitude tick slower for the same reason, of a signal having to traverse more fabric - however describing less change over time and thus a reduced energy content, if the cause for the signal having to traverse more fabric is an increase in energy density of the fabric rather than a dilation of such at invariant density. Thus, an increased energy density of the fabric of space surrounding matter is the likely physical cause behind the phenomenon of gravity.

We can imagine this as a scalar field, the scalar value of which is the deciding factor in slowing clocks. The energy density of space can be understood to be determined by its permeability and permittivity, which dictates the speed of the propagation of a disturbance. Instead of letting the permittivity and permeability of free space  $\mu_o$  and  $e_o$  be variables, let us introduce a factor  $x$ , by which the permeability and permittivity of space varies from its values  $\mu_o$  and  $e_o$  in ungravitated space, due to what we call gravity, in the form of

$$\frac{1}{x * \mu_o e_o} = \frac{1}{x} c_o^2 = c^2 \quad [106]$$

Let us to develop the concept understand  $x$  as a function of the distance  $R$  to the center of gravity of a single object.  $x$  is a unitless factor and a description of a unitless magnitude of gravitational gradient  $V$ , with  $x_o = 1$  at infinity or the absence of gravity when  $V = 0$ , or

$$x(R) = 1 + V(R) \geq 1 \quad [107]$$

at any other point.  $V$  is a positive quantity an exact expression for which we aim to find later. Matter appears to be a standing disturbance and thus an energy accumulation in the fabric of space, causing a gradient to the scalar field which describes the energy density of space. It is the value  $V$  of the scalar field which determines the slowing of clocks or the lowering of the energy content of matter, whilst the gradient  $\nabla V$  is the physical reason that the apple falls as we shall now examine.

We already modelled the energy gain of a moving particle. Now we need to incorporate the energy loss of a particle due to its location within our scalar field caused by a single object. In our lightclock model of a particle, a higher density of space would correspond to a lower velocity and thus momentum of the signal. Hence

$$E(R, v) = \iint dF(R) \cdot dr \quad [108]$$

Where  $F$  is a function of the distance from the center of gravity  $R$  as far as  $x$  is, thus

$$E(R, v) = \iint \frac{dp(R)}{dt} \cdot dr \quad [109]$$

The momentum of light at infinity is a constant

$$\frac{dp_o}{dt} = F_o = constant \quad [110]$$

but  $x$  determines the change of the speed and thus momentum of the signal in the hypothetical lightclock via

$$c = \frac{1}{\sqrt{x}} c_o \quad [111]$$

and as

$$p \propto c \quad [112]$$

via

$$p = \frac{1}{\sqrt{x}} p_o \quad [113]$$

Hence, our matter particle at a singular point in space holds

$$E(R, v) = \int_{r=0}^d \frac{1}{\sqrt{x(R)}} \frac{dp_o}{dt} \cdot dr = \int_{r=0}^d \frac{1}{\sqrt{x(R)}} F_o \cdot dr = \frac{1}{\sqrt{x(R)}} F_o * d \quad [114]$$

Then if we consider  $E$  to be the energy content of our particle, and let  $E_o$  be the energy content of a particle at rest in ungravitated space it holds that

$$\frac{E}{E_o} = \frac{\sqrt{x_o} * F_o * d}{\sqrt{x(R)} * F_o * d_o} = \frac{d}{\sqrt{x(R)} * d_o} \quad [115]$$

because  $x_o = 1$ .

As a particle's energy is a description of a particle's change over space and time, we can therefore express the combined effects of motion and gravity onto a particles energy content by substituting our known relation for  $d/d_o$  into [115], as

$$E(R, v) = \frac{E_o * 1/\sqrt{x(R)}}{\sqrt{1 - \frac{x(R) * v^2}{c_o^2}}} \quad [116]$$

When considering gravity to slow the ageing of matter, we must also note that consequently our hypothetical universal clock needs to be at rest in space as well as located in ungravitated space. Thus, for the universal clock established in theoretical part three, we need to consider the impact of gravity via

$$f = f_o * \sqrt{1 - \frac{x * v_L^2}{c_o^2}} * \frac{1}{\sqrt{x}} \quad [117]$$

No particle is located at a singular point in space as approximated in the above, but occupies a volume of space. Hence a particle's side which is facing the source of gravity, has a lower energy than the side facing away from the source of gravity – which exhibits a higher internal force due to a higher signal speed. Hence, the particle experiences an internal force gradient and pressure towards the source of gravity which it will follow until some equilibrium of forces is reached. This is the reason why the apple falls.

