Re-thinking the foundation of physics its relation quantum gravity and quantum probabilities. Unification of Gravity and Quantum Mechanics!

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Abstract

In this paper we will show that standard physics to a large degree consist of derivatives of a deeper reality. This means standard physics is both overly complex and also incomplete. Modern physics have mostly started from working with first understanding the surface of the world, that is typically the macroscopic world, for then to make theories about the atomic and subatomic world. And we did not have much of a choice, as the subatomic world is very hard to observe directly, if not impossible to observe directly at the deepest level. Despite the enormous success of modern physics, it is therefore no big surprise that we possibly at some point can have taken a step in the wrong direction. We will claim that one such step came when one thought the de Broglie wavelength represented a real matter wavelength. We will claim that the Compton wavelength is the real matter wavelength. Based on such a view we will see many equations of modern physics only are derivatives of much simpler relations. Second, we will claim one in today's physics uses two different mass definitions, one more complete mass definition embedded in gravity equations without being aware of it, as it is concealed in GM, and the standard, but incomplete kg mass definition in non-gravitational physics. First when this is understood, and one uses the more complete mass defection that is embedded in gravity physics, not only in gravity physics, but in all of physics one has a chance to unify gravity and quantum mechanics. Our new theory shows that most physical phenomena when observed over a very short time scale are probabilistic for masses smaller than a Planck mass and deterministic above Planck mass size.

Our findings have many implications, for example we show that the Heisenberg uncertainty principle is rooted in a fundament not valid for rest-mass particles, so the Heisenberg uncertainty principle can say nothing about rest-masses. When re-formulated based on a fundament compatible with a new momentum compatible also with rest-masses a re-defined Heisenberg principle that seems to become a certainty principle in the special case of a Planck mass particle. Further we show that the Planck mass particle is linked to gravity and that we easily can detect the Planck scale from gravity observations. The Planck mass particle is very unique as it only lasts the Planck time, and in that very short time period only can be observed directly from itself, and that it therefore is closely linked to rest. As we show the fundament of the standard Heisenberg uncertainty principle not is compatible with rest-mass particles and also standard quantum mechanics, it is no big surprise that one not has been able to unify gravity with quantum mechanics. Our new theory show that probabilistic effects are dominating for masses significantly below the Planck mass, and that determinism rules masses from the Planck mass size and upwards. We are also presenting a new differential equation showing the relation between mass and energy and also gravity. Further we are also developing a new relativistic quantum wave equation, that also is consistent with gravity. Our theory only depend on two universal constants, l_p and c, compared to standard theory that depends on G, c and $\hbar$.

Key Words: quantum mechanics, de Broglie wavelength, Compton wavelength, quantum mechanics, gravity.

1 Introduction

First of all since we use a series of variables and parameters in this paper and also considerably new notation, we will start by providing a list of symbols (Table 1), as a preface to our paper.

Our beginning of understanding of physics started long time ago, as technical instruments with high precession where not well developed at the early stage, it was natural that such a theory started mainly from top down studies. That is by observing macroscopic easily observable phenomena and how they behaved, and then based on this try to come up with models and theories that also could describe the deeper not directly observable reality. Still, even in ancient times there existed also bottom up theories. Ancient atomism [1–3] was such a theory, it assumed everything consisted of indivisible particles and empty space (void). Based on such a simple

Symbol	Represents (standard notation)
h	Planck constant.
$\hbar$	reduced Planck constant.
r_s	Schwarzschild radius.
g	gravity acceleration.
G	Newtons gravity constant.
δ	Deflection off light angle (light bending angle in a gravitational field).
ω	frequency, used for cyclotron frequency, but also for Compton frequency in wave equation.
f	frequency, used for reduced Compton frequency.
q	charge.
B	uniform magnetic field.
c	speed of light.
v	velocity.
λ_γ	Photon wavelength.
λ	Compton wavelength.
$\bar{\lambda}$	Reduced Compton wavelength.
λ	de Broglie wavelength.
$\bar{\lambda}_b$	Reduced de Broglie wavelength.
λ_e	Compton wavelength electron.
$\bar{\lambda}_e$	Reduced Compton wavelength electron.
m	Rest mass in kg.
$\bar{\lambda}_M$	reduced Compton wavelength of the large mass in the Newton formula.
m_e	rest mass of electron in kg.
m_P	rest mass of proton in kg.
m_p	Planck mass in kg.
l_p	Planck length.
t_p	Planck time.
$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$	Lorentz factor
$p = mv\gamma$	Standard momentum (de Broglie momentum).
E	energy, used for both rest-mass energy and total energy.
E_k	kinetic energy.
Ψ	wave function
New definitions:	
$p_t = mc\gamma$	total Compton momentum based on kg mass.
$p_r = mc$	rest-mass Compton momentum based on kg mass.
$p_k = mc\gamma - mc$	kinetic Compton momentum based on kg mass.
$\bar{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}$	rest mass defined as collision-time.
$\bar{m}_e = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}_e}$	rest mass electron defined as collision-time.
$\bar{m}_P = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}_e}$	rest mass proton defined as collision-time.
$\bar{m}\gamma = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}\gamma$	relativistic collision-time mass.
$p_t = \bar{m}c\gamma$	total Compton momentum based on collision-time mass.
$p_r = \bar{m}c$	rest-mass Compton momentum based on collision-time mass.
$p_k = \bar{m}c\gamma - mc$	kinetic Compton momentum based on collision-time mass.
$\bar{E} = \bar{m}c$	rest mass energy defined as collision length.
$\bar{E} = \bar{m}c\gamma = l_p\frac{l_p}{\bar{\lambda}}\gamma$	energy defined as collision length, symbol used for both rest-mass energy and total energy.
$\bar{E}_k = \bar{m}c\gamma - \bar{m}c$	kinetic energy defined as collision length.
$P_c = \frac{l_p}{\bar{\lambda}}\gamma$	collision-state probability.
$P_n = 1 - \frac{l_p}{\bar{\lambda}}\gamma$	no-collision probability.
$\hat{\bar{p}}_t = il_p^2\nabla$	Total Compton momentum operator with respect to space x.
$\hat{\bar{E}} = il_p\nabla_t$	Total collision-time energy operator with respect to time t.
$v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$	maximum velocity for elementary particles.

Table 1: Symbol list.

theory the ancient atomist where extremely successful at predicting a series of things. For example, Democritus [4, 5] predicted around 500 bc, based on atomism that there had to be binary suns (stars) and a large number of planets, some with life some without life. This was naturally just a theory and we can discuss up and down how sound it was, for example Aristoteles was a big critic of atomism [6]. Based on his writing for example Schrödinger [7] was clearly interested in atomism, but it is unclear if it inspired him to any of his discoveries, we would say probably not. However in recent times it is clear that Democritus at least where correct on his prediction of that the universe contained many planets [8] as well as binary stars. If Democritus was right based on lucky speculations or deep thinking we leave up to other to consider, but we will indeed return to atomism later in this paper.

Still, it was the top down approach that at least until the development of atomic physics and quantum mechanics that has been the dominant approach. And even the quantum mechanics foundation as we will see is based on findings and a fundament laid out by top down principles, and we will claim even top down principles that we will see not necessarily was rooted in experiments, but that at a closer look mainly can be considered an untested hypothesis. When working from top-down principles, then the smallest misunderstanding about the macroscopic world could have massive implications for our theories about the subatomic world. In this paper we will argue for that it has been basically two steps onto the wrong path, that has stopped us from being able to unify quantum mechanics with gravity. We will surprisingly claim of these two erroneous step was how one has held on to the old hypothesis of momentum: $p = mv$. One of the core principles of scientific physics is that something predicted from theory one should be able to observe. One has to be careful here with such statements, as much of the subatomic world is too small for us to in any foreseeable future and perhaps forever to be observed directly, that even by the best technical instruments of the far fetched advanced future. Still theories about the subatomic world should lead to predictions about the observable world that we then can test out and observe. However, the concept of momentum was originally suggested for macroscopic observable objects, so it should be easily observable and test out if: $p = mv$, is a good description of a moving object. Concepts and derivations around momentum is so very well established, that hardly anyone in physics would even think about question our momentum definition. After all, has momentum not been observed over and over again for hundreds of years, is this not one of the best tested corner stones of physics? Well we will ask if anyone can show us how to observed mv. We can observe the kg mass (or pound or similar) of an object m by putting it on a weight (as at least relative mass is proportional to weight in a given gravity field), and we can measure the velocity of the same object when it moves. Velocity is simply how far something move in a given period of time, but we will claim we cannot measure mv, we will claim it is a pure mathematical construct, that we in this paper will prove is never needed. From this mathematical non observable construct, the momentum for anything with mass, de Broglie [9, 10] around 1924 derived what today is known as the de Broglie wavelength, or the matter wave. Further the standard momentum and the de Broglie wavelength are both part of the foundation of quantum mechanics.

Quantum mechanics has been incredible successful in many testable predictions, so such a theory cannot be much wrrong, there must naturally be something to it. Still todays quantum mechanics we will claim shrouded in several what we would could call almost mystical interpretations. We will in this paper try to show that there is another way. There is an alternative and real momentum that easily can be observed, it is the momentum we can derive from the Compton wavelength relation and also observe directly from moving macroscopic objects. The standard momentum and the de Broglie wavelength are both just derivatives (functions) of this real momentum and real matter wavelength. When one understands this, everything gets much simpler. Based on this we will also show that much of today's physics is just mathematical functions (derivatives) of a much simpler and we will claim much more elegant theory.

The second incorrect path we will see was to ignore Newton's original gravity formula and his claim about what matter was. Newton's original gravity formula was $F = \frac{Mm}{r^2}$ and not $F = G\frac{Mm}{r^2}$. If one had held on to this formula, then we will see one had likely long time ago understood that today's mass definition in non-gravitational physics is incomplete and not the same mass as one find embedded in gravity equations, but as we will show unknowingly so concealed in GM. The only way to get Newton's original mass formula to work is to use a mass definition that gives us a theory that makes quantum mechanics and gravity consisted. Naturally, Newton knew nothing about this. We will see how the gravity constant G, that Newton never invented nor used is simply a way to transform the incomplete kg mass definition into a complete mass definition. First when one understands this in combination with that the Compton wavelength is the real matter wavelength and that the de Broglie wavelength is a derivative (function of the Compton wavelength) then one gets a much simpler theory, that also seems able to let us unify key concepts in gravity with quantum mechanics. As we will see the world is dominated by probability for masses much smaller than the Planck mass and are dominated by determinism when we get close to the Planck mass and above. Also we will show there is a Planck mass particle that actually are the building blocks off all matter that agin consist of the collision between two light particles. This is a new way to look at physics so we naturally do not ask the reader to take any of this for granted, but we think our theory is rigorous enough and at the same time that it simplify and makes physics easier to understand. Based on this we think it deserves at least to be considered and discussed, to find out if this is on the right path to a unified theory, or just another step into the desert.

2 Mass, Momentum and Energy

Newton in Principia [11] published in 1686 defined mass as the quantity of matter ("quantities material"). But then what is matter? Newton also had a clear idea about this, he stated in the third part of his book Principia, that mostly was about gravity, that behind all his philosophy was the idea about indivisible particles, and that they also had extension in space, and was movable. This was an idea he likely had got from the ancient atomists. One could claim Newtons idea about indivisible particles was speculative as there seems to have been no way Newton could prove this, at least not in his time. If mass is the quantity of matter, and matter ultimately consist of indivisible particles, then these indivisible particles must be incredibly small. Newton held on to this view also in his later years, as he repeated this view on matter also in his book Opticks [12] published in 1704 .

Newton also repeatedly pointed out that mass was proportional to weight for bodies measured in the same gravity field, that was at the same distance from a large massive object, such as the Earth, something we know fits experiments to this day. In gravity theory today we have not got much further on understanding mass. Mass is defined as kg (or we could use pound), and kg is linked to weight in a gravity field (we are coming back to the 2019 kilogram definition that is linked to the Planck constant), but since mass is proportional to weight this works well for many purposes. In quantum mechanics we have got a bit deeper on matter, where it is assumed matter has a form of wave-particle duality, as likely first suggested by de Broglie, an hypothesis, partly confirmed by experiments, that much of quantum mechanics again was built on. Still we have not been able to build a bridge between quantum mechanics and gravity. Prof. Jammer [13] in his work on mass states: "*mass is a mess*" – his point is that we still do not really understand what mass is. And Feynman putting it a bit on the edge with a pinch of humor said "*It is important to realize that in physics today, we have no knowledge what energy is.*". Despite Feynman's humoristic tone, it is also something to this, here we are about hundred years after introduction of general relativity theory and quantum mechanics, and we have still not been able to unite the "forces" of the macroscopic and the subatomic world, and we likely do not fully understand what energy and mass is at the deepest level, but may be there is still hope.

Here we will show that embedded in Newtons gravity theory, after calibrated to a gravity observation, that one has basically hidden in the formula, without knowing so, a new embedded a mass definition that is very close to Newtons original idea, that matter ultimately consisted of indivisible particles and that there even existed indivisible moments of time (as Newton called it). Further it will be clear that these indivisible particles have physical extension as Newton also mentioned, and that they were movable. We naturally do not mean Newton was hiding such things in his gravity formula on purpose. But as we will see the gravity constant G can be seen as just a parameter for what is missing in the model when one uses a certain mass definition like the kg definition or similar concepts, like for example pound. When calibrating the model to observable gravity phenomena, one are able to indirectly get into the model several things that are missing from its assumptions. This naturally on the condition that these missing things already are embedded in observable gravity phenomena, something we soon will demonstrate is the case. And in non-gravitational physics we are using a different mass definition, the standard kg mass definition, that we will show is incomplete. So indirectly one are in modern physics using a complete mass definition, that is embedded and hidden mass definition in gravity theory, and an incomplete mass definition in non-gravitational theory. First when one truly understand this can one build a bridge between quantum mechanics and gravity, something we will try to do an attempt at here, but without claiming we have a complete theory, but simply that we are on a new and interesting path that likely deserve more attention among researchers.

Let's first go back to today's mass definition. Often, we are only interested in how many kg a mass has, that is we are often just operating with the kg definition of mass. The kg definition of mass is originally an arbitrary clump of matter (quantity of matter) likely chosen to be the standard for weight, and since mass is proportional to weight then it is also a measure for mass. In many if not most physical formulas, that is related to mass, it is the amount of kg this mass has, that one need as input in the formula to do calculations and thereby predictions that can be compared to observations. The kg most likely originated partly from trade. In business it is very important to have a standardized measure of weight. The mass size of the kg was likely chosen so it was not so light that the weight got inaccurate based on weight equipment used at that time. Also, it could not be so heavy that it not easily could be transported. Well enough on that, one could write a whole book about the history of the kg definition. The Planck constant h that was introduced by Max Planck has output units $kg \cdot m^2 \cdot s^{-2}$, so the Planck constant contains kg. From 2019 the kg was re-defined om the basis of the Planck constant by using a watt balance, see [14–16]. This lead us to the important question, exactly how kg is linked to the quantum world, the Planck constant is after all considered to be linked to quantization of energy. We will claim the simplest way to express the rest-mass in terms of kg in terms of constants and parameters linked to the quantum world is by the following formula

$$m = \frac{h}{\lambda}\frac{1}{c} = \frac{\hbar}{\bar{\lambda}}\frac{1}{c} \tag{1}$$

where h and $\hbar$ are respectively the Planck constant and the reduced Planck constant, and λ and $\bar{\lambda}$ are respectively the Compton wavelength and the reduced Compton wavelength, and c is the speed of light. This mass formula one simply get by solving the Compton [17] wavelength formula $\lambda = \frac{h}{mc}$, with respect to m. This formula we can say both incorporate a wavelength, and thereby could be linked to wave-property of matter, as well as quantization of matter as the Planck constant, $\hbar$, is linked to quantization (normally of energy). We will come back to later exactly how we think the Planck constant is linked to quantization, it is far from clear until understood from a deeper perspective. In addition, to perhaps some readers surprise, we have the speed of light there even just to describe a rest-mass, and we will soon understand why.

It is traditionally the de Broglie wavelength that is linked to matter wavelength's and not the Compton wavelength. However, one cannot express a rest-mass in terms of the de Broglie wavelength, this because the de Broglie wavelength [10, 18] is given by $\lambda_b = \frac{h}{mv}$, and since it is not mathematically defined to divide by zero, then the de Broglie wavelength simply do not exist for rest-mass particles. We could argue, based on the Heisenberg uncertainty principle, that a particle never stand absolutely still, and that when v approaches zero the de Broglie wavelength simply approaches infinite. This is may be why several physicists have claimed the de Broglie wavelength is infinite for rest-mass particles, see for example [19]. Still an electron almost at rest with an infinite wavelength seems absurd in our view. Infinite or close to infinite wavelength has naturally never been observed, even if one always could claim one have observed it indirectly. And we think several of the interpretations of the de Broglie wavelength for rest or close to rest-mass particles are just absurd, such as

"*The de Broglie wave has infinite extent in space*" – A. I. Lvovsky. [20]

and there is no clear agreement on how to interpret the infinite de Broglie wavelength, as seen for example by reading the well known book by Max Born [21] :

> "*Physically, there is no meaning in regarding this wave as a simple harmonic wave of infinite extent; we must, on the contrary, regard it as a wave packet consisting of a small group of indefinitely close wave-numbers, that is, of great extent in space.*" – M. Born

On the other hand the Compton wavelength have indirectly been measure many times, and for example the reduced Compton wavelength of an electron with velocity $v << c$ is in the order off approximately 3.86×10^{-13} m, which indeed is a distance not so far from other quantum distances we are aware of, such as for example the radius of the proton (approximately 10^{-15} m). The formula for the Compton wavelength and the de Broglie wavelength given above are non-relativistic. The relativistic formulas for the de Broglie wavelength and the Compton wavelength are given by

$$\lambda_{b,r} = \frac{h}{p} = \frac{h}{mv\gamma}, \qquad \lambda_r = \frac{h}{mc\gamma} \tag{2}$$

where $\lambda_{b,r}$ is the relativistic de Broglie wavelength, and λ_r is the relativistic Compton wavelength, and $\gamma = 1/\sqrt{1 - v^2/c^2}$.

The relativistic de Broglie wavelength was introduced by Broglie himself. To our own surprise we have not found a single paper on deriving a full relativistic Compton wavelength[1], even if it trivial. So we wrote a short paper on the derivation of the relativistic Compton wavelength ourselves [22]. The original Compton wavelength formula assume the electron initially is at rest. Overall the de Broglie wavelength seems to have got much more attention than the Compton wavelength. For example the wave function in the Schrödinger and the Klein Gordon equation are directly linked to the de Broglie wavelength, based on how it is set up based on momentum[2], see fore example [23].