So within a particle itself

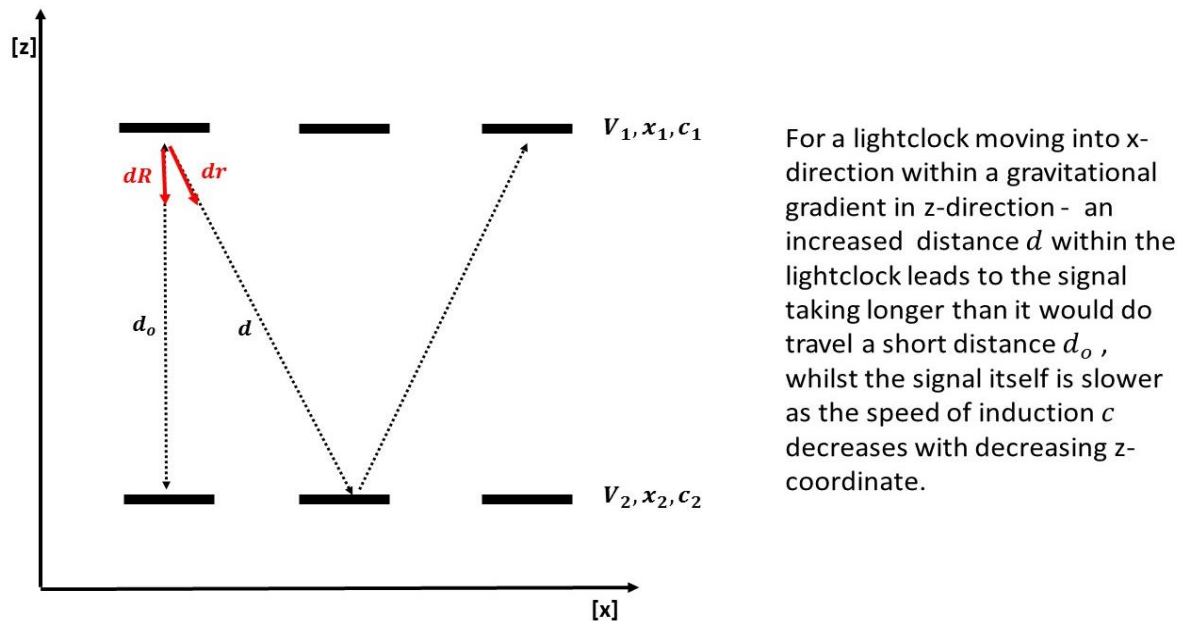
$$F(R) = \frac{dp(R)}{dt} \quad [118]$$

is not constant as the speed of induction changes over the volume that the particle occupies. Hence

$$E(R, v) = \iiint_{R=R_1}^{R_2} \frac{1}{\sqrt{x(R)}} \frac{dp_o}{dt} \cdot dr = F_o \iiint_{R=R_1}^{R_2} \frac{1}{\sqrt{x(R)}} dr \quad [119]$$

as depicted in diagram 9 below

Diagram 9: Lightclockmodel of Restmatter Moving in a Gravitational Gradient



However to be able to mathematically model this situation, we need to understand that when integrating the increased distance the signal has to bridge along  $dr$ , the speed of the signal changes along  $dR$ . And in fact  $d$  is an expression containing the speed of the signal  $c$  which was

$$d = d_o \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad [120]$$

But we must understand  $c$  as a function of  $R$ , such that

$$c(R) = \frac{1}{\sqrt{x(R)}} * c_o \quad [121]$$

Hence

$$d = d_o \frac{1}{\sqrt{1 - \frac{x(R)v^2}{c_o^2}}} \quad [122]$$

But we must find a way to integrate along  $dR$  only, to accommodate not only the change in force, but at the same time the change in the distance the signal has to bridge due to motion. But by the above diagram

$$dr = dR \frac{1}{\sqrt{1 - \frac{x(R)v^2}{c_o^2}}} \quad [123]$$

such that equation [119] becomes

$$E(R, v) = F_o * \int_{R=R_1}^{R_2} \frac{1}{\sqrt{x(R)}} * \frac{1}{\sqrt{1 - \frac{x(R)v^2}{c_o^2}}} * dR \quad [124]$$

Still lacking a formulation for  $x(R)$ , we already know that within a particle

$$\frac{F_{outside}}{F_{inside}} = \frac{\sqrt{x_{inside}}}{\sqrt{x_{outside}}} \quad [125]$$

which causes a particle to accelerate towards the center of gravity .

EM waves also occupy a volume of space, such that if they travel past a source of gravity, their outside travels faster than their inside by

$$\frac{c_{outside}}{c_{inside}} = \frac{\sqrt{x_{inside}}}{\sqrt{x_{outside}}} \quad [126]$$

But this effect reveals an absolute blueshift of light associated to its lower velocity with an increasing value for  $x$ . Because to travel faster at the outside than the inside, a faster speed of light increases the wavelength. But hence, it generally holds that an increasing value of  $x$ , decreases the speed of light  $c$  to decrease its wavelength  $\lambda$ . But as the energy of a photon is given by

$$E = h * f \quad [127]$$

where

$$f = \frac{c}{\lambda} \quad [128]$$

the energy of a photon remains the same in absolute terms, because  $\lambda$  experience a reduction for the physical reason that  $c$  experiences a reduction (such that  $c = \lambda/T$  remains to hold), because through a larger energy density of space, the speed of induction is lowered such that waves follow shorter onto each other. A smaller wavelength paired with a slower speed of light, results in a wave taking the same period to i.e. emerge from a box.

To find  $x(R) = 1 + V(R)$  caused by planet earth at some point in space (outside earth), the individual scalar fields that surround every infinitesimal piece of mass which make up planet earth, will have to be summed up. And advance towards such could look the following: If

$$F = -\frac{GMm}{r^2} \quad [129]$$

expresses a true relation of nature, it holds for singular point particles of matter. We are now going to determine the exact gravitational field surrounding a matter accumulation like planet earth, by summing up the infinite amount of fields that are caused by every infinitesimal matter particle that makes up planet earth. For our purpose of determining  $x$ , we need to arrive at a formula which describes a scalar value at any point in space, by which the energy density of space is increased as opposed to the absence of matter. This hypothetical scalar field surrounding every infinitesimal of matter has a positive value. Therefore its values are additive in nature, and we are expecting to receive the largest value at the center of planet earth, such that a clock at the center of planet earth -if we were to remove the planet but leave its effect- would tick the slowest.

Considering any point in space outside planet earth, for which we are questioning this value, we note that the value at our point is the sum over the value contributions caused by each of our infinitesimal matter particles that compose planet earth:

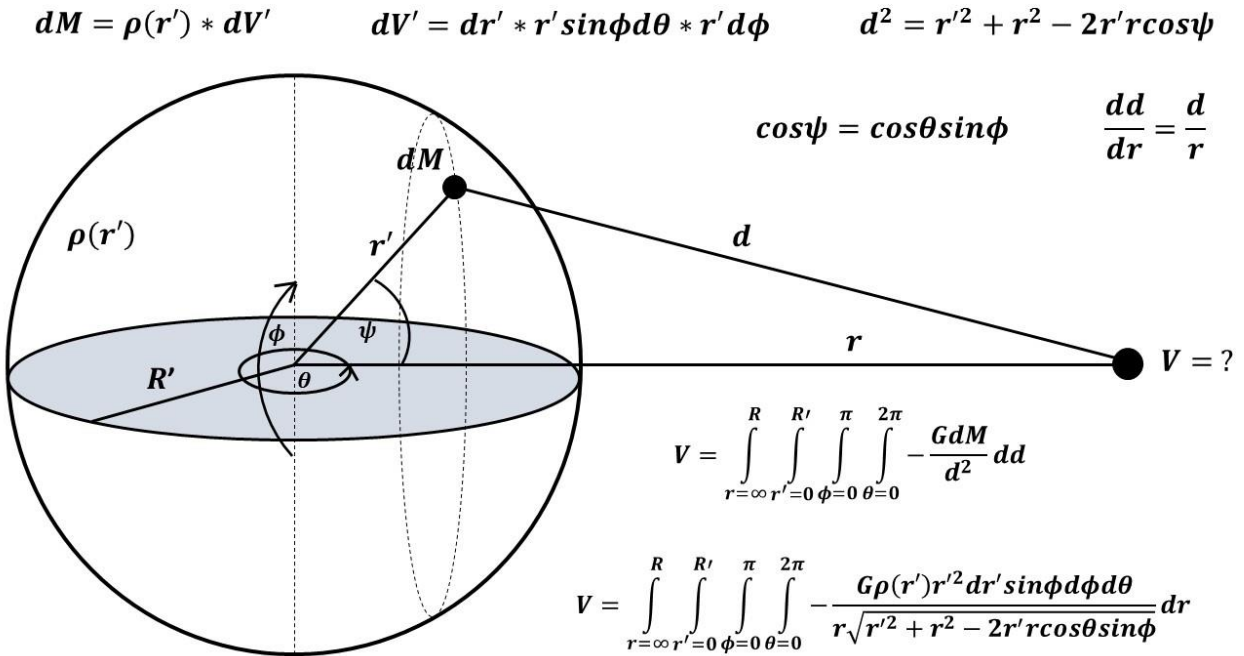
$$V(R) = \int dV = \int -\frac{GdM}{d^2} dd \quad [130]$$

Here,  $d$  is the distance to each of the little  $dM$ 's that compose planet earth. To appreciate their distribution within planet earth and perform a sensible integration, we have to consider a number of



parameters and variables: To find the value of  $V$  at any point in space, let  $r$  denote the variable and  $R$  the final distance to the center of our object,  $d$  the distance to a mass element  $dM$  which composes our object,  $r'$  the distance from the center of the object to  $dM$ , and  $\theta$  and  $\phi$  angles as depicted in the below for the purpose of our integration to express the location of our mass element  $dM$  in terms of polar coordinates from the center of our object. Thus for the purpose of our integration to find an expression for  $V$  – our variables are  $d$  or  $r$ ,  $r'$ ,  $\theta$  and  $\phi$ . Let  $R'$  be the radius of an object and let  $\rho(r')$  denote the density of an object as a function of  $r'$ . For a given object and for the purpose of our integration –  $R'$  and  $\rho(r')$  are our parameters.