After Einstein's [24] explanation of the photoelectronic-effect it was clear that light had both particle and wavelike properties. Further from Einstein's special relativity theory it was clear that the photon wavelength was related to the photon momentum by the formula $\lambda_\gamma = \frac{h}{p_\gamma}$, where p_γ is the photon momentum, and λ_γ is the photon wavelength. In his PhD thesis, de Broglie was likely inspired by Einstein's relation between photon momentum and the photon wavelength, and speculated that also matter likely had wave-like properties. The natural bust guess was then likely to assume also the matter wavelength was linked to the momentum, as it was assumed to be the case for the photon, and he suggested that the matter wavelength was given by $\lambda_b = \frac{h}{p}$, where p was the momentum of the mass in question. De Broglie's PhD supervisor sent his thesis to Einstein, to get his views on it. And Einstein liked the idea and basically endorsed this hypothesis. In 1927 it was experimentally confirmed that electrons had wavelike properties, see [25, 26]. These experiments are claimed to have confirmed the de Broglie hypothesis. However, all that was shown in these experiments was that matter also had wavelike properties as indeed first suggested by de Broglie , it was however not necessarily a measurement or detection of the de Broglie wavelength. It is easily forgotten that Arthur Compton at almost the same time suggested and indirectly measured a wavelength linked to the electron that today is known as the Compton wavelength, from so called Compton scattering. Compton's paper was however much more experimental focused, while de Broglie paper was more about deeper (mathematical) philosophy about the possible properties of matter. The idea from de Broglie that matter had wave-like properties and a wavelength we think was brilliant, but we will see that the wavelength formula he suggested as understood from a deeper perspective likely is just a mathematical derivative (function) of the real matter wavelength, that we will claim is the Compton wavelength.

From the two formulas above (see 2), we can see that the de Broglie wave always is equal to the Compton wavelength multiplied by $\frac{c}{v}$. One can ask why is there two matter wavelength and not only one? Photons do not have two different wavelengths, in particular not one that are short at the same time the other one is close to infinite. We agree that de Broglie was correct in his hypothesis that matter had wavelike properties also, but we will claim his theoretical wavelength is just a mathematical derivative of the real matter wavelengths that we will claim is the Compton wavelength. Why would there be such a simple relation between, $\lambda_b = \lambda \frac{c}{v}$ them if they not where directly related? We have already seen that the Compton wavelength holds for also rest-mass particles, while the de Broglie wavelength is not defined in that case. We will argue that the hypothesis that the de Broglie wave is a real matter wavelength and not only a derivative of the Compton wavelength has led modern physics to develop a whole theory that is just a mathematical derivative of a simpler and more robust theory. But this actually goes all the way back to the definition of momentum, something we will get back to soon.

That the de Broglie wavelength not is valid for rest-mass particles we will show is part of the reason one not has been able to unify gravity with quantum mechanics. But, back to the kg mass first. It is clear that we

[1]Not that we know every paper published in physics.
[2]At least the Plane wave solution.

not can describe a rest-mass with the de Broglie wavelength, the closest we can come is solving the de Broglie formula with respect to the mass gives

$$m = \frac{h}{\lambda_b}\frac{1}{v}\gamma = \frac{h}{\lambda_{b,r}}\frac{1}{v} \tag{3}$$

where $\lambda_{b,r} = \lambda_b/\gamma$. And again, we cannot divide by zero, so this formula can not be valid for $v = 0$. This formula is not valid for rest-mass particles. However we can describe all rest masses in terms of kg with formula 1, that is based on the Compton wavelength, and also moving masses in terms of kg by simply solving the relativistic Compton wavelength formula with respect to m, this gives

$$m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}\gamma = \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{c} \tag{4}$$

That is we have established a very simple mathematical link between the kg definition of mass and quantum parameters and constants. Still the formula 1 or in relativistic form 4 seems to give limited intuition. However if we slightly re-write the formula we get

$$\frac{\hbar}{\bar{\lambda}}\frac{1}{c} = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}\frac{c}{c} = \frac{\frac{c}{\bar{\lambda}}}{\frac{c^2}{\hbar}} = \frac{\frac{c}{\bar{\lambda}}}{\frac{c}{\frac{\hbar}{1\times c}}} = \frac{f}{f_{1kg}} \tag{5}$$

That is the kg mass formula we got from the Compton formula can be interpreted as a frequency ratio. It is the reduced Compton frequency of the mass we are interested in f, divided by the reduced Compton frequency of one kg, f_{1k}, or we could take the two Compton frequencies instead of the reduced Compton frequencies, as this will give the same ratio and numerical outputs. So we will claim the quantity of matter is linked to some frequency inside the matter. We will later on discuss if macroscopic masses like one kg actually can have a Compton wavelength and thereby a Compton frequencies. The reduced Compton frequency of one kg is given by

$$f_{1kg} = \frac{c}{\bar{\lambda}_{1kg}} = \frac{c}{\frac{\hbar}{1kg\times c}} \approx 8.52\times 10^{50} \text{ per second} \tag{6}$$

and to find the kg mass of any mass, we just need to know its reduced Compton frequency, for an electron it is

$$f_e = \frac{c}{\bar{\lambda}_e} \approx 7.76\times 10^{20} \text{ per second} \tag{7}$$

and we get the electrons kg mass equal to $m_e = \frac{f_e}{f_{1kg}} \approx \frac{7.76\times 10^{20}}{8.52\times 10^{50}} \approx 9.11\times 10^{-31}\ kg$, which is the well known electron mass. Also note that a particle with reduced Compton frequency of one, has a kg mass of

$$\frac{1}{f_{1kg}} = \frac{1}{8.52\times 10^{50}} \approx 1.17\times 10^{-51} \text{ kg} \tag{8}$$

This is actually identical to the mass equivalent of a a photon with frequency one per second $\frac{E}{c^2} = \frac{\hbar f}{c^2} = \frac{\hbar\times 1}{c^2} \approx 1.17\times 10^{-51}$ kg.

The Planck constant is therefore linked to a reduced Compton frequency of one per second relative to the Compton frequency in one kg. However, at this point it is not exactly clear what is the interpretation of a frequency of one, but we will get back to this soon, first we will get back to momentum. What is important at this state is to understand that one possible deeper interpretation of one kg is that it represent the Compton frequency ration of the mass we are interested in relative to the Compton frequency in one kg.

The idea of the concept of momentum goes back long back before Newton, but somewhat diffusely. Newton in Principia introduced "quantity of motion" arising from the velocity and quantity of matter conjointly. Jennings [27] in 1721 is specifically defining momentum mathematically as how we know it today, namely $p = mv$. Momentum was what we can call an idea or a concept or simply a hypothesis. An important question is if momentum is directly observable even for macroscopic masses. One can find the kg mass of an object, by finding its weight relative to a kg mass. And we can measure the velocity of an object, as velocity simply is the distance an object (or a particle) has moved inside a chosen observational time-window. That is, we can observe m and we can observe v, but to our knowledge we cannot observe mv. The momentum definition is only a mathematical concept (multiplication) of two observable entities. Some will likely protest here and claim momentum is measured all the time, again one then has to think if one actually are observing momentum, that is mv, or simply m and v separately. Even if we will claim momentum do not exist physically, if it is a derivative of a more real momentum that actually can be observed and therefore still contains valuable information that can be used in derivations. One of the most important concepts where momentum appear is in the relativistic energy momentum relation, that is the foundation behind much of modern quantum mechanics. The momentum $p = mv$ is actually only an approximation when $v << c$. The more precise momentum formula is the well-known relativistic formula

$$p = mv\gamma \tag{9}$$

This is basically one has taken the old momentum that was introduced in the past for granted and made it relativistic, after the discovery of relativity theory. When $v << c$ we can approximate the relativistic momentum very well with the first term of a Taylor series expansion, which gives us the well known "ancient" momentum formula $p \approx mv$. But again we will claim mv never have been directly observed. The de Broglie wavelength was calculated from the momentum formula, we repeat it again here $\lambda_b = \frac{h}{p\gamma} = \frac{h}{mv\gamma}$. But if momentum not is observable, then may be standard momentum simply do not exist, except as a mathematical construct. We can also solve the de Broglie formula formula with respect to p this gives

$$p = \frac{h}{\lambda_b}\gamma \tag{10}$$

But then no one has observed the de Broglie wavelength, for example for a particle almost at rest. Such a de Broglie wavelength would extend beyond or solar system, and if v very close to zero it would extend beyond our galaxy and when v close enough to 0 beyond the assumed diameter of the observable universe. One can naturally argue about the interpretation about the de Broglie wavelength and claim our interpretation here is wrong, see for example [28]. More important, again the de Broglie wave is not defined for $v = 0$, so if we then derive the standard momentum from the de Broglie wavelength, or at least requere the momentum to always be consistent with the de Broglie wavelength, then it is not that standard momentum is zero when $v = 0$, the standard momentum simply do not mathematically exist for rest-mass particles. No surprise some will possibly say, because momentum has to do with moving particles, but then things in quantum mechanics derived from the standard momentum can also not say anything about rest-mass particles.

Actually it is when we derive a new momentum from the Compton wavelength formula that we soon will see something very interesting

$$\lambda = \frac{h}{mc\gamma} \tag{11}$$

Solved similar to the way we did to find standard momentum from the de Broglie wavelength formula, the Compton wavelength formula gives us a new momentum that we will call Compton momentum

$$p_t = mc\gamma = \frac{h}{\lambda}\gamma \tag{12}$$

This is more precisely the total Compton momentum, and we use notation, p_t, to distinguish it from the standard momentum p. First of all, this new Compton momentum is also valid when $v = 0$, as $v = 0$ simply makes $\gamma = 1$, and in that special case the formula above simplifies to mc. The Compton momentum when $v = 0$ we can call rest-mass momentum, $p_r = mc$. We can then also define a kinetic momentum which must be given by

$$\bar{p}_k = mc\gamma - mc \tag{13}$$

The kinetic momentum is the momentum of the moving particle. When $v = 0$ the kinetic momentum is zero, but it is not that it is non-defined mathematically as with standard momentum. Second if $v << 0$ we can approximate the kinetic momentum formula very well with the first term of a Taylor series expansion, this gives

$$p_k \approx \frac{1}{2}\frac{mv^2}{c} \tag{14}$$

That is the kinetic momentum for a given rest-mass is a function of v^2 and not v as standard momentum. While mv is non observable, $\frac{1}{2}mv^2/c$ is observable. This brings us all the way back to the discussion on kinetic energy, and as we will see it is linked to the Compton momentum. Historically we know it was a many year debate on if if kinetic energy was a function of v or v^2. In 1686, one year before Newton published his Principia, Leibniz published that kinetic energy (vis viva as he called it: Living force) was proportional v^2 and not v. However that kinetic energy was a function of the squared of velocity and not just proportional to the velocity was not easily accepted. However in 1720 Gravesande [29] performed and published experiments where he had dropped brass balls in clay. If the brass ball had twice the velocity, the indent in the clay was not twice as deep, but approximately four times as deep. And a brass ball with three times the velocity would leave a mark approximately nine times as deep. Clay was an excellent medium here, because one need a medium where a minimum amount of the kinetic energy is used to bounce the ball back. In other words the Gravesande experiment confirmed that kinetic energy was a function of v^2 and not v. Actually the first kinetic energy formula was $E_k = mv^2$, and the half multiplier we are used to was actually first suggested by Bernoulli [30] in 1741. The half multiplier for kinetic energy was discussed in more detail and made popular by Coriolis [31] and Poncelet [32] in the early 19th century.

This bring us back to our Compton momentum, it is proportional to v^2 and not v. It is only different from todays kinetic energy by division by a constant, namely c. To divide or multiply by a constant only in general only changes the output units. We will claim the Compton momentum is much more directly observable, compared to the standard momentum, that is not observable and only calculatable from two things we can observe, namely m and v . Also the wavelength we can predict from the Compton momentum is indirectly observable, and it has as we have discussed a length that indeed is at the scale of what we would expect at the quantum scale, while the hypothetical de Broglie wavelength linked to standard momentum can stretch out beyond our galaxy.

We noticed earlier that the de Broglie wavelength always can be expressed as a function of the Compton wavelength, or opposite, that is $\lambda_b = \lambda\frac{c}{v}$. We have a similar relation between the standard momentum (which is linked to the de Broglie wavelength) and the Compton momentum, namely we always have

$$p = p_t\frac{v}{c} \tag{15}$$

We will claim we have an observable momentum, the Compton momentum and an indirectly observable wavelength, the Compton wavelength, and we have a non-observable momentum, the standard momentum, and a unobservable wavelength with properties that basically seems absurd, the de Broglie wavelength. We will claim that the standard momentum and the de Broglie wavelength is nothing more than mathematical functions of the real momentum and the real matter wavelength. If this is the case it has several important implications for such things as quantum mechanics as we will start to look at in the next section. If we have found the deeper reality a good indication would be that many equations derived from this deeper fundament got simpler and still where able to describe what the existing theory can do, and perhaps that we also could discover something new.

2.1 Implications for quantum mechanics

As we have shown in the section above the standard momentum that is linked to the de Broglie wavelength is not mathematical valid for rest-mass parties. Second the standard momentum is likely a derivative of the real momentum, the Compton momentum. This alone has series of implications for quantum mechanics. A corner stone in the foundation of quantum mechanics is Einstein's relativistic energy momentum relation, that is given by

$$E^2 = p^2c^2 + m^2c^4 \tag{16}$$

where $p = mv\gamma$, or for a photon $p = \frac{h}{\lambda}$. While the relation between energy and the relativistic Compton momentum is much simpler, namely it must be

$$E = p_tc \tag{17}$$

Since $p_t = mc\gamma$. Does this mean we claim Einstein's relativistic momentum relation is wrong? Not at all, since the standard momentum is a function of the real momentum then it is only unnecessarily complex, and also not necessarily valid for $v = 0$. We can easily demonstrate that the Einstein's relativistic energy momentum relation can be derived from the simpler energy relativistic Compton momentum relation, because we must have (keep in mind that the standard momentum is $p = p_t\frac{v}{c}$, and $p_t = p\frac{c}{v}$) :

$$\begin{aligned}
E &= p_k + mc^2 \\
E &= p_tc \\
E &= \frac{pc^2}{v} \\
E &= mc^2\gamma \\
E^2 &= m^2c^4\gamma^2 \\
E^2 &= m^2c^4\gamma^2 - m^2c^4 + m^2c^4 \\
E^2 &= m^2c^4(v^2/c^2 - 1)\gamma^2 + m^2c^4(v^2/c^2)\gamma^2 + m^2c^4 \\
E^2 &= m^2c^4\gamma^2 - m^2c^4\left(1 - \frac{v^2}{c^2}\right)\gamma^2 + m^2c^4 \\
E^2 &= m^2c^4v^2/c^2\gamma^2 + m^2c^4 \\
E^2 &= m^2v^2c^2\gamma^2 + m^2c^4 \\
E^2 &= p_0^2c^2\gamma^2 + m^2c^4 \\
E^2 &= p^2c^2 + m^2c^4
\end{aligned} \tag{18}$$

In other words, the standard relativistic energy momentum relation is unnecessarily complex, because it is a derivative (function) of the real and simpler relativistic energy Compton momentum relation. If correct this also means quantum mechanics is unnecessarily complex as the relativistic energy momentum relation is one of its corner stones . For example, the Klein Gordon equation that was the first derived relativistic wave equation, is directly linked to the Einstein relativistic energy momentum relation by replacing the energy with the energy operator $i\hbar\frac{\partial}{\partial t}$, and the momentum with the momentum operator, $i\hbar\nabla$, we get the following wave equation

$$\begin{aligned} i^2\hbar^2\frac{\partial^2\psi}{\partial t^2} - i^2\hbar^2c^2\nabla^2\psi - m^2c^4\psi &= 0 \\ -\hbar^2\frac{\partial^2\psi}{\partial t^2} + \hbar^2c^2\nabla^2\psi - m^2c^4\psi &= 0 \\ \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} - \nabla^2\psi + \frac{m^2c^2}{\hbar^2}\psi &= 0 \end{aligned} \tag{19}$$

The last line is how the Klein–Gordon equation is most often presented. Already at this stage we can instead start to think, what if we instead can start out with the relativistic energy Compton momentum relation as it is fully consistent and we can even claim the deeper physical foundation of the Einstein relativistic energy momentum relation, and then "speculate" how we can get a new and simpler wave equation, but we will leave this for a later stage in our paper as there are also other aspects of the foundation of physics we first need to look closely at. But let us also quickly look at the Schrödinger [33] equation in its relation to the standard momentum. The foundation of the Schrödinger equation is the following relation

$$E = E_k + mc^2 \tag{20}$$

where we can approximate $E_k \approx \frac{p^2}{2m} = \frac{m^2v^2}{2m} = \frac{1}{2}mv^2$, which is the kinetic energy approximation when $v << c$. That is the Schrödinger equation must be non-relativistic as is well known, so it is only valid for $v << c$. However as we have shown earlier the standard momentum is likely not mathematical valid, at least if we want it consistent with the de Broglie wavelength, when $v = 0$. So the Schrödinger equation and all that comes out from it we will claim is not valid for rest-mass particles, and as we later will see, rest is likely the very essence of gravity. In addition the Schrödinger equation have 'somewhat 'strange" properties, such as it has terms of first order partial derivative with respect to the time dimension and second order with respect to the space dimension.

2.2 The Heisenberg uncertainty principle and the momentum

We will also already now shortly comment on the Heisenberg's [34] uncertainty principle, which was originally given by

$$\Delta p \Delta x \geq \hbar \tag{21}$$

Kennard [35] in the same year published a paper showing we likely should have $\Delta p\Delta x \geq \frac{\hbar}{2}$, but the half factor is beyond our interest here. What is important to pay attention to at this stage is that the Heisenberg uncertainty principle also relay on the momentum, this is even more clear when one derive the Heisenberg uncertainty principle from scratch as we will do later on. If the standard momentum not is mathematical valid for a rest-mass particle, then also Heisenberg's uncertainty principle can not be valid to also include rest-mass particles, or at least it must be incomplete. According to the Heisenberg's uncertainty principle a particle can likely never stand completely still, but then the Heisenberg's uncertainty principle is in our view in the first place derived from a foundation, namely standard momentum (actually a momentum operator that is linked to the standard momentum), that not is valid for a rest-mass particle. The Heisenberg's uncertainty principle in its known form can-therefore likely say nothing about rest-mass particles. We will later show how we can modify the foundation of it, and then also show what we get in the special case of rest mass particles, $v = 0$.

We will show that to really understand rest-mass at the deepest level is the very essence of understanding quantum gravity at a deeper level and also to have a chance to unify quantum mechanics with gravity. We will therefore now first return to gravity before we return to quantum mechanics and how we likely can get simpler quantum mechanics that is consistent with quantum gravity.