Diagram 10: The Exact Gravitational Gradient caused by One Object



To find  $V$  at any point in space, we need to integrate the contributions to  $V$  caused by every  $dM$  of our object as depicted in the above diagram. Hence

$$V = \int_{r=\infty}^R \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} -\frac{GdM}{d^2} dd \tag{131}$$

By substitution (see diagram 10) we get

$$V = \int_{r=\infty}^R \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} -\frac{G\rho(r')r'^2 \sin\phi d\phi d\theta dr'}{r\sqrt{r'^2 + r^2 - 2r'r \cos\theta \sin\phi}} dr \tag{132}$$

which is difficult to solve – so we stop here.

To find  $V$  at some point in space caused by several objects of masses  $M1, M2, \dots$ , we have to consider all of the contributions to  $V$  the following way:

$$V = \int_{r=\infty}^R \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} -\frac{GdM1}{d^2} dd + \int_{r=\infty}^R \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} -\frac{GdM2}{d^2} dd + \dots \quad [133]$$

This allows us to find our factor  $x = 1 + V$ , considering we change the units of  $G$ . If the density of space indeed varies by a factor determined purely by this Newtonian gravitational potential without there being another relation hiding in nature, then our x-factor by which the energy content and frequency of clocks changes by equations [131] and [132], is in the millions ( $\sim 62.5$  million), but so is that of a man 100km above us (61.5 million). From there we can backwards calculate the i.e. energy content  $E_o$  under no influence of gravity, as well as  $\mu_o * \epsilon_o$  of ungravitated space, i.e.

$$\mu_o * \epsilon_o = \frac{\mu * \epsilon}{x} \quad [134]$$

With an x-factor in the millions on the surface of earth, matter would contribute a larger amount of change to space, than ungravitated space describes itself. The question arises whether the fabric of space exists in the absence of matter. But if the fabric of space only existed as an extension of matter, gravitational potentials around matter would not stay put over time but stretch out with the expansion of the universe leading to a change in the gravitational constant  $G$ . But this is not the case. Hence the fabric of space exists independently from the presence of matter – agreeing with our understanding of matter being a disturbance in such.

Now, to consider the impact from one object onto the other, we need to consider the mass-distribution of the second object in a sense that every  $dM$  of the first object acts onto every  $dm$  of the second object – or that every  $dm$  of the object of interest is subject to the scalar value at its location. If we imagine we had solved the prior integral [132] to an expression in the form of  $V = B/R$  (where  $B$  is a placeholder containing the gravitational constant  $G$  in its usual units), equation [133] would solve to

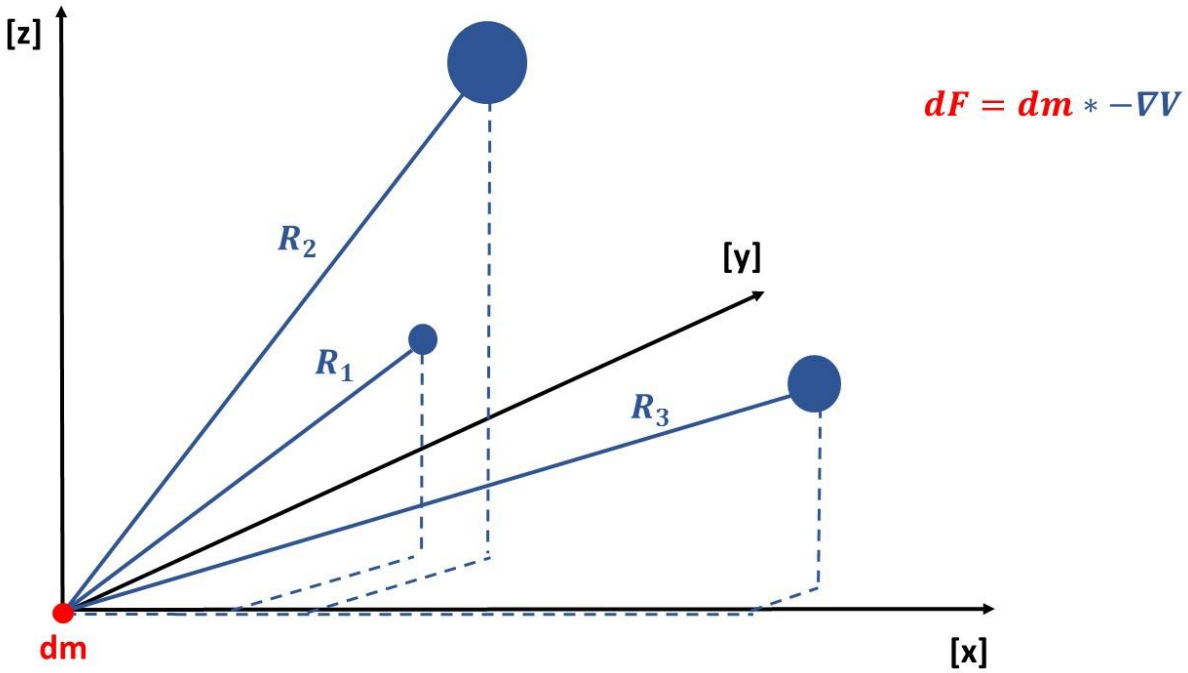
$$V = \frac{B_1}{R_1} + \frac{B_2}{R_2} + \frac{B_3}{R_3} + \dots \quad [135]$$

such that  $\nabla V$  is in the units of  $m/sec^2$ . Then the force onto any point of an object can be described as

$$dF = dm * -\nabla V \quad [136]$$

where the minus sign implies acceleration into the direction of larger values of the scalar field  $V$ . To be able to find the gradient, we need to assign space with directions in form of a Cartesian coordinate system. Let the center of the object of interest which is subject to the gravitational field, be at the center of this coordinate system such that the distances to the objects causing the gravitational field are described in diagram 11 below.

Diagram 11: Force experienced by a Point-Particle



We can now express  $V$  at the location of  $dm$  as

$$V = \frac{B_1}{\sqrt{x_1^2 + y_1^2 + z_1^2}} + \frac{B_2}{\sqrt{x_2^2 + y_2^2 + z_2^2}} + \frac{B_3}{\sqrt{x_3^2 + y_3^2 + z_3^2}} + \dots = T_1 + T_2 + T_3 + \dots \quad [137]$$

And because

$$\nabla V = \frac{\delta T_1}{\delta x} \hat{i} + \frac{\delta T_1}{\delta y} \hat{j} + \frac{\delta T_1}{\delta z} \hat{k} + \frac{\delta T_2}{\delta x} \hat{i} + \frac{\delta T_2}{\delta y} \hat{j} + \frac{\delta T_2}{\delta z} \hat{k} + \frac{\delta T_3}{\delta x} \hat{i} + \frac{\delta T_3}{\delta y} \hat{j} + \frac{\delta T_3}{\delta z} \hat{k} + \dots \quad [138]$$

or

$$\nabla V = \left( \frac{\delta T_1}{\delta x} + \frac{\delta T_2}{\delta x} + \frac{\delta T_3}{\delta x} + \dots \right) \hat{i} + \left( \frac{\delta T_1}{\delta y} + \frac{\delta T_2}{\delta y} + \frac{\delta T_3}{\delta y} + \dots \right) \hat{j} + \left( \frac{\delta T_1}{\delta z} + \frac{\delta T_2}{\delta z} + \frac{\delta T_3}{\delta z} + \dots \right) \hat{k} \quad [139]$$