3 Gravity and the hidden mass definition that is the key to the Planck scale and the speed of gravity

One of the biggest challenges in physics for the last hundred years or so have been that there seems to be no link between gravity and quantum mechanics. Gravity theory has been extremely accurate to predict heavenly objects. Further it seems at least from the mathematical surface, that gravity theory as it is today, I am thinking of Newtons gravitational theory as well as Einstein's general relativity theory contains no information about the atomic, or subatomic world and therefore no information about the quantum world, an exception would possibly be micro black holes that we will come back to later on. Quantum mechanics on the other had has been extremely successful at predicting observable phenomena related to the atomic and subatomic world. We will show that even Newtonian gravity indirectly contains much more information about the quantum world than is thought. Later on, we will understand that gravity is directly linked to rest. We have in the previous section argued for that today's quantum mechanics is built on a fundament that not is defined for $v = 0$, and soon we will understand that gravity is closely linked to the case where we in the subatomic world have $v = 0$. But before we get to understand this we need to go back to the history of gravity, so we will start with a short history of Newton gravity, because we will claim modern physics have a very limited understanding of Newtonian gravity and even wrong assumptions about it.

The Newton gravitational force formula is likely the second most known formula in physics after Einstein's $E = mc^2$, and is given by

$$F = G\frac{Mm}{R^2} \tag{22}$$

There is no scientific device I can use to measure the gravity force directly. Perhaps not that unexpected as a force is something acting on something, for example on a mass. One can however on the basis of this formula combined with other formulas derive predictions for such things as orbital velocity, orbital time and gravitational acceleration. We can naturally easily observe such things as the orbital time of the Moon around the Earth, or the orbital time of the Earth around the Sun, we can also easily find the distance to these objects with parallax. Then one can naturally check the predictions from a gravity formula (theory) with observations. Table 2 give an overview of many Newtonian gravitational observations that have been observed and also things that not have been observed, such as the gravity force itself. That they not have been observed can mean they actually not exist physically and never can be observed, or it can mean they are difficult to observe, or only can be observed indirectly. However we can only be "sure" on what we have observed at least indirectly, and the observations are very close to predictions we get by plugging values for M, R and G into the formulas, so at least we know the Newton formula is a very good approximation for these phenomena.

Non-Observable, contains GMm	**Formula:**
Gravity force	$F = G\frac{Mm}{R^2}$
Observable Predictions, all contains GM not GMm:	**Formula:**
Gravity acceleration	$g = \frac{GM}{R^2}$
Orbital velocity	$v_o = \sqrt{\frac{GM}{R}}$
Orbital time	$T = \frac{2\pi R}{\sqrt{\frac{GM}{R}}}$
Velocity ball Newton cradle[a]	$v_{out} \approx \sqrt{2\frac{GM}{r^2}H}$
Frequency Newton spring	$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi R}\sqrt{\frac{GM}{x}}$
Periodicity pendulum (clock)[b]	$T \approx 2\pi\sqrt{\frac{L}{g}} = 2\pi R\sqrt{\frac{L}{GM}}$
Predictions that not have been observed:	**Formula:**
Escape velocity	$v_e = \sqrt{\frac{2GM}{R}}$

Table 2: The table shows a series of gravity effects that can be predicted from Newton's formula. As expected, the speed of light (gravity) does not appear in any of the formulas.

[a] H is the hight of the ball drop. This is a very good approximation when $v << c$.

[b] This was actually derived by Huygens [36] some years before Newton. L is the length of the pendulum. This is a very accurate approximation for a small angle, and it is actually exact for a full circe, see [37].

In table 3 we show observable gravity phenomena that are considered to not be predictable from Newton theory, but from general relativity theory.

Observable predictions (from GR), contains only GM and not GMm	
Advance of perihelion	$\sigma = \frac{6\pi GM}{a(1-e^2)c^2}$
Gravitational red-shift	$z = \frac{\sqrt{1-\frac{2GM}{R_1c^2}}}{\sqrt{1-\frac{2GM}{R_2c^2}}} - 1$
Time dilation	$T_R = T_f\sqrt{1-\sqrt{\frac{2GM}{R}}^2/c^2}$
Gravitational deflection (GR)	$\delta = \frac{4GM}{c^2R} = \frac{4}{R}\frac{l_p^2}{\lambda_M}$

Table 3: The table shows a series of gravity effects that can be predicted from Newton's formula.

In all observable gravity phenomena in the two tables above, we only see GM and never, GMm, that is the small mass m in Newtons gravitational formula always cancels out in derivations to predict directly observable gravity phenomena. All these phenomena described above is basically one gravity body predictions. The small mass m has insignificant gravitational effect relative to the large mass M. It is still a two-body problem somehow, but it is only how one large mass affect the smaller mass, and only the gravitational force from the large body is relevant. This is why one always here have GM and not GMm in all such observable gravity phenomena. In real two body problems where m is significantly large relative to M, we also need to take into account gravity effect from both masses on each other. Then the gravity parameter is then changed from $\mu = GM$ to $\mu_2 = G(M_1 + M_2) = GM_1 + GM_2$, in other words also here we have GM_1 and GM_2 and never GMM. Off course I could invent something, for example gravitational bending multiplied by the small mass and come up with a new term and coin it 'Ikonok' effect, this would have the formula $\frac{4GMm}{c^2R}$, and indeed it contains GMm, but that dose not make it directly observable, it is a mathematical construct, a composite of two things that we can observe, namely the gravitational bending of light from mass M plus the kg mass of the small mass m, that we then have multiplied with each other, that dose not make it real and observable. Even if I can observe an apple and a banana, that dose not mean an "apple-banana" exist.

An important question is if that all predictable gravity phenomena that we actually directly can observe only contain GM and not GMm, do this imply anything special or significant? Yes, we will soon see this is a key to understanding what is missing in the standard kg definition of mass. To understand this let us first go back in the history of gravity. Newton never invented nor used a gravity constant. In Principia [11] Newton stated out the gravity force by words, and his formula is equivalent to

$$F = \frac{\bar{M}\bar{m}}{R^2} \tag{23}$$

we are on purpose using a different notation for the two masses here, as we will see the original Newton formula leads to a different mass definition than the modern version of Newton gravity force formula. Even the historians seems in general to have ignored that Newton introduces a gravity force formula without any gravity constant, see for example [38] and [39][3], so we encorage the readers to go back and study Principia itself.

Even without any gravity constant Newton was able to perform a long series of gravity predictions, for example he could find the relative mass between Planets in our solar system and the Sun. For example, we can find the relative mass between two masses just by observing the orbital time for one satellite around each of the masses we want to compare, the formula is

$$\frac{M_2}{M_1} = \frac{R_1^3 T_2^2}{R_2^3 T_1^2} \tag{24}$$

where T_2 and T_1 are the orbital times of for example the Moon around the Earth, and the Earth around the Sun, R_2 is the distance from the center of the Earth to the Moon, and R_1 is the distance from the center of the Sun to the Earth. Newton used similar approach, see Principia and also [40]. Newton was also able to calculate the density of the Earth relative to the Sun very accurately, as he knew their relative mass only from orbital velocities, and could find their relative density by knowing the approximate diameters of the objects and there by their relative volumes. What Newton not where able to do in his time, but that he clearly tried to do, was to find the relative density of the Earth (or any other heavily object) relative to a known uniform substance, such as water, lead or gold. To do this somewhat accurately we had to wait for Cavendish in 1798. In the Cavendish apparatus the large gravity object is the large ball (actually two balls) in the apparatus. Unlike a planet or a moon, one can have full control of the substance one is making these balls from. From this Cavendish could find the density of the Earth relative to lead, and as one easily can find the density of a series of uniform materials relative to lead by simply using a simple old fashion weight and their volumes, one therefore had gained additional insight. Still Cavendish used no gravitational constant to do this, something historians and physics books also often get wrong. What is true is that one can use a Cavendish apparatus also to find the gravity constant.

The gravitational constant was actually likely first introduced in 1873 by Cornu and Baille [41], where they introduced the formula $F = f\frac{Mm}{R^2}$. Boys in 1894 was likely the first to introduce the well known notation G for the gravity constant and thereby how we know the Newton formula today, namely $F = G\frac{Mm}{R^2}$. Naturally if one uses f or G for the constant is mere cosmetic. The important point here is that one worked with Newton gravity for almost two hundred years before the gravity constant was introduced. One of the main reasons for the invention of the gravity constant can have been that in the mid 1870s the kg definition of mass become international standard in much of the world. If one used the kg definition of mass, then one had to add such a constant and calibrate the value of the constant to a gravity phenomenon to get the formula to work. And G was then clearly a constant, because if first calibrated to one observable gravity phenomena, for example with the use of a Cavendish apparatus, one did not need re-calibrate the value of G to predict other gravity phenomena that easily could be checked with observations. Also G did not seem to change over time, so "all" observations and use of the formula indeed points toward G being a constant. However, what do G truly represent? Its

[3]Milstrom [39] correctly points out that Newton basically only in words pointed out that Newton in Principia points out that the gravity force between two masses is proportional to the product of those two masses and inversely proportional to the square of the distance between them, but he then mistakenly claim this correspond to the equation, $F = G\frac{Mm}{R^2}$, there is not a single word about a gravity constant by Newton, so from a historical point of view this is wrong, the book is otherwise excellent.

output units are $m^3 \cdot kg^{-1} \cdot s^{-2}$. Can anyone imagine anything physical that has such properties; meters cubed divided by kg and seconds squared? I cannot. I can however easily imagine something with length (in meters), for example my shoe, or something with weight (in kg), my shoe, or something that takes time (in seconds), for example moving my shoe from point A to B. Already from the output dimensions of G one gets a hint that the so called Newton gravity constant could be a composite constant, something we soon will get back to. Also one should ask why was it possible to predict a series of gravity phenomena from the Newton gravity force formula long before the gravity constant even was invented. Do the gravity constant simply has to do with the choice of units, or dose it embedded contain a deeper secret about gravity? We will soon understand what the gravity constant truly represent.

Already in 1883, only ten years after the introduction of the gravity constant, Stoney [42] suggested that there were some natural units that could be derived from G, c as well as the elementary charge and the Coulomb constant, today known as the Stoney units. Then in 1899 Max Planck [43, 44] assumed there where three universal fundamental constants, G, c and $\hbar$, and then based on dimensional analysis derived a fundamental length $l_p = \sqrt{\frac{G\hbar}{c^3}}$, a time $t_p = \sqrt{\frac{G\hbar}{c^5}}$, and a mass $m_p = \sqrt{\frac{\hbar c}{G}}$, today known as the Planck units. The Planck units would over time overtake the Stoney units as considered to be the essential and fundamental natural units, a view held by most to this day. This is also a view we hold, but it is much more than just a view, we will soon show how we can build both gravity theory and quantum mechanics only from these two constants, namely l_p and c, rather than from G, c and $\hbar$, but first we need a little more history.

Einstein was after the publication of his general relativity theory in 1916 suggested that a quantum gravity theory was the next natural step, or in his own words

> *Because of the intra-atomic movement of electrons, the atom must radiate not only electromagnetic but also gravitational energy, if only in minute amounts. Since, in reality, this cannot be the case in nature, then it appears that the quantum theory must modify not only Maxwell's electrodynamics but also the new theory of gravitation.* – A. Einsten

Eddington [45] then in 1922 suggested that the Planck length likely would be essential for building a quantum gravity theory. However, as no sign of the Planck units had been detected, others where more skeptical. Prominent physicists like Bridgman [46] (who received the 1946 Nobel Prize in physics) ridiculed the idea that the Planck units meant anything special, for him it was more just like some mathematical artifacts coming out of dimensional analysis. In the present times it seems like most physicists involved in the topic think the Planck length represent the smallest possible length, see for example [47–49], but some seems to think there are lengths and structures below the Planck length, see for example [50]. Still there are we would say a minority grope of physicists that still claim like Bridgman did in 1931, that the Planck units are not useful, for example Unzicker [51] bases such a claim on his view that "*there is not the remotest chance of testing the validity of the Planck units*". His point we think is or we should perhaps say seemed like a valid claim, as it is somewhat similar to Einstein's claim that if we not could detect the ether then why not simply abandon it. If it is not there and not even have indirect effects we can measure from it, then to include it in our theories will likely only make our theories unnecessarily complex, incomplete or even wrong. However we will show that the Planck length and thereby the Planck units can be detected, and that they are directly linked to quantum gravity.

There is nothing wrong mathematically in solving the Planck length formula, $l_p = \sqrt{\frac{G\hbar}{c^3}}$, with respect to G, this gives $G = \frac{l_p^2 c^3}{\hbar}$. And we could next based on this claim it is the Planck length together with c and $\hbar$ that is the essential constants for gravity and that G simply is a composite constant. Some will likely protest here as it is assumed that we need to know G to find the Planck length, so making G a function of l_p just seems to lead us into a unsolvable circular problem. However, we will soon see this is not the case. We will in other words claim that G is a composite constant. Haug in 2016 [52] has suggested that G likely is such a composite constant as it gives a strong simplification of many Planck units related formulas that seems to give better intuition. However back then we could not see a way to find the Planck length without first knowing G, this has changed. That G came before l_p dose not necessarily make it more fundamental. On the contrary most things in physics have first consisted of scratching the surface of reality before we have understood thing at a deeper level. But before we prove that l_p easily can be found with no knowledge of G, let us also look closer at the mass M in the gravity formula. This mass is expressed in kg, and we have in section 2 pointed out that the simplest way to express a kg mass from quantum related parameters and constants is by the following formula

$$M = \frac{\hbar}{\bar{\lambda}_M} \frac{1}{c} \tag{25}$$

we have have here added subscript notation M to the reduced Compton wavelength, just to later not confuse it with the reduced Compton wavelength from the smaller mass m in the Newton formula. So when dealing with both M and m, we will use $\bar{\lambda}_M$ and $\bar{\lambda}$ to distinguish between the reduced Compton wavelength from the large and the small mass. A natural question is if non elementary particles (composite masses like the proton) and even macroscopic masses can have Compton wavelength? The answer is yes and no. Composite masses do not have a single "physical" Compton wavelength like the electron likely have, they have many, but we can aggregate the Compton wavelength of that particles making up the composite mass using the following relation

$$\bar{\lambda} = \frac{1}{\sum_{i=1}^{n} \frac{1}{\bar{\lambda}_i}} = \frac{1}{\frac{1}{\bar{\lambda}_1} + \frac{1}{\bar{\lambda}_2} + \frac{1}{\bar{\lambda}_3} + \cdots + \frac{1}{\bar{\lambda}_n}} \tag{26}$$

and in the case the Composite mass only consist of elementary particles with the same Compton wavelength we have

$$\bar{\lambda} = \frac{1}{n\frac{1}{\bar{\lambda}_1}} = \frac{\bar{\lambda}_1}{n} \tag{27}$$

This formulas above are fully consistent with the standard mass addition rule, because we have

$$\begin{aligned}
m &= m_1 + m_2 + m_3 \\
\frac{\hbar}{\bar{\lambda}}\frac{1}{c} &= \frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} \\
\frac{\hbar}{\frac{1}{\frac{1}{\bar{\lambda}_1}+\frac{1}{\bar{\lambda}_2}+\frac{1}{\bar{\lambda}_3}}}\frac{1}{c} &= \frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_2}\frac{1}{c} + \frac{\hbar}{\bar{\lambda}_3}\frac{1}{c}
\end{aligned} \tag{28}$$

and in the special case the where the composite mass m consist only of one type of elementary particles, we can simplify this to

$$\begin{aligned}
m &= n \times m_1 \\
\frac{\hbar}{\bar{\lambda}}\frac{1}{c} &= n\frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} \\
\frac{\hbar}{\frac{1}{n\frac{1}{\bar{\lambda}_1}}}\frac{1}{c} &= n\frac{\hbar}{\bar{\lambda}_1}\frac{1}{c} \\
\frac{\hbar}{\frac{\bar{\lambda}_1}{n}}\frac{1}{c} &= n\frac{\hbar}{\bar{\lambda}_1}\frac{1}{c}
\end{aligned} \tag{29}$$

The point is simply that any mass in terms of kg can be described in terms of one variable, the Compton wavelength combined with two constants, $\hbar$ and c; $m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}$. This even holds for massive objects such as the Earth and the Sun, that is for any mass, from the smallest to the largest. However when we deal with the Compton wavelength of a composite mass we must keep in mind it is not a single physical Compton wavelength, if not we can go wrong on later interpretations. Let us now for a moment assume G is a composite constant of the form $G = \frac{l_p^2 c^3}{\hbar}$. Remember again that all observable gravity phenomena contain GM and not GMm, so we have in predictions of all observable gravity phenomena

$$GM = \frac{l_p^2 c^3}{\hbar} \times \frac{\hbar}{\bar{\lambda}_M}\frac{1}{c} = c^2 \frac{l_p^2}{\bar{\lambda}_M} \tag{30}$$

Pay close attention to how the Planck constant embedded in G cancels out with the Planck constant in the kg mass defintion. Next take a look at table 4.

	Modern Newton:
Mass	$M = \frac{\hbar}{\bar{\lambda}_M}\frac{1}{c}$ (kg)
Non observable (contains GMm)	
Gravitational constant	$G, \left(G = \frac{l_p^2 c^3}{\hbar}\right)$
Gravity force	$F = G\frac{Mm}{R^2}$ $(kg \cdot m \cdot s^{-2})$
Observable predictions, identical for the two methods: (contains only GM)	
Gravity acceleration	$g = \frac{GM}{R^2} = \frac{c^2}{R^2}\frac{l_p^2}{\bar{\lambda}_M}$
Orbital velocity	$v_o = \sqrt{\frac{GM}{R}} = cl_p\sqrt{\frac{1}{R\bar{\lambda}_M}}$
Orbital time	$T = \frac{2\pi R}{\sqrt{\frac{GM}{R}}} = \frac{2\pi\sqrt{\bar{\lambda}_M R^3}}{cl_p}$
Velocity ball Newton cradle	$v_{out} = \sqrt{2\frac{GM}{r^2}H} = \frac{cl_p}{R}\sqrt{\frac{2H}{\bar{\lambda}_M}}$
Frequency Newton spring	$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi R}\sqrt{\frac{GM}{x}} = \frac{cl_p}{2\pi R}\sqrt{\frac{1}{\bar{\lambda}_M x}}$
Periodicity pendulum (clock)	$T = 2\pi\sqrt{\frac{L}{g}} = 2\pi R\sqrt{\frac{L}{GM}} = \frac{2\pi R}{cl_p}\sqrt{L\bar{\lambda}_M}$
Observable predictions (from GR): (contains only GM)	
Advance of perihelion	$\sigma = \frac{6\pi GM}{a(1-e^2)c^2} = \frac{6\pi}{a(1-e^2)}\frac{l_p^2}{\bar{\lambda}_M}$
Gravitational red-shift	$z = \frac{\sqrt{1-\frac{2GM}{R_1 c^2}}}{\sqrt{1-\frac{2GM}{R_2 c^2}}} - 1 = \frac{\sqrt{1-\frac{2l_p^2}{R_1\bar{\lambda}_M}}}{\sqrt{1-\frac{2l_p^2}{R_2\bar{\lambda}_M}}} - 1$
Time dilation	$T_R = T_f\sqrt{1 - \sqrt{\frac{2GM}{R}}^2/c^2} = T_f\sqrt{1 - \frac{2l_p^2}{R\bar{\lambda}_M}}$
Deflection	$\delta = \frac{4GM}{c^2 R} = \frac{4}{R}\frac{l_p^2}{\bar{\lambda}_M}$
Microlensing	$\theta_E = \frac{2}{R}\sqrt{GM\frac{(d_S-d_L)}{d_S d_L}} = \frac{2l_p}{R}\sqrt{\frac{d_S-d_L}{\bar{\lambda}_M(d_S d_L)}}$

Table 4: The table shows that any gravity observations we can make contain GM and not GMm; GM contains and needs less information than is required to find G and M.