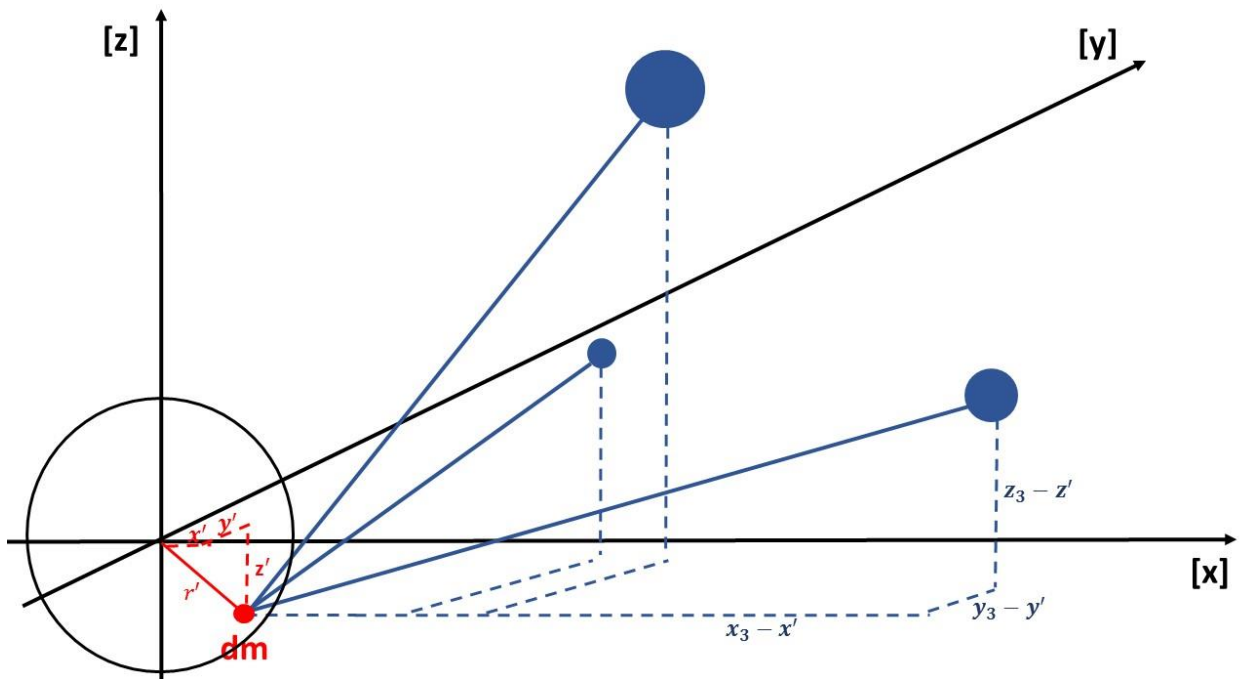
we get

$$dF = -dm * \left[ \left( -\frac{x_1 B_1}{(x_1^2 + y_1^2 + z_1^2)^{\frac{3}{2}}} - \frac{x_2 B_2}{(x_2^2 + y_2^2 + z_2^2)^{\frac{3}{2}}} - \dots \right) \hat{i} + \left( -\frac{y_1 B_1}{(x_1^2 + y_1^2 + z_1^2)^{\frac{3}{2}}} - \frac{y_2 B_2}{(x_2^2 + y_2^2 + z_2^2)^{\frac{3}{2}}} - \dots \right) \hat{j} + \left( -\frac{z_1 B_1}{(x_1^2 + y_1^2 + z_1^2)^{\frac{3}{2}}} - \frac{z_2 B_2}{(x_2^2 + y_2^2 + z_2^2)^{\frac{3}{2}}} - \dots \right) \hat{k} \right] \quad [140]$$

$$\|dF\| = dm * \sqrt{\left( \frac{x_1 B_1}{(x_1^2 + y_1^2 + z_1^2)^{\frac{3}{2}}} - \frac{x_2 B_2}{(x_2^2 + y_2^2 + z_2^2)^{\frac{3}{2}}} - \dots \right)^2 + \left( \frac{y_1 B_1}{(x_1^2 + y_1^2 + z_1^2)^{\frac{3}{2}}} - \frac{y_2 B_2}{(x_2^2 + y_2^2 + z_2^2)^{\frac{3}{2}}} - \dots \right)^2 + \left( \frac{z_1 B_1}{(x_1^2 + y_1^2 + z_1^2)^{\frac{3}{2}}} - \frac{z_2 B_2}{(x_2^2 + y_2^2 + z_2^2)^{\frac{3}{2}}} - \dots \right)^2} \quad [141]$$

where inserting the x,y,z coordinates with their correct signs, yields the correct direction of the gradient and force within our coordinate system. If we would approximate our i.e. apple as a point particle of mass  $m = dm$  at the origin of our coordinate system, we would be done, with  $F = dF$  describing the force on the apple. But even though this would yield a good approximation for an apple, it would not yield a good approximation for larger objects – where each larger object is affected by the other larger objects. Let us center one such larger object at the center of our coordinate system as depicted in the below diagram 12. We have previously found a description for the field caused by any amount of large objects onto any point in space, and thus onto the location of every  $dm$  that composes our object of interest.

Diagram 12: Force experienced by an Object



We now need to understand the total force onto our object of interest, as the sum of the forces acting onto every  $dm$ . Hence

$$F = \int dF = \int dm * -\nabla V \quad [142]$$

It again holds that

$$dm = \rho(r') * r'^2 dr' \sin\phi d\phi d\theta \quad [143]$$

But we must consider the distances from the centers of the masses that describe our field, to the  $dm$  of interest as the difference of the coordinates, such that

$$\nabla V = \frac{(x_1 - x')B_1}{\sqrt{(x_1 - x')^2 + (y_1 - y')^2 + (z_1 - z')^2}^3} \hat{i} + \frac{(y_1 - y')B_1}{\sqrt{(x_1 - x')^2 + (y_1 - y')^2 + (z_1 - z')^2}^3} \hat{j} + \dots \quad [144]$$