We can from the table see that all Newtonian gravity phenomena are a function of two constants, l_p and c. Further we can see that all observable gravity phenomena typically only assumed possible to predict based on general relativity only contains one constant, namely l_p. And this is more than just some cleaver re-writing of G, this gives new and deeper insight in gravity. Because if we are right, and also these observable gravity phenomena are only dependent on c and l_p and some only on l_p, plus some variables, then we should be able to extract l_p from gravity phenomena without any prior knowledge of G, something we now will demonstrate is the case.

Let us consider what we can extract by simply observing the orbital time of the moon around the Earth. The orbital time of the moon is approximately 27.32 days (the sidereal month is the time the Moon takes to complete one full revolution around the Earth with respect to the background stars.), that is we have

$$T = \frac{2\pi\sqrt{\bar{\lambda}_M R^3}}{cl_p} \tag{31}$$

solved with respect to $l_p c$ we get

$$l_p = \frac{2\pi\sqrt{\bar{\lambda}_M R^3}}{Tc} \tag{32}$$

That is to find the value for l_p from the orbital time of the moon, we in addition need to know c, that we can find by measuring the speed of light. Further we need to know two variables, namely R and $\bar{\lambda}_M$. The variable R is simply in this case the distance from the center of the earth to the moon, this we can for example approximate very well with parallax, it is 384400000 m. Then we also need to find the reduced Compton wavelength of the Earth. Actually, we can find this with no knowledge of G or $\hbar$, but we have to start with an electron. The Compton frequency of an electron is by the original Compton paper also given by (based on Compton scattering):

$$\begin{aligned}
\lambda_1 - \lambda_2 &= \frac{h}{mc}(1-\cos\theta) \\
\lambda_1 - \lambda_2 &= \frac{h}{\frac{h}{\bar{\lambda}_e}\frac{1}{c}c}(1-\cos\theta) \\
\lambda_1 - \lambda_2 &= \bar{\lambda}_e(1-\cos\theta) \\
\bar{\lambda}_e &= \frac{\lambda_1-\lambda_2}{1-\cos\theta} \\
\bar{\lambda}_e &= \frac{\lambda_1-\lambda_2}{1-\cos\theta}
\end{aligned} \tag{33}$$

That is to find the reduced Compton wavelength of the electron we simply need to measure the wavelength of an outgoing photon λ_1 (photon beam) and the wavelength of the reflected photon, λ_2, and the angle between the outgoing and incoming beam, that have been reflected when hitting the electron. Further, we have that the cyclotron frequency is given by

$$\omega = \frac{v}{r} = \frac{qB}{m} \tag{34}$$

A proton and an electron have the same charge, so the cyclotron ratio is equal to their mass ratio. This is well known, as one has used cyclotron frequencies to find the well-known proton electron ratio (≈ 1836.15) also by this method, see [53]. Their mass ratio is therefore equal to their Compton wavelength ratio

$$\frac{\omega_P}{\omega_e} = \frac{\frac{qB}{m_P}}{\frac{qB}{m_e}} = \frac{m_e}{m_P} = \frac{\bar{\lambda}_e}{\bar{\lambda}_P} \approx 1836.15 \tag{35}$$

where $\bar{\lambda}_P$ and $\bar{\lambda}_e$ is respectively the Compton wavelength of the proton and the electron. That is, we now know the reduced Compton frequency of the proton, it is equal to the reduced Compton frequency we found from the electron multiplied by the cyclotron ratio, and we have found both of these with no knowledge off $\hbar$. Next we can find the reduced Compton frequency off the Earth by counting the number of protons in the earth and multiply this number with the reduced Compton frequency of the proton. There is no physical law that forbids this, but it is practical impossible with our technology and resources, also this would likely destroy our planet so not so smart. However there exist a way that likely is quite practical using existing technology. We can first count the number of protons, and neutrons that we for simplicity assume have the same mass as the protons, in a handful of uniform matter. This has basically recently been done. Silicon (^{28}Si) is very uniform and have crystal structures that basically makes it possible to count the number of atoms inside almost perfect sphere, see [54, 55], and this has been one of the competing methods also for a new kg standard. Other promising methods to count the numbers of atoms also exist, see for example [56]. After (or before) we have counted the number of atoms in a silicon sphere, about the size we can hold in our hand, we can measure the gravitational acceleration field created by such a sphere by using it as the large balls in a Cavendish apparatus, it is given by

$$g = \frac{L4\pi^2\theta}{T^2} \tag{36}$$

where T is the oscillation time, θ is the angle of the arm in the apparatus and L is the distance between the two arms. In addition, we have R_1 which is the distance from the center of the large ball in the Cavendish apparatus to the center of the small ball when the arm in the apparatus is deflected. Figure 1 show a modern Cavendish apparatus where the angle and oscillation frequency is measured by fine electronics, and then feed directly into a computer.

The relative Compton wavelength between two masses are proportional to their gravitational acceleration in the following way

$$\frac{g_1R_1^2}{g_2R^2} = \frac{\frac{GM_1}{R_1^2}R_1^2}{\frac{GM_2}{R^2}R_2^2} = \frac{M_1}{M_2} = \frac{\bar{\lambda}_2}{\bar{\lambda}_1} \tag{37}$$

In this way we know the Compton frequency of the Earth. First, we found the Compton wavelength of the electron from Compton scattering, it is given by 3.86×10^{-13} m, and from a cyclotron we found the cyclotron frequency ration of a proton versus an electron is 1836.15, and thereby the Proton Compton wavelength. Assume we then measured the gravitational acceleration we measure from our silicon sphere ball (the large balls in the Cavendish) apparatus if $r_1 = 7cm$ is approximately 1.36×10^{-8} m/s^2. The gravitational acceleration in the Earth we can for example find by simply by using a pendulum, the gravitational acceleration at the surface of the Earth is given by

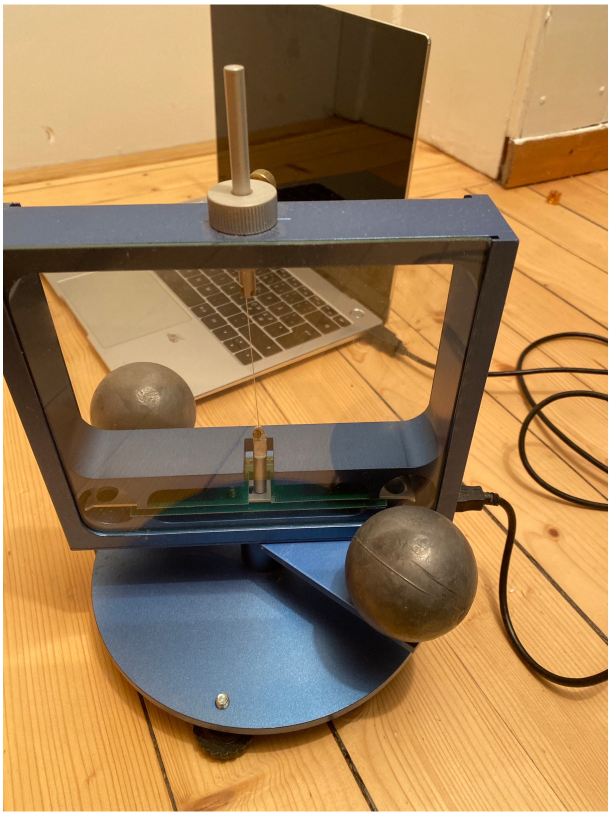

Figure 1: Low budget modern Cavendish apparatus combining old mechanics with modern electronics that feed directly to your computer through a USB cable. It is remarkable that using such an instrument, we can measure the Planck mass with only about 5% error.

$$g = \frac{2\pi L}{T^2} \tag{38}$$

where L is the length of the Pendulum. Actually, we can look at the Earth Moon system as a giant pendulum clock, the orbital time is 27.23 days, the distance to the moon is again 384400000 meters, this gives. Some will possibly protest as the Huygens [36] formula often is mentioned to only be a good approximation if the angle of the pendulum is small. This is only partly true, the Huygens formula is a good approximation for a small angle, it is inaccurate for a large angle, but it is actually exact for a 360 angle, based on the assumption of a perfect circular orbit, see [37]. So by plugging in the orbital velocity of the moon we get

$$g = \frac{4\pi^2 L}{T^2} \approx \frac{4\pi^2 \times 384400000}{(27.23 \times 24 \times 60 \times 60)^2} \approx 0.00274\ m/s^2 \tag{39}$$

This is the gravitational acceleration from the Earth at the distance of the moon. This means we have all the input to find the reduced Compton wavelength of the Earth, which is equal to

$$\bar{\lambda}_E = \bar{\lambda}_e \times \frac{\text{Cyclotron frequency ratio}}{\text{Number of protons in the large Cavendish sphere}} \times \frac{gR^2}{g_E R_E^2} \approx 5.8 \times 10^{-68}\ m \tag{40}$$

where R_E is the distance from the center of the Earth to the center of the Moon. We could naturally have found the reduced Compton wavelength by using the formula $\bar{\lambda}_E = \frac{\hbar}{M_E c}$, however this would in general require both knowledge of $\hbar$ and G, as one in this method would need G in general to find the kg mass of the Earth. An important point here is that these two constants are not needed. We now have all we need to find the Planck length from the orbital time of the Moon, we get

$$l_p = \frac{2\pi\sqrt{\bar{\lambda}_M R^3}}{Tc} \approx \frac{2\pi\sqrt{5.8 \times 10^{-68} \times 384400000^3}}{27.322 \times 24 \times 60 \times 60 \times 299792458} \approx 1.61 \times 10^{-35}\ m \tag{41}$$

And based on knowledge of l_p and c we do not need any other constant to predict observable gravity phenomena, or at least not any of the well known phenomena we are looking at here, as clearly demonstrated in table 4.

So how can it be that G plays such an important role in modern gravitational theory if we do not need it? We think the reason is that G is needed to turn an incomplete mass definition, the kg into a mass definition that is complete, or at least more complete. We have

$$GM = \frac{l_p^2 c^3}{\hbar} \frac{\hbar}{\bar{\lambda}_M} \frac{1}{c} = c^3 \times \frac{l_p}{c} \frac{l_p}{\bar{\lambda}_M} \tag{42}$$

This we have shown before in this paper, but it is a reason we here write it as c^3 multiplied by the Planck time, $t_p = \frac{l_p}{c}$, that is multiplied again with $\frac{l_p}{\bar{\lambda}_M}$, we will suggest that GM at a deeper level indeed represent c^3 multiplied by a complete or at least more complete mass definition. This new rest mass definition will be

$$\bar{M} = \frac{l_p}{c} \frac{l_p}{\bar{\lambda}_M} = t_p \frac{l_p}{\bar{\lambda}_M} \tag{43}$$

We will claim that standard physics are using two different mass definitions, and that this has been one of two main reasons one not has been able to unify gravity with quantum mechanics. This new mass definition is already embedded in standard gravity theory, but unknowingly so. In non-gravitational physics, one does not multiply the kg mass with G and thereby indirectly use a different mass definition in gravity physics and non-gravity physics. This new mass definition has output dimensions of time and we have before [57] called this mass definition for collision-time. We will soon discuss the interpretation of this mass definition. We naturally do not mean Newton or his precursor in any way knew this and was hiding c and the Planck length in their formula. But G can simply be seen as something missing in the formula, that we get into the formula after first calibration to a gravity phenomena.

Frequency, how long is the ding?

We show in section 2 that the kg mass can be seen as a Compton frequency ratio. To observe a frequency, we will claim one must observe something changing. Assume a clock making a beep every hour. The clock has a frequency of one beep per hour, and twenty-four in a day and night period. Assume there were no silence period between the beeps, then it would just be one long beep, then there could not be a frequency. In the other extreme if the beep had zero duration, then we would just have silence, and again no frequency. So, a frequency means we must have minimum two distinguishable states, and not only that, each state must have a duration in time, if not we cannot have a frequency. A frequency ratio that is linked to the Compton frequency, which is what the kg definition is, says nothing about the duration of the "beep", it has no change of state, so then it cannot be a frequency, or more precisely it must be an incomplete description of a frequency. However, by multiplying G with M we keep the frequency, but as we will see we then in addition know how long the two different states in the frequency last. We will propose a new theory of matter that in our view already is embedded in today's gravity theory through GM, but by understand what GM truly represent at a deeper level, we will get a simpler gravity theory that also will be a quantum gravity theory, that then again likely can be unified with quantum mechanics.

Back to the indivisible particles of Newton and the ancient Greeks

Newton claimed in Principia in his book part 3, that was mostly about gravity, that indivisible particles was behind all his philosophy, and in the same chapter he also mentioned indivisible moment of time, in other words quantized time. Few of today's physicists seems to be aware of this. Very similar to Newton and the ancient Greek atomists, we will base our theory on two postulates,

- Everything ultimately consist of indivisible particles that moves at a constant speed, except when they collide with another indivisible particle.
- and empty space that the indivisible particles can move in.

Assume the diameter of such an indivisible particle is the unknown x, but we will see when calibrated to gravity it is l_p. No diameter can naturally be smaller than this as all mass and energy are built from this particle. When not colliding this particle move at a constant unknown speed y, that we will see is c. The duration of the collision between two such particles we will assume is $\frac{x}{y}$, which we will see is $\frac{l_p}{c}$. This time interval is directly linked to how far an indivisible particle moves during the period two indivisible particles are colliding. In elementary particles such as the elecrtron we assume we have collisions at a Compton periodicity, that is every reduced Compton time there is an internal collision inside the elementary particle between two indivisible particles. So $\frac{\frac{x}{y}}{\frac{\bar{\lambda}}{c}} = \frac{x}{\bar{\lambda}}$ will be the percentage of a time window the particle is in collision state.

The indivisible particle itself is massless, and yes it moves at speed c. The distance between two indivisible particles moving after each other correspond to the wavelength of a photons. In this model a monochrome light beam consists simply of a "train" of indivisible particles moving after each other. This is very similar to Newton's corpuscular theory of light, that perhaps was abandoned too early. In elementary particles such as the electron, the indivisible particles are moving back and forth over the reduced Compton wavelength at the speed of light, but colliding with each other at the reduced Compton frequency. In other words, like in the kg mass we have a reduced Compton frequency. However, at the end of each Compton time period we have a collision between two indivisible particles. That is our frequency consist of two different states which is the minimum needed to actually define a real frequency. The collision lasts the Planck time, and the non collision state last the Compton time of the particle minus the Planck time. In other words, pure mass is collisions, and pure energy is non collisions. A mass that is defined as collision-time sounds very different than what we are used to, namely mass in terms of kg, but this new mass definition is much closer to the kg mass than one first would think. The kg mass we demonstrated was a Compton frequency ratio. If we find the collision-time mass of one kg, and all we need to do this is to know the Compton wavelength of one kg and the Planck length and the speed of light, and in addition divide another mass collision-time on the collision-time of one kg then we get (in other word a collision-time mass ratio)

$$\frac{\bar{m}}{\bar{m}_{1kg}} = \frac{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}}{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}_{1kg}}} = \frac{f}{f_{1kg}} = \frac{\frac{c}{\bar{\lambda}}}{\frac{c}{\bar{\lambda}_{1kg}}} \tag{44}$$

This is identical to the kg definition of matter, when the kg definition of matter is understood from a deeper perspective as we looked at in section 2. However, we see when we take the collision-time ratio as done in the formula above, then anything about the Planck length cancels out. That is, we are left with a frequency ratio (identical to the frequency ratio in the kg definition of mass), but anything about the Planck length and thereby the Planck time has dropped out of the definition. That is the duration and everything about the special event that is needed for a proper frequency has dropped out of the equation. The special event, the second state of the frequency, is simply the collision between two indivisible particles. And it is this collision, and the duration of it that is the very essence of gravity in our view. Standard physics have built into its kg mass the frequency periodicity, but have no information about the duration of the special event. The duration of the special event inside the Compton frequency, that actually even make a frequency possible is missing in the standard mass definition. The standard kg mass definition has an incomplete frequency definition, as it do not have two distinguishable states in each frequency, which is the minimum needed to have a complete frequency definition.

However standard physics surprisingly get the collision-state and the non collision state into gravity by multiplying M with G, for the other mass m in the Newton formula it is not important that this mass is missing something essential related to gravity, because the small mass cancels out in derivations to predict anything observable from the formula, remember all observable gravitational phenomena depends on GM and not GMm. Based on this new view we can represent Newton gravity with the formula

$$\bar{F} = c^3\frac{\bar{M}\bar{m}}{R^2} \tag{45}$$

This formula will give all the same predictions for observable gravity phenomena as the modern version of the Newton formula as demonstrated in table 5.

Our new simplified gravity formula only needs two constants l_p and c. From these two constants plus some variables we can predict all observable Newtonian gravity phenomena. The new theory is now founded on the Planck length, and is therefore directly linked to the Planck scale. We can solve any of the formulas for observable Newton gravity phenomena with respect to cl_p (the unknown y times the unkown x with no knowledge of G. For example by simply solving the gravitational acceleration field with respect to cl_p (the unknown yx) we get

$$xy = cl_p = R\sqrt{g\bar{\lambda}} \tag{46}$$

Actually all Newtonian gravitational phenomena contains cl_p, for example we [58] have recently shown how cl_p can be be extracted from a Newton gravity force spring without any knowledge of G or $\hbar$. We have already shown how to find the Compton frequency. We can easily also extract c from only gravity phenomena without any prior knowledge of the speed of light. We have that

$$c = R\sqrt{g\frac{\bar{\lambda}}{l_p^2}} = R\sqrt{\frac{2g}{r_s}} \tag{47}$$

where r_s is the Schwarzschild radius. The Schwarzschild radius of the Sun we can for example find by observing the deflection of light. It is important that we not are predicting the deflection of light, as this in general would require general relativity theory that assume the speed of gravity is the speed of light, we are only observing the deflection, not predicting it. Be also be aware that the Schwarzschild radius is not unique for general relativity theory. Already in 1784 Michell [59] calculated a radius identical to the Schwarzschild radius for an object with 500 times the radius of the Sun, but with same density as the Sun. Michell predicted that such an object would be a dark star as the escape velocity at just inside this radius would be larger than the speed of light, somewhat similar to general relativities theory of black holes. What is important here is that we easily can extract the Schwarzschild radius indirectly from just observations. From the observed deflection of light δ we have

	Modern Newton:	Alternative:
Mass	$M=\frac{\hbar}{\lambda_M}\frac{1}{c}$ (kg)	$\bar{M}=\frac{l_p}{c}\frac{l_p}{\lambda_M}$ (collision-time, see [57])
Non observable (contains GMm)		
Gravitational constant	$G, \left(G=\frac{l_p^2c^3}{\hbar}\right)$	c^3
Gravity force	$F=G\frac{Mm}{R^2}$ $(kg\cdot m\cdot s^{-2})$	$F=c^3\frac{\bar{M}\bar{m}}{R^2}$ $(m\cdot s^{-1})$
Observable predictions, identical for the two methods: (contains only GM)		
Gravity acceleration	$g=\frac{GM}{R^2}=\frac{c^2}{R^2}\frac{l_p^2}{\lambda_M}$	$g=\frac{c^3\bar{M}}{R^2}=\frac{c^2}{R^2}\frac{l_p^2}{\lambda_M}$
Orbital velocity	$v_o=\sqrt{\frac{GM}{R}}=cl_p\sqrt{\frac{1}{R\lambda_M}}$	$v_o=\sqrt{\frac{c^3\bar{M}}{R}}=cl_p\sqrt{\frac{l_p^2}{R\lambda_M}}$
Orbital time	$T=\frac{2\pi R}{\sqrt{\frac{GM}{R}}}=\frac{2\pi\sqrt{\bar{\lambda}R^3}}{cl_p}$	$T=\frac{2\pi R}{\sqrt{\frac{c^3\bar{M}}{R}}}=\frac{2\pi\sqrt{\bar{\lambda}R^3}}{cl_p}$
Velocity ball Newton cradle	$v_{out}=\sqrt{2\frac{GM}{r^2}H}=\frac{cl_p}{R}\sqrt{\frac{H}{\lambda}}$	$v_{out}=\sqrt{2\frac{c^3\bar{M}}{r^2}H}=\frac{cl_p}{R}\sqrt{\frac{H}{\lambda}}$
Periodicity Pendulum (clock)	$T=2\pi\sqrt{\frac{L}{g}}=2\pi R\sqrt{\frac{L}{GM}}=\frac{2\pi R}{cl_p}\sqrt{L\bar{\lambda}}$	$T=2\pi\sqrt{\frac{L}{g}}=T=2\pi R\sqrt{\frac{L}{c^3\bar{M}}}=\frac{2\pi R}{cl_p}\sqrt{L\bar{\lambda}}$
Frequency Newton spring	$f=\frac{1}{2\pi}\sqrt{\frac{k}{m}}=\frac{1}{2\pi R}\sqrt{\frac{GM}{x}}=\frac{cl_p}{2\pi R}\sqrt{\frac{1}{\bar{\lambda}x}}$	$f=\frac{1}{2\pi}\sqrt{\frac{k}{m}}=\frac{1}{2\pi R}\sqrt{\frac{c^3\bar{M}}{x}}=\frac{cl_p}{2\pi R}\sqrt{\frac{1}{\bar{\lambda}x}}$
Observable predictions (from GR): (contains only GM)		
Gravitational red-shift	$z=\frac{\sqrt{1-\frac{2GM}{R_1c^2}}}{\sqrt{1-\frac{2GM}{R_2c^2}}}-1=\frac{\sqrt{1-\frac{2l_p^2}{R_1\bar{\lambda}_M}}}{\sqrt{1-\frac{2l_p^2}{R_2\bar{\lambda}_M}}}-1$	$z=\frac{\sqrt{1-\frac{2c^3\bar{M}}{R_1c^2}}}{\sqrt{1-\frac{2c^3\bar{M}}{R_2c^2}}}-1=\frac{\sqrt{1-\frac{2l_p^2}{R_1\bar{\lambda}_M}}}{\sqrt{1-\frac{2l_p^2}{R_2\bar{\lambda}_M}}}-1$
Time dilation	$T_R=T_f\sqrt{1-\sqrt{\frac{2GM}{R}}^2/c^2}=T_f\sqrt{1-\frac{2l_p^2}{R\bar{\lambda}_M}}$	$T_R=T_f\sqrt{1-\sqrt{\frac{2c^3\bar{M}}{R}}^2/c^2}=T_f\sqrt{1-\frac{2l_p^2}{R\bar{\lambda}_M}}$
Gravitational deflection (GR)	$\delta=\frac{4GM}{c^2R}=\frac{4}{R}\frac{l_p^2}{\bar{\lambda}_M}$	$\delta=\frac{4c^3\bar{M}}{c^2R}=\frac{4}{R}\frac{l_p^2}{\bar{\lambda}_M}$
Advance of perihelion	$\sigma=\frac{6\pi GM}{a(1-e^2)c^2}=\frac{6\pi}{a(1-e^2)}\frac{l_p^2}{\bar{\lambda}_M}$	$\sigma=\frac{6\pi c^3\bar{M}}{a(1-e^2)c^2}=\frac{6\pi}{a(1-e^2)}\frac{l_p^2}{\bar{\lambda}_M}$
Indirectly/"hypothetical" observable predictions: (contains only GM)		
Escape velocity	$v_e=\sqrt{\frac{2GM}{R}}=cl_p\sqrt{2\frac{1}{R\bar{\lambda}_M}}$	$v_e=\sqrt{\frac{2c^3\bar{M}}{R}}=cl_p\sqrt{2\frac{1}{R\bar{\lambda}_M}}$
Schwarzschild radius	$r_s=\frac{2GM}{c^2}=2\frac{l_p^2}{\bar{\lambda}_M}$	$r_s=\frac{2c^3\bar{M}}{c^2}=2\frac{l_p^2}{\bar{\lambda}_M}$
Gravitational parameter	$\mu=GM=c^2\frac{l_p^2}{\bar{\lambda}_M}$	$\mu=c^3\bar{M}=c^2\frac{l_p^2}{\bar{\lambda}_M}$
Two body problem	$\mu=G(M_1+M_2)=c^2\frac{l_p^2}{\bar{\lambda}_1}+c^2\frac{l_p^2}{\bar{\lambda}_1}$	$c^3(\bar{M}_1+\bar{M}_2)=c^2\frac{l_p^2}{\bar{\lambda}_1}+c^2\frac{l_p^2}{\bar{\lambda}_2}$
Quantum analysis:		
Constants needed	G, $\hbar$, and c or l_p, $\hbar$, and c	l_p and c, for some phenomena only l_p
Variable needed	one for mass size	one for mass size

Table 5: The table shows that any observable gravity phenomena are linked to the Planck length and the speed of gravity, which is equal to the speed of light. For all observable gravity phenomena, we have GM and not GMm. This means that the embedded Planck constant cancels out, and all observable gravity phenomena are linked to the Planck length and the speed of gravity that again are identical to the speed of light. When this is understood, one can even rewrite Newton and GR gravity formulas in a simpler form that still gives all of the same results.

$$r_s=\frac{\delta R}{4} \tag{48}$$

Next we can find the Schwarzschild radius of the Earth as the relative Schwarzschild radius of the Earth relative to the Sun can be found by using the following relations, this is basically the same as equation 24.

$$\frac{r_{s,2}}{r_{s,1}}=\frac{R_1^3T_2^2}{R_2^3T_1^2} \tag{49}$$

So, when we have the Schwarzschild radius of the Earth, we can plug it into formula 47, we now can extract the speed of light (gravity) from the gravitational acceleration field. It is beyond this paper, but it is assumed that the Newton theory is only compatible with that gravity is infinite. This because when looking at the Newton formula it seems to only be dependent on the variable R and the mass M, one have failed to understand that the gravity constant and also the mass embedded contains c, not by assumption, but by calibration. Also the Gauss law of gravity, also known as the Newtonian field equation, that normally (in differential form) is given as $\nabla^2\phi=4\pi G\rho$, where ρ is the mass density, can when G and M is understood at a deeper level be re-written as $\nabla^2\phi=2\pi c^2\frac{r_s}{V}$. The point is that c now is embedded in the Newtonian equation, but this is outside the main topics of this paper and discussed in detail in one of our recent papers [60]. We just mention this, so the reader understand that we have thought much about possible weakness and inconsistencies in our model, and we have not found anyone so far.

Also we do not need the Planck constant $\hbar$ in our model. Standard gravity theory indirectly needs three constants, G, $\hbar$ and c to predict gravity phenomena. At least if we want to describe also the mass with constants and quantum related variables, such as the matter wavelength of the particle. This in contrast to our theory where we only need two constants. Actually superstring theory suggests that the speed of light c and that the Planck length are the two fundamental constants, see for example [61]. However superstring theory has not lead to a way to find the Planck length independent of G, nor has it lead to other testable predictions that distinguish it experimentally from other theories. Our new view gives us an idea that we may have been using two different mass definitions all along without being aware of it, as explained in the section above. When one understand this one see that even standard Newton theory at a deeper level is directly linked to the Planck scale, not by assumption, but by calibration to gravity phenomena. All gravity phenomena can be predicted with c and l_p and some only with l_p. To observe something affected by gravity is in this view remarkable to observe the Planck scale.

In the special case we link the time unit to a length unit through the speed of light, as is often also done in standard physics [62], we can set $c = 1$, (this do not imply we also set $G = 1$ and $\hbar = 1$ as these are not even needed) our new gravity force formula then simplify to Newton's original formula $F = \frac{\bar{M}\bar{m}}{R^2}$. This simple formula we can still use to predict all Newtonian gravity phenomena, and also to find the Planck length. Instead of calibrating the formula to a constant, it is then directly calibrated to a mass, and when $c = 1$ this mass is $\bar{M} = \frac{l_p}{1}\frac{l_p}{\bar{\lambda}}$, which is also identical to half the Schwarzschild radius.

Newton naturally did not have this in mind with his formula, but that said, Newton actually knew the approximate speed of light as he in Principia said the time it would take for light to travel from the Sun to the Earth was about 7 to 8 minutes, so he could theoretically have done so. Anyway if one calibrate his original formula $F = \frac{\bar{M}\bar{m}}{R^2}$ to a gravity observation, this involves only $\bar{M}$ as also in this case the small mass, $\bar{m}$, cancels out in derivations of observable phenomena, then one are finding a mass that is fully compatible with Newtons view that mass was the quantity of matter and that the ultimate particles where indivisible and even that there where indivisible units of time.

It is important to be aware that we can always go back and forth between our new mass detention collision-time and the modern kg mass definition. The new mass is linked to the kg mass simply by $\bar{m} = \frac{G}{c^3}m = \frac{l_p^2}{\hbar}m$. This mean we have

$$\bar{F} = c^3\frac{\bar{M}\bar{m}}{R^2} = c^3\frac{\frac{G}{c^3}M\frac{G}{c^3}m}{R^2} = G\frac{M\frac{G}{c^3}m}{R^2} \tag{50}$$

That is our new gravity force formula where we now simply that we have incorporated the new mass definition in both masses in the force formula. To get a unified theory this new mass definition must be incorporated not only in gravity theory, but in all areas of physics. In gravity we strictly only need to do it with one mass in the Newton type formula, as the other mass cancel out to get a predictable phenomena that we can observe. It is in other areas of physics we need to do it for all masses. One could do this by everywhere one has a mass, replace the mass m with $\frac{G}{c^3}m$, however this would give a very ugly notation that contained information not needed, remember to know $G = \frac{l_p^2c^3}{\hbar}$ and $m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}$ contains more information than the finished product $GM = c^3\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}$, that is the $\hbar$ cancels out. It is first when we understand that

$$\frac{G}{c^3}m = \frac{\frac{l_p^2c^3}{\hbar}}{c^3} \times \frac{\hbar}{\bar{\lambda}}\frac{1}{c} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}} = \bar{m}, \tag{51}$$

that we can get a simple theory with nice notation that also unifying gravity with quantum mechanics.

4 Quantum probability embedded in the mass defenition

Our new mass definition is collision-time

$$\bar{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}} \tag{52}$$

The first part $\frac{l_p}{c} = t_p$ represent the duration of the collision between two indivisible particles. In an elementary particle that has a "physical" Compton wavelength such a collision happens at the reduced Compton periodicity. This because in our model the indivisible particles making up the particle moves back and forth, each over a distance equal to the reduced Compton wavelength at the speed of light, for then to collide when they meet. This journey takes the reduced Compton time, $t_c = \frac{\bar{\lambda}}{c}$, while the collision itself laste the Planck time, $t_p = \frac{l_p}{c}$, This means the percentage of the observational time window the particle has been in collision state is $\frac{t_p}{t_c} = \frac{l_p}{c}/\left(\frac{\bar{\lambda}}{c}\right) = \frac{l_p}{\bar{\lambda}}$, and the percentage of time it has not been in collision state is $1 - \frac{l_p}{\bar{\lambda}}$. If we observe an electron for one second it has been in collision-state in only $\frac{l_p}{\bar{\lambda}_e} \approx 4.18 \times 10^{-23}$ seconds. This is a very small fraction of the total time, but still this means it has been in collision states $4.18 \times 10^{-23}/t_p \approx 7.76 \times 10^{20}$ times per second. Assume next we use an observational time-window equal to the Planck time. Now the last term in our mass definition represent a probability

$$P_c = \frac{l_p}{\bar{\lambda}} \tag{53}$$

this because we only have one collision per Compton time period. So this is now the probability for an elementary particle to be in a collision-state for this Planck time observational time-window. Until we actually observe this Planck time observational time-window we cannot know if the electron is in a collision-state or not in that time window. So one could even try to claim it is both in a collision-state and in a non collision state at the same time until observed, and that we only can say something about the probability of these two states before we actually look to see if the particle is in a collision state or not in this time window. Such an interpretation we think however would be somewhat incorrect. It is not that the electron at any time can be both in a collision state and at the same time in non collision state inside a Planck time window, it can only be in one of the two states, it is simply that we do not know before we observe. If we kept trace of every Planck time, and knew when it was in collision state last time, then this was no longer a probability, but then just the percentage of time the particle is in a collision state. It could even be more complicated than that, as a real observation could disturb the system, but that is outside the topic here.

This probability can also not be higher than one, because if the reduced Compton wavelength is the distance between two indivisible particles (center to center), then this distance can not be shorter than l_p. This because l_p is the diameter of the indivisible particle and if two indivisibles lay side by side (the collision state) they cannot get closer to each other. We will soon study how it is only is a Planck mass particle that has collision probability $P_c = \frac{l_p}{l_p} = 1$. An exception to the rule that $\frac{l_p}{\bar{\lambda}} \leq 1$ is for composite particles (composite mass). For example a one kg mass has a reduced Compton wavelength much shorter than the Planck length, $\bar{\lambda}_{1kg} = \frac{\hbar}{1kg \times c} \approx 3.52 \times 10^{-43}\ m$. This will give $\frac{l_p}{\bar{\lambda}_{1kg}} \approx 45994327.12$, this cannot be a probability as it is above one, the integer part here represent the number of collisions in the one kg during one Planck time, and the decimal part 0.12 represent the probability for one more collision. When the Compton wavelength is shorter than the Planck length then P_c will be a sum of probabilities, and only the decimal part then is what we normally consider a real probability, as the integer parts are the aggregates of 100% probabilities. That case of $\frac{l_p}{\bar{\lambda}} > 1$ can then only happen with composite masses, remember the reduced Compton wavelength of a composite mass consist of the Compton wavelength of many particles and is given by formula 26. So even if no elementary particle can have reduced Compton wavelength shorter than the Planck length, a composite mass can have a composite Compton wavelength shorter than the Planck length, but when interpreting it we have to be careful with interpretations, as we have been here.

And the probability for a given particle type for not being in a collision state in a Planck time observational time window is simply

$$P_n = 1 - \frac{l_p}{\bar{\lambda}} \tag{54}$$

This probability is for a the Planck mass particle always zero, as $\bar{\lambda} = l_p$ for a Planck mass particle. This again is consistent with that the Planck mass particle is the collision between two indivisible particles. While all other elementary particles, such as an electron, consist of the the Planck-mass particles coming in and out of existence at the reduced Compton frequency. In this model there is no other mass in an electron or any other particle than the Planck mass coming in and out of existance. In terms of kg the Planck mass is much larger than the electron so is this not contradictory? Well one must multiply the Planck mass by the percentage of time an electron is in a collision-stat, that is in a Planck mass state, the electron mass in kg is

$$m_e = m_p \frac{l_p}{\bar{\lambda}_e} = f_e m_p t_p \tag{55}$$

where f_e is the reduced Compton frequency. That is the electron is a Planck mass coming in and out of existence $f_e = 7.76 \times 10^{20}$ times per second. This is a bit similar to Schrödingers [63] 1930 hypothesis of a tremble motion (Zitterbewegung) in the electron that he predicted to have a frequency og $\frac{2m_e c^2}{\hbar} = 2fe$. The Zitterbewegung has never been observed, and this would not be so strange if it is an internal frequency in the electron (and other elementary particles). If the observational time-window of the electron is smaller than the Compton time of the electron, well let us assume the observational time window is the Planck time. Then the electron can be seen as a probabilisitic Planck mass, this is true for any observational time window shorter than the Compton time, as there is only one collision per reduced Compton time. If working with kg mass the electron is the Planck mass, $2.17 \times 10^{-8}\ kg$ multiplied by the probability it is in a collision-state (Planck mass state), which is $P_c = \frac{l_p}{\bar{\lambda}_e}$, this gives the well known kg mass of the electron, but when going to observe an the electron in such a short time window the electron is probabilistic until we actually observe it.

Next let's move to incorporate relativistic effects. The shortest possible reduced Compton wavelength is the distance between two indivisible particles when they collide, and this distance is $\bar{\lambda} = l_p$. This distance can also only be observed from this particle itself. This because the Planck mass particle dissolves after the Planck time, and to observe it from a distance would mean even a light signal could not reach it or leave it before the collision-state had dissolved. This is as will see important to understand Lorentz symmetry "break down" at the Planck scale.