In the above equation  $x_1, y_1, z_1$  etc. are parameters. We however need to convert  $x', y'$  and  $z'$  into polar coordinates, to be able to form and solve integral [142] with [143] and [144] substituted. If we do such it follows, considering a simplified example for the contribution of object 1 to the field alone, that

$$F = \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} \rho(r')r'^2 dr' \sin\phi d\phi d\theta * \frac{-(x_1 - r' \sin\phi \cos\theta)B_1}{\sqrt{(x_1 - r' \sin\phi \cos\theta)^2 + (y_1 - r' \sin\phi \sin\theta)^2 + (z_1 - r'(-\cos\phi))^2}^3} \hat{i} + \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} \rho(r')r'^2 dr' \sin\phi d\phi d\theta * \frac{-(y_1 - r' \sin\phi \sin\theta)B_1}{\sqrt{(x_1 - r' \sin\phi \cos\theta)^2 + (y_1 - r' \sin\phi \sin\theta)^2 + (z_1 - r'(-\cos\phi))^2}^3} \hat{j} + \int_{r'=0}^{R'} \int_{\phi=0}^{\pi} \int_{\theta=0}^{2\pi} \rho(r')r'^2 dr' \sin\phi d\phi d\theta * \frac{-(z_1 - r'(-\cos\phi))B_1}{\sqrt{(x_1 - r' \sin\phi \cos\theta)^2 + (y_1 - r' \sin\phi \sin\theta)^2 + (z_1 - r'(-\cos\phi))^2}^3} \hat{k} \quad [145]$$

For more contributions to the field causing the force onto our object of interest, the i-hat, j-hat and k-hat components of other contributors simply have to be added to the above expression vectorially.

To model dynamics of the bodies of our solar system, it makes sense to consider the x,y and z components separately, to via a numerical method determine the change of x,y and z location respectively over time dictated by the acceleration as calculated at a prior location. A spreadsheet to enable such numerical solution could look the following:

Table 1: Gravitational Dynamics

|       | S u n |           |            |       |           |            |       |           |            | M e r c u r y |           |            |       |           |            |       |           |            | ... |
|-------|-------|-----------|------------|-------|-----------|------------|-------|-----------|------------|---------------|-----------|------------|-------|-----------|------------|-------|-----------|------------|-----|
|       | x     |           |            | y     |           |            | z     |           |            | x             |           |            | y     |           |            | z     |           |            |     |
|       | $x$   | $\dot{x}$ | $\ddot{x}$ | $y$   | $\dot{y}$ | $\ddot{y}$ | $z$   | $\dot{z}$ | $\ddot{z}$ | $x$           | $\dot{x}$ | $\ddot{x}$ | $y$   | $\dot{y}$ | $\ddot{y}$ | $z$   | $\dot{z}$ | $\ddot{z}$ |     |
| $t_0$ | $x_0$ | $v_{x_0}$ | 1          | $y_0$ | $v_{y_0}$ | 1          | $z_0$ | $v_{z_0}$ | 1          | $x_0$         | $v_{x_0}$ | 1          | $y_0$ | $v_{y_0}$ | 1          | $z_0$ | $v_{z_0}$ | 1          |     |
| $t_1$ | 3     | 2         | 4          | 3     | 2         | 4          | 3     | 2         | 4          | 3             | 2         | 4          | 3     | 2         | 4          | 3     | 2         | 4          |     |
| ....  |       |           |            |       |           |            |       |           |            |               |           |            |       |           |            |       |           |            |     |

From the initial locations of the other members of the solar system, placeholder 1 of a given member is determined according to equation 14 considering that  $a = F/m$ . But if we now know the accelerations of all solar system bodies, by knowing their initial velocities we can determine their change in velocity after a tiny amount of time to use the approximation  $v_1 = v_0 + a\Delta t$ . But likewise we can then determine the next coordinates of our bodies via  $x_1 = x_0 + v_0\Delta t + 1/2a\Delta t$ . Then we use these new coordinates to calculate entry 4 and so on.

Now there is one detail still missing to describe an exact dynamical model. And that is that the mass of a body changes depending on the potential it is subject to. Considering table 1 to be numerically modeling

the gravitational dynamics of the solar system, we should at every step in time correct the masses of the body by adding their correct  $\Delta U/c^2$  in a numerical process.  $\Delta U_n = U_n - U_{n-1}$  must be determined for each body and step, by calculating the change in potential between these infinitesimal steps. To make this task doable, it may be a suitable approximation to employ equation 133 to calculate the potentials  $V_n$  and  $V_{n-1}$  at the center of each object (multiplied by the mass of the object) at each step during the numerical process from the coordinates of the other bodies, and add the difference divided by  $c^2$  to the according mass within this numerical process.

### Relevance for Cosmology

If light experiences a blueshift through gravity, by encountering a higher density of space which slows its forward motion, then in an earlier universe with a higher matter density, light was blueshifted by gravity to a larger degree than today. But if this effect -which is a new result from the present manuscript- would not be, galaxies in the past would be redder than they appear to us. So to correct for this effect, we have to additionally multiply the measured wavelength of past and present galaxies by the square root of the x-factor determined of the energy density in the past or present universe, to appreciate that

$$\frac{\lambda_{past}}{\lambda_{present}} = \frac{\sqrt{x_{present}}}{\sqrt{x_{past}}} \quad [146]$$

So the further a galaxy is in the past, the effectively redder it should be considered than it appears to us – because if the blueshift towards the past due to the x-factor would not be – it would be that much redder. This may put the acceleration of the universe into doubt, but slow the expansion down.