Again the reduced Compton wavelength is the distance between indivisible particles. This length can undergo length contraction until the two indivisible particles making up the fundamental particle lay side by side (collide). To understand this in relation to relativistic effects let us first look at the standard mass broken down in quantum parameters and constants when we deal with relativistic mass, we then have

$$m\gamma = \frac{m}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{\hbar}{\bar{\lambda}}\frac{1}{c}}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{c} \tag{56}$$

This formula will always give the correct kg mass of a particle. This basically means that the reduced Compton wavelength undergoes standard length contraction, and there is no limit on how much it can length contract as long as $v < c$. This also means there is basically no limit on how big the relativistic mass (and thereby the kinetic energy) even for a single electron can be, as long as it is smaller than infinite. There is a big room between very large and infinitely-large, that the electron kinetic energy than can contain. The mass of the milky way is about 10^{12} solar masses. Assume for a moment an electron moves at a velocity equal to $v \approx c\sqrt{1-\frac{m_e^2}{M_m^2}} \approx c \times (1 - 1.04 \times 10^{-145})$. This velocity is still $< c$, so fully valid inside Einstein's [64] special relativity theory. This would mean there is nothing forbidding a single electron to have a kinetic energy basically equal to the rest-mass energy of our galaxy. Even if the Earth was hit by one such electron it would likely pulverize the whole Earth. This has clearly not happened in the billions of years the Earth have existed, because the Earth is still here. In a theory one should not only look to see if what it predicts and that has been confirmed by observations, but one should also look for what the model predict that never have been observed even in billions of years. So either such electrons must be extremely remote or they simply do not exist or cannot exist. One could go into a long discussion on why this not have happened, one possibility is that it simply is absurd that an electrons can take such a high kinetic energy, as discussed by [65, 66]. May be our new mass definition can give us a better explanation why we dont observe such electrons. Our collision-time mass in a relativistic settings must be

$$\bar{m}\gamma = \frac{\bar{m}}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{57}$$

The formula is structural not that different from the standard formula (it is just to multiply the standard relativistic mass formula with $\frac{l_p^2}{\hbar}$), but here we will claim the Compton wavelength not can contract to a length smaller than the Planck length, as the Compton wavelength is the distance between two indivisible particles, and they have a diameter of the Planck length. This means we must have that $\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}} \geq l_p$, this means we must also have

$$\begin{aligned} \bar{m}\gamma &\geq \frac{l_p}{c}\frac{l_p}{l_p} \\ \frac{l_p}{c}\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} &\geq \frac{l_p}{c}\frac{l_p}{l_p} \\ v &\leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} \end{aligned} \tag{58}$$

That is we get a new exact maximum velocity limit for elementary particles, as have been suggested by Haug [52, 67][4]. The maximum speed of the electron would then be approximately $v_{max} \leq c(1 - 8.78 \times 10^{-46})\ m/s$, which is below c, but considerably higher than the velocity one can achieve in the Large Hadron Collider. So at least there does not exist an experiment that have been done that can prove this hypothesis on maximum velocity of elementary particles wrong. However, if such a maximum speed limit exists for elementary particles, then it would indeed explain why the Earth not have observed (been hit by) for example electrons with a kinetic energy equal to the rest-mass energy of our Sun, the Milky Way or even much higher. The maximum kinetic energy of any elementary particle based on this assumption is equal to the rest-mass energy of the Planck mass. This is still a lot of energy, but extremely much less energy than what we have talked about above. There is a lot of energy between the Planck mass energy and infinite. Our new maximum velocity gives a clear cut-off at the Planck scale. For a composite mass such as a proton the maximum velocity of the proton will then likely depend on the elementary particle making up the proton with the shortest reduced Compton wavelength, that is the most massive fundamental particle embedded in the proton. Haug [67] suggested that the proton will then likely start to dissolve when reaching this speed, this is currently a hypothesis hard to test out as this speed will be far above what we can observe in LHC for example.

[4] We actually suggested such a maximum velocity based on a more general formula at presentation we gave at the Royal Institution in London October 15, 2015.

Another important point is that special relativity without incorporating our maximum velocity is not compatible with the idea often used in quantum gravity, that the shortest possible length is the Planck length. One can take any particle or object with length $L > l_p$, then by moving this object at a speed of $v \leq c\sqrt{1-\frac{l_p^2}{L^2}} < c$, and then the length contracted observation of L will be below the Planck length. This we have discussed in more detail in [66, 68]. On the other hand by incorporating our suggested maximum speed limit one will likely ensure that one have a relativity theory that always is compatible with that the shortest possible observable length is l_p. We are here thinking about an ideal observer, that is even an electron and as we will see that even a photon can be an observer, we are not talking about the technical possibilities to observe this directly.

But back to our newly introduced quantum probabilities, for the rest-mass particle we said that $P_c = \frac{l_p}{\bar{\lambda}}$ could be interpreted as the probability for an elementary particle to be in a collision state when using a observational time-window of the Planck-time. At the moment we observe it, if we observe a particle in the Planck time observational time-window, it will either be in Planck mass state (collision state) or not. For a moving particle, that is for a relativistic mass (particle), we have that this probability now is given by

$$P_c = \frac{l_p}{\bar{\lambda}}\gamma = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{59}$$

Based on standard physics assumptions, where the only only speed limit for a mass is $v < c$, then this probability can become larger than one and can therefore not be a valid probability. However since we have $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$ we see that the maximum probability is

$$P_{c,max} = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}} = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}} = \frac{l_p}{l_p} = 1 \tag{60}$$

That is the frequency probability for an elementary particle to be in collision-state (Planck mass particle state) never can be higher than one for any elementary particles. It can be higher for composite particles, but again it can then be seen as a aggregate of probabilities, where the integer part then represent the number of collision-events per Planck time, and the decimal part represent the probability for one more event. This means masses with relativistic mass of the Planck mass and up will be dominated by determinism and relativistic masses considerably below m_p will be dominated by probability (uncertainty).

5 The Planck mass particle and its unique quantum probability

The Planck mass particle plays an extremely important role in our theory, so we must take a closer look at it. Planck in 1899 suggested what today is known as the Planck mass, but said little about what it represented except indicating it likely was a very important mass. Lloyd Motz, while working at the Rutherford Laboratory, [69–71] was likely the first to suggest there could be an important particle (in 1962) that had a mass equal to the Planck mass. Motz coined this particle the *uniton*, see also Markov [72] that in 1967 introduces a similar particle that he coined *maximon*. Motz was naturally fully aware that his suggested Planck mass particle (uniton) had an enormous mass compared to the mass of any particles one had observed. He tried to get around this challenge by suggesting the unitons had radiated most of their energy away:

> *According to this point of view, electrons and nucleons are the lowest bound states of two or more unitons that have collapsed down to the appropriate dimensions gravitationally and radiated away most of their energy in the process.* – Lloyd Motz

Others [73] have similarly suggested that Planck mass particles only existed just after the Big Bang and that most of their mass have radiated away, to become todays known observed particles, such as the electron and the proton. Others, including Motz and Hawking have suggested that the Planck mass particles could exist today as micro-black holes [74–76]. Planck mass particles have also been suggested as a candidate for cosmological dark matter [77, 78]. Our theory is in many ways much simpler, we have shown that the Planck mass is observational time dependent. It is only if the Planck mass particle, the collision between two indivisible particles, is observed in the Planck time that it has the assumed mass of $m_p \approx 2.17 \times 10^{-8}\ kg$ (per Planck time), and it can only be directly observed in the Planck time window. This because the Planck mass is one collision, and the kg mass is a collision frequency ratio. The reduced Compton frequency of one kg in a Planck time observational time window is $\frac{c}{\bar{\lambda}_{1kg}}t_p \approx 45994327$. The collision frequency of the Planck mass particle is 1. So we have that the Planck mass particle in kg as observed in the Planck time is $m_p \approx \frac{1}{45994327} \approx 2.17 \times 10^{-8}$ kg (per Planck time), which is the well known Planck mass. However it is important to pay attention to that the Planck mass particle only can be directly observed inside a Planck time observational time window, as this is the life time of the particle. One has to be part of the Planck mass particle to observe the Planck mass particle. This again because the maximum speed of a signal is the speed of light. The Planck mass particle has a radius equal to the Planck length, and only last the Planck time, before dissolving into its two indivisible particles, that again is energy. The Planck mass particle still has many indirect effects outside a time frame of the Plank time that can be observed. Assume we have a one second resolution observational time window, the collision frequency inside one kg is now $\frac{c}{\bar{\lambda}_{1kg}} \approx 8.52 \times 10^{50}$, while a single Planck mass particle is still only one collision, because that is the very definition of a Planck mass particle, that it is one collision between two indivisible particles. Its mass in kg is now $\frac{1}{8.52\times 10^{50}} \approx 1.17 \times 10^{-51}$ kg. That is a super small mass, much smaller than the electron mass 10^{-31}. This mass is also equal to an energy with frequency one per second, as $\hbar f_p = \hbar \times 1 = 1.05^{-34}$ J since this correspond to a res-mass of $\frac{\hbar}{c^2} = \frac{1}{8.52\times 10^{50}} \approx 1.17 \times 10^{-51}$ kg. This correspond closely to the suggested photon mass in several studies, see for example the review article by [79]. Further the Planck mass particles is the building blocks of all masses and all energy. At the observational time windows we tend to operate, such the second, the Planck mass particle correspond to an incredible small mass in terms of kg. This resolve the puzzle why the Planck mass particle is much larger than any observed particle such as the electron, it is actually a much smaller mass in the observational time-window we observe. Still it is the standard Planck mass size if observed directly in its life-time of the Planck time.

Back to the maximum velocity of particles, that we gave in the section above as $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. For a Planck mass particle we have $\bar{\lambda} = l_p$, the maximum velocity for a Planck mass particle relative to an observer is

$$v_{max} = c\sqrt{1-\frac{l_p^2}{l_p^2}} = 0 \tag{61}$$

That means the velocity of a the Planck mass particle always must be zero. This seems to be absurd at first, and in conflict with such things as Lorentz symmetry and the relativity principle itself. However it is fully consistent with that the Planck mass particles simply is a collision between two indivisible particles and that this collision only last the Planck time. In the Planck time the speed of a light signal can only move the Planck length, since $ct_p = l_p$. And since l_p is the radius of the Planck mass particle (two indivisibles colliding), then one must be part of the Planck mass particle itself to observe it. In other words one are at rest with the Planck mass particle to observe it directly, again this do not mean we cannot observe a series of indirect effects from this collision from other reference frames, such as gravity. This make the Planck mass particle very unique, it can only be observed from its own frame of reference, it is therefore invariant, not because it is the same as observed from a series of reference frames, but because it only can be observed (directly) from its own reference frame. We therefore actually have what we can call a legal break with Lorentz symmetry. We have a unique reference frame, because this frame only can be observed from its own rest-frame. We already know that light has a unique and constant speed, this also means that light particles has a unique rest-mass frame when colliding. It is a reference frame that only last the Planck time. So the Planck time, the Planck length is invariant, and they are both directly linked to the collision between two indivisible (light) particles, that then is making up the Planck mass particle. In other words, the the Planck mass particle is in our view a photon-photon collision, and it is predicted also by standard theory that when two photons's collide we get mass, see for example [80].

Also the relativistic collision-time mass of the Planck mass particle is given by

$$\bar{m} = \bar{m}_0\gamma = \frac{l_p}{c}\frac{l_p}{l_p\sqrt{1-\frac{v}{c^2}}} \tag{62}$$

but since the maximum velocity $v_{max} = 0$, then we are left with

$$\bar{m} = \bar{m}_0\gamma = \frac{l_p}{c}\frac{l_p}{l_p\sqrt{1-\frac{0}{c^2}}} = t_p \times \frac{l_p}{l_p} \tag{63}$$

Interestingly here is that as we have mentioned before, that the last part $\frac{l_p}{\bar{\lambda}} = \frac{l_p}{l_p} = 1$, is a probability for the particle to be in a collision state inside a Planck time window. That is the Planck mass particle is always in a collision state in the observational time window we can observe it, namely the Planck time. This because this is the life-time of the Planck mass particle, and if we observer the Planck mass particle, it is in collision-state, as the collision-state is the Planck mass particle. All other particles go in and out of the collision-state, and known observed particles such as an electron is a majority of the time not in a collision state, but still in a collision state $\frac{c}{\bar{\lambda}_e}$ per second. We are here talking about internal collisions in the electron (and any other particle), not external. That the Planck mass particle is the only particle with a collision state probability of always one will be essential to understand the limitation of the Heisenberg uncertainty principle, and also to unify quantum mechanics with gravity.

Still this is only a hypothesis as long as we not can observe a consequence linked to the Planck mass particle. The collision time from one collision event is only the duration of the Planck time, this is a time interval far shorter than anything we have instruments to detect today. But ,what if one have an enormous amount of such collisions each lasting one Planck time, then we should be able to detect and measure the aggregate of them. And we will claim this is exactly what we can do in gravity observations, and is why we now unlike previously assumed have shown it is possible to extract the Planck length independently of knowledge of G. Gravity is directly linked to the Planck scale, and we claim it is easy to detected the Planck scale for large masses, it is gravity.

6 Energy

The standard relativistic energy relation for rest-mass particles is $E = mc^2$. There is nothing wrong by dividing both sides by c, so $\frac{E}{c} = mc$, and we could then re-define the energy to a new energy as $E_n = \frac{E}{c}$ and simply write $E_n = mc$, this would simply give a different output dimension of energy than the one used today. We can always multiply existing equations with known constants on both sides, for example we could multiply $E = mc^2$ with $c^{2.5}$ on each side, however this would just make the equation and the output units more complex. To multiply or divide each side of a known equation by known constants on each side must have a purpose, such as simplifying without losing out on something that already is there. To divide $E = mc^2$ to get $E_n = mc$ does not seem to do much of a simplification, but perhaps a little, the standard energy is Joule which is $kg \cdot m^2/s^2$ and Joule divided by c is $kg \cdot m/s$. Even if the output dimensions are slightly simplified, it does not seem worth to do, and also it would need an explanation for why we would do something like that. However, when we switch the mass definition to collision-time, then we see that if we have $\breve{E} = \bar{m}c^2$, then the energy output dimensions are m^2/s, but if we divide by c on each side, that is re-define the energy to $\bar{E} = \frac{\breve{E}}{c}$ then the output units for energy is simply meter (m), that is we end up with that mass is collision-time and energy is collision-length. However, we must must be very careful that we not are manipulate the energy units/dimensions in ways making it inconsistent with observations. We can as describe in section 2 easily run experiments showing kinetic energy is a function of v^2 and not v, if we have the following energy mass relation

$$\bar{E} = \bar{m}c\gamma \tag{64}$$

and a kinetic energy as

$$\bar{E}_k = \bar{m}c\gamma - \bar{m}c \tag{65}$$

then the approximation for this when $v << c$ is the first series of a Taylor expansion then we get $\bar{E}_k \approx \frac{1}{2}\bar{m}\frac{v^2}{c}$, that is it is dependent on v^2 for low velocities as has been tested. This is also fully consistent with $E = mc^2\gamma - mc^2$, because we can always multiply our collision-time mass $\bar{m}$ with $\frac{\hbar}{l_p^2}$, and multiply both sides of $\bar{E} = \bar{m}c$ with c on both sides. We have done extensive research on this outside what we can describe in this paper, and have found no inconsistencies, readers should naturally not take this for granted, but investigate it further. That is our new energy definition is identical to our Compton momentum. That is in our new theory there is actually no need for both momentum and energy, all we need is energy and mass (or Compton momentum and mass, which is the same thing). At the deeper level our energy is given by

$$\bar{E} = \bar{m}c\gamma = l_p \frac{l_p}{\bar{\lambda}\sqrt{1 - \frac{v^2}{c^2}}} \tag{66}$$

That is energy at the deepest quantum level is a collision length l_p multiplied by a probability of collision-state of $\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$. In pure energy we have that $v_{max} = 0$, this seems contradictory to that energy moves at speed c. However this is to observe energy, a photon, we need to collide with another light particle (building block off photon and all matter). We need a photon to photon collision to observe a photon. The photon is then longer a photon as it is colliding with another photon, it is then a Planck mass particle, that last one Planck time. Light dose not only have an invariant upper speed, c, but also an invariant lower speed $v = 0$, but it is then no longer light, but in a Planck particle mass state.

For energy we are used to think of frequency times the Planck constant. Our new energy defenition is a length that we call collision-length, that is equal to half the Schwarzschild radius and also the Compton momentum, all of these three are the same. However we can easily go from collision-length to frequency by simply dividing energy by the Planck length. Our new energy is the Planck length multiplied by the collision-frequency per Planck time, which is equal to the reduced Compton frequency per Planck time. For example an electron has collision frequency per Planck time (which is the reduced Compton frequency per Planck time) of simply

$$f = \frac{\bar{E}}{l_p} = \frac{\bar{m}_e c}{l_p} = \frac{l_p}{\bar{\lambda}_e} = 4.19 \times 10^{-23} \text{ per plank time} \tag{67}$$

So the frequency is less than one per Planck time, actually all masses smaller than the Planck mass will have such a frequency less than one, so it is an expected frequency, in other words it is identical to the probability of the electron being in a collision state. To get the more familiar reduced Compton frequency per second, we simply have to multiply the above frequency (frequency probability) with the number of Planck times in one second, $\frac{1}{t_p}$, this gives 7.76×10^{20} per second which is identical to $\frac{c}{\bar{\lambda}_e}$. So to convert collision-length to joule we simply do the following $\frac{\bar{E}}{l_p}\frac{1}{t_p} \times \frac{1}{8.52\times10^{50}} = \bar{E}\frac{\hbar}{l_p^2}c = E$. In other words, standard energy in terms of Joule is just collision-length multiplied by a composite constant, $\frac{\hbar}{l_p^2}c$, we can at any time go back and forth between standard energy to collision-time energy, or from our collision-time mass to kg mass. The standard energy and the standard mass are dependent on the same variable, the reduced Compton wavelength. We have to ask ourselves what is easier to understand intuitively a length (collision-length in meter) or Joule ($kg \cdot m^2/s^2$), we clearly think the first. And this is also in our view much more than just a fancy change of output units and dimensions, the new view gives significantly new insight into the quantum world as it even is compatible with gravity and quantum gravity.

7 The connection between the Energy the Schwarzschild radius and quantum gravity

Half the Schwarzschild radius, it is given by

$$\frac{1}{2}r_s = \frac{GM}{c^2} = l_p\frac{l_p}{\bar{\lambda}} \tag{68}$$

This is equal to the rest-mass energy in our model $\bar{E} = \bar{m}c = l_p\frac{l_p}{\bar{\lambda}}$. The Schwarzschild radius is therefore what we can call the gravitational energy, it is simply our collision-length, which is a more complete description of energy than standard energy. For all particles we have observed such as electrons and also composite particles like protons, then $\bar{\lambda} >> l_p$. This means the Schwarzschild radius of such particles are smaller than the Planck length, which should be impossible that claims to be consistent with the idea that the Planck length is the shortest possible length. Actually we will claim all elementary particles have a Schwarzschild radius equal to the Planck length, which is the radius of the collision between two indivisible particles that go in and out in collision state. That is actually particles with mass smaller than the Planck mass dose not have a stable Schwarzschild radius, but a Schwarzschild radius equal to the Planck length, that comes in and out of existence with a probability of $\frac{l_p}{\bar{\lambda}}$ in a observational time window of the Planck time. We have not derived general relativity theory from our theory, and we have hardly investigated general relativity theory much in this paper, this we leave for another time, so how can it be that we suddenly now incorporate the Schwarzschild radius in our theory? It is important to be aware that the Schwarzschild radius not only is unique for general relativity theory. The Schwarzschild radius is simply the radius a mass must be inside where the escape velocity is c for that radius. As we mentioned earlier also an identical radius was calculated and presented by Michell [59] already in 1784 based on Newton mechanics.