### Gravitational waves

We understand gravitational waves as the propagation a disturbance in the energy density of space caused by moving bodies, mathematically following the same mechanisms as those described in chapter 3.4. for electromagnetic waves.

### Other Thoughts on Gravity

I would like to experimentally determine whether EM radiation, or whether only inertial-matter causes the phenomenon of gravity. An experiment could be to weight two identical boxes, one of which contains free EM radiation bouncing between mirrors which is not absorbed into matter. If only inertial matter caused gravity there should make no difference until the EM radiation is absorbed into the rest matter of the box.

## **Summary and Conclusions**

If you sent a clock with almost the speed of light to your right but with half the speed of light to your left, you would have correctly expected the clock you sent to your right to have recorded less cycles than the clock you sent to your left, despite their relative velocity being the same for both.

Hafele and Keating's predictions demonstrate that people intuitively expected motion to have meaning in an absolute sense. This demonstrates that the essence of this manuscript already exists within peoples' minds, awaiting clarification.

In summary we have shown, that motion has meaning in an absolute, observer independent sense, and that unaccelerated motion causes matter to age slower.

Direct comparison of atomic clocks is the key and an essential tool, to deduce the absolute, observer independent picture of reality.

The speed of light is constant in absolute terms and measures  $c$  in the universal restframe, which can be determined by the experiment proposed in theoretical part 3.

Absolute motion can hence be understood and determined as motion relative to EM radiation which propagates at a fixed, absolute speed  $c$ .

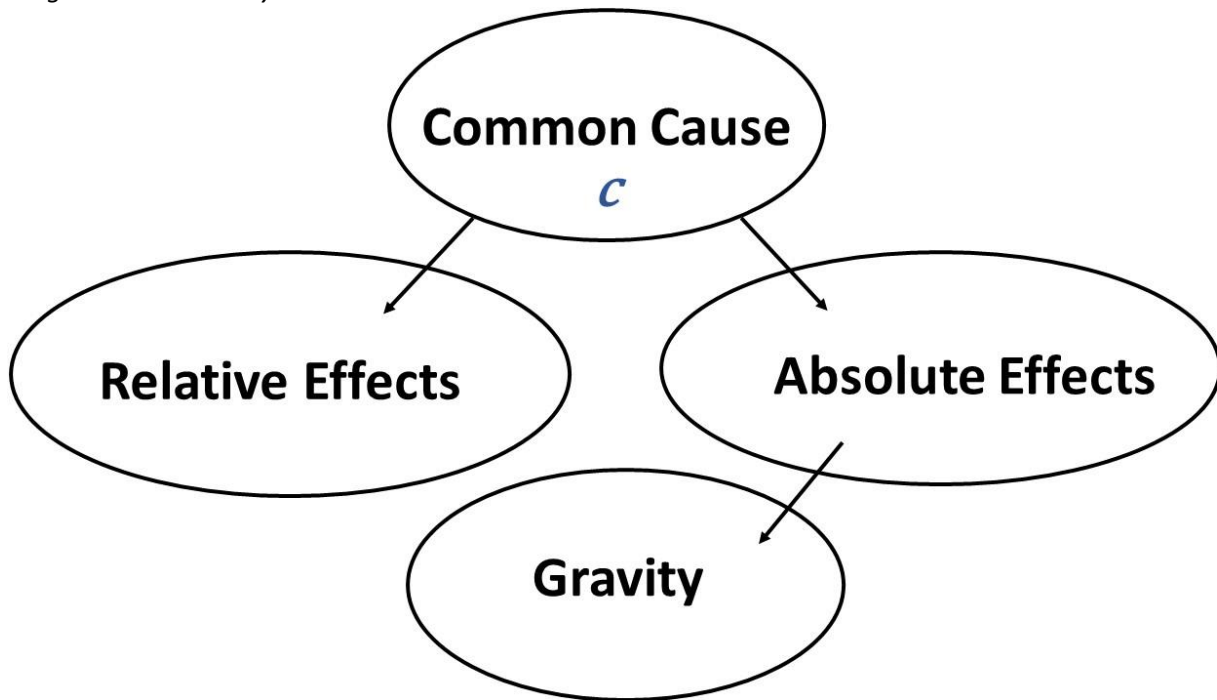
Being at rest relative to an event means being at absolute rest, because an event occurs at one designated place.

Relativistic effects do not explain but share a common cause with the absolute effects, which rests in the fixed speed at which a disturbance propagates through the fabric of space.

Gravity causes matter to age slower for a shared reason as motion.

An increased energy density of the fabric of space surrounding matter is the likely physical cause behind the phenomenon of gravity.

Diagram 13: Summary



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