Based on formula 68 also mean that Schwarzschild radius, and thereby the gravity is probabilisitic for particles below the Planck mass, as they have $\bar{\lambda} > l_p$, and remember $\frac{l_p}{\bar{\lambda}}$ can be seen as a probability for the particle to be in a collision-state if the observation time-window is the Planck time. For mass sizes from and above from and above Planck mass particles the Schwarzschild radius is stable, that is deterministic. This means for Planck mass size and up the gravity is stable and not probabilisitic.

If we know the speed of light (gravity) c, that we for example can find from simply measure the speed of light of a laser beam, then we from any Newton gravitational phenomena can very easily extract the Schwarzschild radius, which is the rest-mass collision-length energy. This we can see by looking closely at table 5. For example we can find the Schwarzschild radius from the Earth by simply observing the gravitational acceleration on the surface of the Earth, if we solve the gravitational acceleration formula in table 5 with respect to the Schwarzschild radius we get

$$\bar{p}_r = \bar{m}c = \frac{1}{2}r_s = g\frac{R^2}{c^2} \tag{69}$$

Next we only need the Schwarzschild radius and the speed of light to predict other gravity phenomena, we do not need G or $\hbar$. Also we do not the Compton wavelength in this case, see table 6.

We are here working with the aggregates of Planck particle events, and extract their rest-mass energy, which is the sum of the collision lengths. To know the Compton wavelength is only needed if we want to separate out how long one Planck-mass event (collision-event is). That we can predict all observable gravity phenomena from the collision-length energy (the Schwarzschild radius) and c is quite remarkable. Because if mass is what is causing gravity, and we do not need to find the traditional kg mass and also not G first to do so, then it is perhaps because the collision-time contains all about the mass we need to know to predict gravity, and this is exactly what our theory tells us.

Table 7 summarize how mass and energy and also the Schwarzschild radius can be looked at as probabilisitic.

8 Partial derivatives with respect to space and time gives us frequency probabilities and a differential equation

It is interesting to note that we have

What to measure/predict	Formula
Schwarzschild radius / rest mass Compton momentum	$\frac{1}{2}r_s = \bar{m}c = \frac{gR^2}{c^2}$
Gravitational acceleration field	$g = \frac{r_s}{2R^2}c^2$
Orbital time	$T = \frac{2\pi}{c}\sqrt{\frac{2R^3}{r_s}}$
Orbital velocity	$v_o = c\sqrt{\frac{r_s}{2R}}$ t
Velocity ball Newton cradle	$v_{out} = \frac{c}{R}\sqrt{\frac{Hr_s}{2}}$
Periodicity Pendulum (clock)	$T = \frac{2\pi R}{c}\sqrt{\frac{2L}{r_s}}$
Advance of perihelion	$\sigma = \frac{3\pi r_s}{a(1-e^2)}$
Time dilation	$t_2 = t_1\sqrt{1 - 2\frac{r_s}{2R}}$
GR bending of light	$\delta = 4\frac{r_s}{2R}$
Gravitational red-shift	$\lim_{R\to+\infty} z(R) = \frac{r_s}{2R}$
Microlensing	$\theta_E = \frac{1}{R}\sqrt{\frac{2(d_S-d_L)r_s}{(d_S d_L)}}$

Table 6: The table shows how a series of common gravitational measurements and predictions can be done without any knowledge of the traditional mass size or knowledge of G, when we relay on the Schwarzschild radius which is identical to the rest-mass Compton momentum, and in our view actually represents the collision-length, which is the collision-time mass multiplied by the speed of light.

$$\frac{\partial \bar{m}}{\partial t_p} = \frac{\partial t_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}}{\partial t_p} = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{70}$$

and

$$\frac{\partial \bar{E}}{\partial l_p} = \frac{\partial \bar{p}_t}{\partial l_p} = \frac{\partial l_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}}{\partial l_p} = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{71}$$

This mean we can describe the change in energy and gravity (or the Compton momentum, which is the same thing) with respect to change in space: $x = l_p$, and the change in mass with respect to change in time $t = t_p$, with the following simple differential equation

$$\frac{\partial \bar{E}}{\partial l_p} = \frac{\partial \bar{m}}{\partial t_p} \tag{72}$$

which describe the relation between how energy changes as we move in space and how mass changes as we move in time, and the result is we two identical quantum frequency probabilities. Further in the special case of the Planck mass particle we have

$$\frac{\partial \bar{m}_p}{\partial t_p} = \frac{\partial t_p \frac{l_p}{l_p\sqrt{1-\frac{v^2}{c^2}}}}{\partial t_p} = \frac{l_p}{l_p\sqrt{1-\frac{0^2}{c^2}}} = 1 \tag{73}$$

and

$$\frac{\partial \bar{p}_t}{\partial l_p} = \frac{\partial \bar{E}_p}{\partial l_p} = \frac{\partial l_p \frac{l_p}{l_p\sqrt{1-\frac{v^2}{c^2}}}}{\partial l_p} = \frac{l_p}{l_p\sqrt{1-\frac{0^2}{c^2}}} = 1 \tag{74}$$

Again this simply mean the Planck mass particle always have probability one for being in a collision state, and the same with the Planck mass Compton momentum. However, one can question if it even make sense to look at change in time and space with respect to the Planck mass particle, as it will dissolve after the Planck time and the minimum time unit we can move is t_p and the minimum space length we can move is $x = l_p$.

We also have that

	Probabilistic approach
Electron mass as collision-time	$\bar{m}_e = \frac{\bar{m}_e}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}_e\sqrt{1-\frac{v^2}{c^2}}} = \bar{m}_p P_c$
Proton mass as collision-time	$\bar{m}_P = \frac{\bar{m}_P}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}_P\sqrt{1-\frac{v^2}{c^2}}} = \bar{m}_p P_c$
Planck particle mass as collision-time	$\bar{m}_p = \frac{\bar{m}_p}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l_p}{c}\frac{l_p}{l_p\sqrt{1-\frac{o^2}{c^2}}} = \frac{l_p}{c} = \bar{m}_p P_c = m_p \times 1$
Schwarzschild radius as collision length	$\frac{1}{2}r_s = \bar{E} = \frac{\bar{m}c}{\sqrt{1-\frac{v^2}{c^2}}} = l_p\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} = l_p P_c$
Schwarzschild radius Planck mass as collision-space	$\frac{1}{2}r_s = \bar{E}_p = \frac{\bar{m}_p c}{\sqrt{1-\frac{v^2}{c^2}}} = l_p\frac{l_p}{l_p\sqrt{1-\frac{0^2}{c^2}}} = l_p P_c = l_p \times 1$

Table 7: This table shows the "standard" relativistic mass as well as the probabilistic approach. Be aware of the notation difference between the Planck mass m_p and the proton rest-mass $m_{\mathbf{P}}$. All masses and even such things as the Schwarzschild radius can be expressed as Planck units multiplied by a frequency probability P_c.

$$\begin{aligned} l_p\frac{\partial \bar{E}}{\partial l_p} &= ct_p\frac{\partial \bar{M}}{\partial t_p} \\ \bar{E}_p\frac{\partial \bar{E}}{\partial l_p} &= c\bar{m}_p\frac{\partial \bar{M}}{\partial t_p} \\ \bar{E}_p\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} &= c\bar{m}_p\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \end{aligned} \tag{75}$$

That basically means that all elementary particles and even the mass of composite particles can be described as a frequency probabiltiy multiplied by the Planck mass.

Further since $\bar{E} = \frac{1}{2}r_s$ we also have that

$$\frac{1}{2}\frac{\partial r_s}{\partial l_p} = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{76}$$

and also

$$\frac{1}{2}\frac{\partial r_s}{\partial l_p} = \frac{\partial \bar{m}}{\partial t_p} \tag{77}$$

that is the the change in the Schwarzschild radius with respect to change in space is identical to the change in the mass with respect to change in time.

9 A fresh view on the Heisenberg uncertainty principle

We now return to the Heisenberg uncertainty principle and look at it in a new perspective. Our perspective is controversial, but we ask the reader to try to look at it without prejudice. The Heisenberg uncertainty principle is again given by

$$\Delta p \Delta x \geq \hbar \tag{78}$$

That it often also is given as $\Delta p \Delta x \geq \frac{\hbar}{2}$, which is the Kennard version of the uncertainty principle is not our concern here. Keep in mind that in standard physics we have two momentum formulas, one for photons and one for particles with rest-mass. Let us start with particles with rest mass, the momentum broken down in physical constants and quantum entities such as the de Broglie matter wavelength is in our view given by

$$p = mv\gamma = \frac{mv}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{\hbar}{\bar{\lambda}_b}\frac{1}{v}v}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\hbar}{\bar{\lambda}_b\sqrt{1-\frac{v^2}{c^2}}} \tag{79}$$

This is the momentum as well as the kg mass as derived from the de Broglie wavelength, in other words it is the other side of the coin of the de Broglie wavelength relativistic formula, and therefore fully compatible with the de Broglie wavelength. We could call the standard momentum the de Broglie momentum. Since the Planck constant and the speed of light are constants, the only variable is the de Broglie wavelength, well $\bar{\lambda}_b\sqrt{1-\frac{v^2}{c^2}}$ is the relativistic de Broglie wavelength. The de Broglie wavelength is a function of the type of particle and its velocity. Assume we are dealing with a known type of particle for example an electron. Fora given velocity the de Broglie wavelength is given. The only uncertain variable is therefore the velocity. We therefore will claim one can re-write the Heisenberg uncertainty principle as

$$\frac{\hbar}{\bar{\lambda}_b\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x \geq \hbar \tag{80}$$

As the Planck constant is a constant, we will claim there is no fundamental uncertainty around it, except measuring uncertainty, but that is not what the Heisenberg uncertainty principle is about, also it should not be confused with the observer effect. Assume that we have $\Delta x = \bar{\lambda}_b$, this gives

$$\begin{aligned} \frac{\hbar}{\bar{\lambda}_b\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\bar{\lambda}_b &\geq \hbar \\ \frac{\hbar}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq \hbar \\ \frac{1}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq 1 \end{aligned} \tag{81}$$

We can only have that $\frac{1}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}} = 1$ if $\Delta v = 0$, but we know we not can have $v = 0$ as the de Broglie wavelength is not defined for $v = 0$ and also not the standard momentum consistent with a de Broglie wavelength. One could protest here and say that $\Delta v = 0$ do not mean $v = 0$, as we are talking about the uncertainty in the velocity and not in the velocity itself. This we think would be a misinterpretation, as we will claim only a velocity that always is $v = 0$ has an uncertainty in velocity of zero, something that will become clear later on when we get to the Planck mass particle. But then the standard Heisenberg uncertainty principle is not valid for the Planck mass particle that is the very essence of gravity. We claim the Heisenberg uncertainty principle is basically nothing more than to say that $v < c$ and that before we have measured the velocity of a particle, then the particle can have any velocity between zero and $v < c$, as this indeed will give

$$.\infty > \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \geq 1 \tag{82}$$

This simply means $v < c$ that again correspond to a de Broglie wavelength $\bar{\lambda}_b > 0$. However, since the standard momentum not is valid for $v = 0$ we must actually for the standard Heisenberg uncertainty principle have

$$\infty > \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} > 1 \tag{83}$$

and

$$\Delta p \Delta x > \hbar \tag{84}$$

That is, we will claim the Heisenberg uncertainty principle in its current form, linked to the standard momentum is not valid for $v = 0$, that is it can say nothing about rest-mass particles. One could try to interpret this as all particles with mass always has a velocity $0 < v < c$, and that a particle therefore never can stand still, and that it therefore does not matter that the de Broglie wavelength and thereby the momentum not is valid for $v = 0$, this we think would be a grave mistake. The correct interpretation we think is to understand that the Heisenberg uncertainty principle for particles with rest-mass are rooted in the standard momentum that not is mathematically defined for rest-mass particles, so that the Heisenberg uncertainty principle can say nothing about the uncertainty in rest-mass particles in its standard form.

Let us assume we try to incorporate a Planck length limit and set $\Delta x \geq l_p$. We can then in the special case $\Delta x = l_p$, and this gives

$$\frac{\hbar}{\bar{\lambda}_b\sqrt{1-\frac{(\Delta v)^2}{c^2}}} l_p \geq \hbar \tag{85}$$

Solved with respect to Δv this gives $\Delta v \leq \sqrt{1-\frac{l_p^2}{\bar{\lambda}_b^2}}$, which is different than our previously derived maximum velocity of matter. This maximum velocity do not make much sense as it is a function of the de Broglie wavelength, $\bar{\lambda}_b$, that itself is a function of the velocity, so we get a maximum velocity that again is a function of the velocity of the particle, this do not make much sense. Second as long as we work with kg mass definition that contains no information about the Planck length, then setting a Planck length limit is only a speculative hypothesis with no solid foundation of why this should be the case.

10 Uncertainty principle based on the Compton momentum

Next, let us instead of using the standard momentum as the foundation for the uncertainty principle, suggest an uncertainty principle based on the Compton momentum, from this we get, if we still work with the kg mass definition, the following

$$
\begin{aligned}
\Delta p_t \Delta x &\geq \hbar \\
mc\gamma \Delta x &\geq \hbar \\
\frac{\frac{\hbar}{\bar{\lambda}}\frac{1}{c}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq \hbar \\
\frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq \hbar \\
\frac{1}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq 1
\end{aligned} \tag{86}
$$

This modified Heisenberg uncertainty principle based on the Compton momentum is compatible with $\Delta v = 0$ and a particle at absolute rest. We can also here assume $\Delta x \geq l_p$ and in the special case where we have $\Delta x = l_p$ and solve with respect to Δv we get $\Delta v = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$, which is the maximum velocity formula we have derived before, but here linked to maximum uncertainty in velocity. In this maximum velocity uncertainty formula, we do not have the problematic issue that the maximum velocity velocity formula itself is a function of velocity, that we got from the maximum uncertainty in velocity formula that we got from the standard Heisenberg uncertainty principle, when we assumed $\Delta x \geq l_p$. However still there is no clear reason from this uncertainty principle based on the Compton momentum with the kg definition of mass, that we should have a minimum limit on uncertainty in the position equal to the Planck length.

Let us also incorporate our new mass definition in the Compton momentum. We start out with the Compton momentum and the kg mass

$$
\begin{aligned}
\Delta p_t \Delta x &\geq \hbar \\
mc\gamma \Delta x &\geq \hbar \\
\frac{mc}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq \hbar
\end{aligned} \tag{87}
$$

Next we are turning the kg mass into a collision-time mass, remember we have $\bar{m} = m\frac{l_p^2}{\hbar}$. That is we simply need to multiply both sides with $\frac{l_p^2}{\hbar}$ (a more formal derivation based on quantum mechanics is given in section 12), this gives

$$
\begin{aligned}
\frac{\bar{m}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq l_p^2 \\
\frac{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq l_p^2 \\
\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq \frac{l_p}{\Delta x}
\end{aligned} \tag{88}
$$

Next we can try to investigate the boundaries conditions for this new uncertainty principle. We know the minimum uncertainty in Δv not can be below zero, so we set $\Delta v = 0$, which is the case of a particle we know is at rest, then solved with respect to Δx we get $\Delta x = \bar{\lambda}$. That is the maximum uncertainty in Δx is up to the reduced Compton wavelength of the particle in question, in other words we have $\Delta x \leq \bar{\lambda}$. That is we must have

$$\begin{aligned} \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq \frac{l_p}{\Delta x} \\ \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(0)^2}{c^2}}} &\geq \frac{l_p}{\bar{\lambda}} \end{aligned} \tag{89}$$

Keep in mind that $\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}}$ is a frequency probability of the particle being in a collision-state as observed in the Planck time observational time window, and it is also the percentage of time in a longer observational time interval that the particle is in collision state. This in other words put a lower limit on this collision-state quantum probability for a given particle equal to $P_c \geq \frac{l_p}{\bar{\lambda}}$.

Next from our previous analysis we have that $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$, this mean we also must have $\Delta v \leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. If we now set $\Delta v = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$, this leads to

$$\begin{aligned} \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}}\Delta x &\geq l_p \\ \frac{l_p}{l_p}\Delta x &\geq l_p \\ \Delta x &\geq l_p \end{aligned} \tag{90}$$

This mean we must have $l_p \geq \Delta X \leq \bar{\lambda}$ and $0 \geq \Delta v \leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. And unlike in the standard frame work, in our collision-time mass theory we also have very good reasons to assume $\Delta x \geq l_p$. Contrary to in standard theory, here we have a solid fundament to suggest so, as l_p is the diameter of the indivisible particles making up all particles. And because the reduced Compton wavelength is the distance to distance between indivisible particles. If we set $\Delta x = l_p$, we must also have $\Delta v = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$, and this gives

$$\begin{aligned} \Delta \bar{p}_t \Delta x &\geq l_p^2 \\ \bar{m}_p c\gamma l_p &= l_p^2 \\ l_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &= l_p^2 \\ l_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}})^2}{c^2}}} l_p &\geq l_p^2 \\ 1 &\geq 1 \end{aligned} \tag{91}$$

We cannot have $1 > 1$, so $\geq$ can be replaced with $=$ sign in the case $\Delta x = l_p$. That is our new uncertainty principle give us a range for the quantum probability of a particle being in a collision state, we end up with

$$\begin{aligned} \frac{l_p}{\bar{\lambda}} &\leq \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \leq 1 \\ \frac{l_p}{\bar{\lambda}} &\leq P_c \leq 1 \end{aligned} \tag{92}$$

Again pay attention to that $P_c = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$ is the frequency probability for the particle to be in a collision state as observed in the Planck time. On the other hand if we mistakenly only incorporate the velocity limit we have in standard theory $v < c$, and thereby also $\Delta v < c$ then we do not get an upper unit limit on this probability, that is at a deeper level the standard Heisenberg uncertainty principle indirectly allows probabilities above unity. We are not going to investigate that further here, but we can speculate that this also is one of the reasons why we sometimes need negative pseudo probabilities [81–85] in standard quantum physics, to compensate for the above unit pseudo probabilities. In other words, we would think the negative pseudo probabilities in parts of quantum physics potentially could be linked to make an incomplete uncertainty principle and its corresponding incomplete quantum mechanics still somehow work also for rest-mass particles. That one can use negative pseudo probabilities to get a get an incomplete model to work is known from quantitative finance, see [86]. However in finance one know why the model is incomplete as the models and the assets markets are much easier to understand and observe, and thereby to model than quantum physics. So negative probabilities have not got popular in finance, as one instead has been able to fix the incomplete model. We possibly think we have done something similar here, that is to fix an incomplete model for uncertainty in the quantum realm .

The special case of the Planck mass particle

In the special case of the Planck mass particle we have

$$\begin{aligned} \Delta\bar{p}_t\Delta x &\geq l_p^2 \\ \frac{\frac{l_p}{c}\frac{l_p}{l_p}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq l_p^2 \\ \frac{l_p}{l_p\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta x &\geq l_p \end{aligned} \tag{93}$$

As the Planck mass particle always is at rest if it is observed, as it must be observed from its self. We have that Δv must be zero for this special case. Well we have from previous that the maximum uncertainty in $\Delta v = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. And since the reduced Compton wavelength of a Planck mass particle is $\bar{\lambda} = l_p$ we get that its maximum uncertainty in velocity is $\Delta v = c\sqrt{1-\frac{l_p^2}{l_p^2}} = 0$, this gives

$$\begin{aligned} \frac{l_p}{l_p\sqrt{1-\frac{0^2}{c^2}}}\Delta x &\geq l_p \\ \Delta x &\geq l_p \end{aligned} \tag{94}$$

Actually we must have $\Delta x = l_p$ for the Planck mass particle as the radius of the particle only is l_p, this gives

$$\begin{aligned} \Delta\bar{p}_{t,p}l_p &\geq l_p \\ \frac{\frac{l_p}{c}\frac{l_p}{l_p}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}l_p &\geq l_p \\ \frac{1}{\sqrt{1-\frac{0^2}{c^2}}} &\geq 1 \\ 1 &\geq 1 \end{aligned} \tag{95}$$

In other words the $\geq$ sign actually should be replaced with $=$ for the Planck mass particle, as we know $1 = 1$, and $1 \geq 1$ dose not give much meaning. This simply mean the quantum probability for a Planck mass particle to be in a collision-state always must be one. If it is not in a collision state it simply do not exist. That is for a Planck mass particle we have zero uncertainty. This because the Planck mass particle dissolves into its indivisible particles after the Planck time. The Planck mass particle only has one state, that is a collision-state, while all other particles made up of Planck mass particles going in and out of existence have two different states, collision state and non collision state. The Planck mass particle is simply two indivisible particles laying next to each other in collision state, it has a radius equal to the Planck length. A signal cannot travel faster than light, and in the life time of the Planck mass particle we therefore have to be part of it to observe it.

Energy time uncertainty principle

Our collision-length energy leads to the following energy time uncertainty principle

$$
\begin{aligned}
\Delta E \Delta t &\geq \frac{l_p^2}{c} \\
\frac{\bar{m}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta t &\geq \frac{l_p^2}{c} \\
\frac{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}c}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}}\Delta t &\geq \frac{l_p^2}{c} \\
\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq \frac{l_p}{c\Delta t} \qquad (96)
\end{aligned}
$$

Assume now the minimum uncertainty in time is $\Delta t = l_p$, and we put this into the equation above, this gives

$$
\begin{aligned}
\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq \frac{l_p}{c\frac{l_p}{c}} \\
\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{(\Delta v)^2}{c^2}}} &\geq 1 \qquad (97)
\end{aligned}
$$

Solved with respect to Δv this gives $\Delta v = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$, and since for a Planck mass particle $\bar{\lambda} = l_p$ this gives $\Delta v = c\sqrt{1-\frac{l_p^2}{l_p^2}} = 0$. So, this confirms that in the special case of the Planck mass particle, we have zero uncertainty. That is for the Planck mass particle the $\geq$ sign in the uncertainty principle becomes an equal sign.

11 An attempt to make a new and simplified quantum mechanics

So far in our paper we are very confident we have a mathematical rigorous theory that is consistent with all experiments and observations that have been done in physics. We in the next sections attempt to develop a new and simplified quantum mechanics. However, we are here breaking into uncharted territory on a rather complex topic, so we are less certain about the rigorousness of the theory we will present here, than in the rest of the paper. However, we think it is as a minimum should be seen as an interesting introduction to a possibly new path. First of all, it is important to understand our theory in general is fully consistent with existing quantum mechanics, as our theory also leads to the standard relativistic energy momentum relationship as shown in section 2. And we can always switch back from our collision-time mass to the standard kg mass simply by multiplying it by the composite constant $\frac{\hbar}{l_p^2}$, however this will only leas to a more complex theory, the existing theory that also not can lead to unification of gravity with quantum mechanics.

We already have shown in section 2 the standard relativistic energy momentum relation is just a function of the much simpler relativistic energy Compton momentum relation, that is given by

$$
E = p_t c = mc^2\gamma \qquad (98)
$$

If we in addition replace the kg mass with the collision-time mass and the energy with collision-length we get

$$
\bar{E} = \bar{p}_t = \bar{m}c\gamma \qquad (99)
$$

Before we suggest a relativistic wave equation we also have to know if the collision-length energy $\bar{E}$ and Compton momentum and the collision-time mass, $\bar{m}$, are scalars or vectors, this must also be chosen in a way to get a consistent mathematical theory, that also makes logical sense with respect to our assumptions about the quantum world.

In modern physics mass is considered a scalar, the same is the case with energy, while momentum is a vector. Here we will try to take a close look at the assumptions behind why this is so. In our new theory it seems like mass and energy actually should be vectors and not scalars. This has implications for quantum mechanics, and also of our understanding of time and fundamental particles. As this can be seen as a new hypothesis it should naturally be scrutinized by other researchers, but we hope it also will not be prematurely rejected due to prejudice. We think the findings are interesting enough to deserve further investigation by other researchers.

Assume the smallest possible particle is a spherical indivisible particle as shown in figure 2. It clearly has no direction in space as it is perfectly spherical, so it must be a scalar and not a vector. In standard physics elementary particles are point particles, but they also have wave-particle duality. In standard physics it is assumed that the matter wave that has length equal to the de Broglie wave spread outs symmetrical in all directions, this is at least one of several possible interpretation in standard physics. So yes, standard physics assume a rest-mass is a scalar.

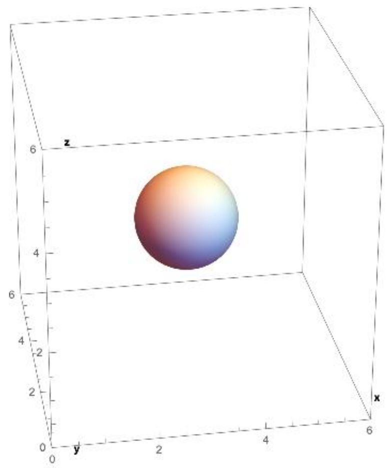

Figure 2: The figure show one indivisible particle, if it is at rest it is a scalar. However indivisible particles not colliding are energy that moves at speed c (velocity $\boldsymbol{c}$), since the motion is in a direction they are vectors.

When it comes to macroscopic object all will agree a parked car is standing in a given direction, it seems like it better can be described by a vector than a scalar. However, a ball laying on the ground is symmetrical and is a scalar. Still we could imagine that the building blocks of the ball was many oval shaped particles, then the building blocks of the ball would be vectors. What we are interested in is if the most fundamental particles are vectors or scalars. In our model the ultimate particle is indeed indivisible, but this is a particle that always travel at velocity $\boldsymbol{c}$, except when colliding with other particles. This particle makes up both energy and mass. When it moves, and it moves with velocity $\boldsymbol{c}$ then it is what we call energy. So, if the particle in figure one moves relative to the observer in a given direction then it can likely best be described as a vector. That is energy is likely a vector at the deepest level, not a scalar. In this model a photon is a series of such particles moving after each other with distance to distance between them equal to the photon wavelength. A mass in our model is two colliding indivisible particles, the Planck mass particle, this is illustrated in figure 3.

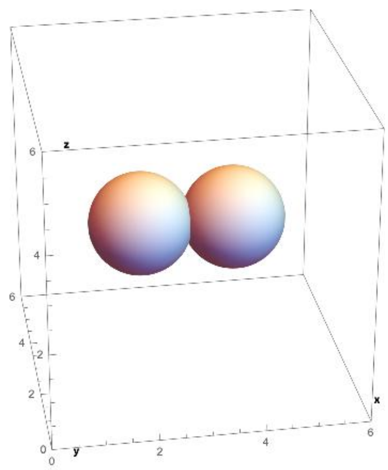

Figure 3: The figure shows two indivisible particles colliding, this structure is what we call mass, it can simplified be described as a vector.

The Planck mass particle, consisting of two colliding indivisibles, is not symmetrical, it has a direction in space, so it is a vector. Non planck-mass particles in our model consist of indivisible particles, each moving back and forth over a distance equal to the reduced Compton wavelength of that particle and then colliding, this can be illustrated by figure 4, this is also clearly a vector as such structure also have direction in space.

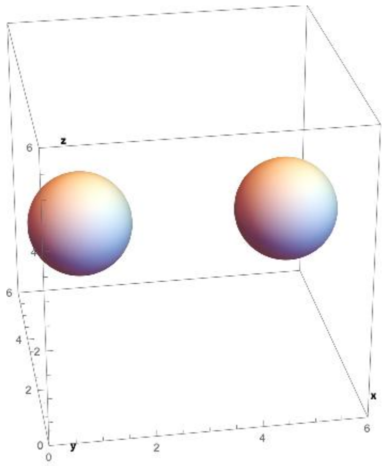

Figure 4: The figure shows two indivisible particles traveling after each other with a distance center to center equal to the Compton wave, this is a vector.

From this perspective we have

$$\boldsymbol{m} = (m_x, m_y, m_z) = \frac{\hbar}{\bar{\boldsymbol{\lambda}}}\frac{1}{c} = \left(\frac{\hbar}{\bar{\lambda}_x}\frac{1}{c}, \frac{\hbar}{\bar{\lambda}_y}\frac{1}{c}, \frac{\hbar}{\bar{\lambda}_z}\frac{1}{c}\right), \tag{100}$$

that is the reduced Compton wavelength in our model is not spreading out in all directions for elementary particles, but has a direction in space, as illustrated in figure 3 and 4, where the reduced Compton wavelength is the distance center to center between the indivisibe particles. This mean also the Compton momentum is a vector, as we have

$$\boldsymbol{p}_t = (p_x, p_y, p_z) = \boldsymbol{m}c\gamma = (m_x c\gamma, m_y c\gamma, m_z c\gamma) \tag{101}$$

Another alternative to assume that mass is a vector and that the Compton momentum and also energy for this reason is a vector is that mass is a scalar, but that the Compton momentum and energy still can be vectors by assuming the velocity of light is a vector velocity-field. This would mean we have $\bar{\boldsymbol{p}} = \bar{m}\boldsymbol{c}\gamma$ and $\bar{\boldsymbol{E}} = \bar{m}\boldsymbol{c}\gamma$. Another way to make the Compton momentum and energy into vectors is to multiply each with a unit velocity vector, $\bar{\boldsymbol{p}} = \bar{m}c\gamma\hat{\boldsymbol{v}}$ and $\bar{\boldsymbol{E}} = \bar{m}c\gamma\hat{\boldsymbol{v}}$. That is there are several ways to get our theory mathematical consistent, but each method would likely lead to different interpretations, so it is not enough just to have it mathematics consistent. A small side step is the photon mass, the photon mass is in general given by simply $p = \frac{\hbar}{\lambda_\gamma}$. There is no need for velocity in the standard photon momentum. The way standard physics turn standard momentum into a vector is by assuming one have a light velocity field and now writing the momentum as fourth momentum, $\mathbf{P} = (p_t, p_x, p_y, p_z) = \left(\frac{E}{c}, \frac{Ev_x}{c^2}, \frac{Ev_y}{c^2}, \frac{Ev_z}{c^2}\right)$, however what if it is the wavelength of the photon that has direction in space, we could alternatively getting a vector from the photon momentum this way, $\boldsymbol{p} = (p_x, p_y, p_z) = \frac{\hbar}{\boldsymbol{\lambda}_\gamma} = \left(\frac{\hbar}{\lambda_{\gamma,x}}, \frac{\hbar}{\lambda_{\gamma,y}}, \frac{\hbar}{\lambda_{\gamma,z}}\right)$, just to illustrate that perhaps our idea of mass being a vector due to that the reduced Compton wavelength likely best can be described as a vector, likely is closer to standard theory than one intially can get the impression off.

Anyway, let us assume, mass, energy and momentum are vectors. Remember the Compton momentum is identical to our energy. This is unlike standard physics. So we have

$$\bar{\boldsymbol{E}} = \boldsymbol{m}c = \boldsymbol{p}_t \tag{102}$$

We can replace the energy vector with the following energy time operator $\hat{\bar{E}} = il_p\nabla_t = l_p\boldsymbol{i}\frac{\partial}{\partial t_x} + l_p\boldsymbol{j}\frac{\partial}{\partial t_y} + l_p\boldsymbol{k}\frac{\partial}{\partial t_z}$ and the Compton momentum space operator with $\hat{\bar{p}} = il_p^2\boldsymbol{c}\cdot\nabla = il_p^2\boldsymbol{v}_x\frac{\partial}{\partial x} + il_p^2\boldsymbol{v}_y\frac{\partial}{\partial y} + il_p^2\boldsymbol{v}_z\frac{\partial}{\partial z}$. This gives the following quantum wave equation[5] that should be consistent with our relativistic energy Compton momentum relation, and therefore indirectly also the standard relativistic energy momentum relation, see section 2

$$il_p\nabla_t\Psi = il_p^2\boldsymbol{c}\cdot\nabla\Psi \tag{103}$$

[5]We [52] have done a very similar attempt before, where we got $\frac{\partial\Psi}{\partial t} = \boldsymbol{c}\cdot\nabla\Psi$, we now have discovered we had done an error there with respect to the energy operator, and that this wave equation should be corrected to $\frac{\partial\Psi}{\partial t} = l_p\boldsymbol{c}\cdot\nabla\Psi$. This time we have also carefully considered if mass and energy are vectors or scalars and paid attention to get the math consistent here, this lead us to our new and this time we hope complete and robust quantum wave equation of $\nabla_t\Psi = l_p\boldsymbol{c}\cdot\nabla\Psi$. Our previous wave-equation could likely not handle gravity, but after the fix it should handle gravity, energy, mass, and even space and time.

where $\boldsymbol{c}$ is an incompressible light vector velocity field, and and Ψ is a scalar wave-function. We can divide by il_p on each side and simplify further to

$$\nabla_t \Psi = l_p \boldsymbol{c} \cdot \nabla \Psi \tag{104}$$

That is we have three dimensional time and three dimensional space, so one could even claim six dimensional collision space-time (3+3), but it is more like the familiar three dimensions in space are both connected to both space and time, this because mass is collision-time, and mass also has physical extension at the deepest subatomic level, collision-length also has extension and direction. Collision-time and collision-length are two sides of the same coin, we cannot observe space without time, and we can not observe time without space. In this theory it is not like we can move only along the x-axis and at the same time we move in the $t_x, t_y and t_z$ direction. To move only in the x direction in space means also only moving in the t_x direction in time, the time direction follows the space direction as they ultimately are one and the same. Calling our six dimensional space-time double-three-dimensional would perhaps be a better way to coin our theory than six dimensional. In our theory time just means something was standing still while something was moving relative to it. Time simply means we can move in three dimensions. If we not could move, then the world would be 100% static, and could not even be observed.

To observe space we need to move in space, and also to observed time we need to be able to move in space. We are not the first that seriously are consider the quantum world to have three time dimensions and three space dimensions, see for example [87–97] that also suggested there where three time dimensions and three space dimensions (3+3). Still this line of thought have not seemed to gain momentum and was mostly discussed in the 1970s to 1980s, and is partly forgotten. Perhaps we are much closer to understand the possibility of this now.

Our new relativistic quantum equation has quite a different plane wave solution than the Klein–Gordon and Schrödinger equations, but at first glance it looks exactly the same:

$$\psi = e^{i(kx-\omega t)} \tag{105}$$

In our theory, we should have $k = \frac{2\pi}{\lambda}$, where λ is the relativistic Compton wavelength and not the de Broglie wavelength as assumed to be in standard wave mechanics, see for example [23, 98]. We have

$$\bar{p}_t = \bar{m}_t c = \frac{l_p}{c}\frac{l_p 2\pi}{\lambda} c = k l_p^2 \tag{106}$$

and we have remember the frequency per Planck time is given by $\frac{\bar{E}}{l_p} = \frac{l_p}{\lambda}$, this means if ω is the frequency per Planck time then we have

$$\bar{E} = \bar{m}_t c = \frac{l_p}{c}\frac{l_p 2\pi}{\lambda} c = l_p \frac{l_p}{\bar{\lambda}} = l_p \frac{l_p 2\pi}{\lambda} = l_p \omega \tag{107}$$

One normally think of frequency as $\frac{c}{\lambda}$, but this is the frequency per second. The frequency per Planck time is $\frac{c}{\lambda} t_p = \frac{l_p}{\lambda}$. So standard physics is working with the de Broglie frequency per second, while we are working with the Compton frequency per Planck time.

Based on the above, we can rewrite the plane wave solution as

$$\psi = e^{i(kx-\omega t)} = e^{i\left(\frac{\bar{p}_t}{l_p^2} l_p - \frac{\bar{E}}{l_p} t_p\right)} \tag{108}$$

$$\begin{aligned} \psi &= e^{i\left(\frac{1}{\bar{\lambda}}\gamma x - \frac{\bar{l_p}}{\bar{\lambda}}\gamma t\right)} && (109)\\ \psi &= e^{i\left(\frac{1}{\bar{\lambda}}\gamma l_p - \frac{\bar{l_p}}{\bar{\lambda}}\gamma t_p\right)} && (110)\\ \psi &= e^{i\left(1 - \frac{\bar{l_p}^2}{l_p c}\right)} && (111)\\ \psi &= e^{i\left(1 - \frac{\bar{l_p}}{c}\right)} && (112)\\ & && (113) \end{aligned}$$

$$\psi = e^{i\left(\frac{1}{\bar{\lambda}} x - \frac{\bar{l_p}}{\bar{\lambda}} t\right)} \tag{114}$$

where $\bar{p}_t$ is the total Compton momentum as defined earlier. So, our quantum wave function is rooted in the Compton wavelength instead of the de Broglie wavelength. For the formality of it, we look at the momentum and energy operators and see that they are correctly specified

$$\frac{\partial \psi}{\partial x} = \frac{i\bar{p}_t}{l_p^2} e^{i\left(\frac{\bar{p}_t}{l_p^2} x - \frac{\bar{E}}{l_p} t\right)} \tag{115}$$

This means the momentum operator must be

$$\hat{\bar{p}}_t = -il_p^2\nabla\cdot \tag{116}$$

and for energy we have

$$\frac{\partial\psi}{\partial t} = -\frac{i\bar{E}}{l_p}e^{i\left(\frac{\bar{p}_t}{l_p^2}x - \frac{\bar{E}}{l_p}t\right)} \tag{117}$$

and this gives us a energy operator of

$$\hat{\bar{E}} = -il_p\nabla_t \tag{118}$$

We see that also the momentum and energy operators are not the same as under standard quantum mechanics. An alternative would to instead speculatively assume the field is a vector field instead of a scalar field, this would likely lead to the following equation

$$\nabla_t\boldsymbol{A} = l_p\boldsymbol{c}\cdot\nabla\boldsymbol{A} \tag{119}$$

here $\boldsymbol{A}$ is a vector field. This is just an initial speculative idea we suggest here that should also be investigated further before it is rejected.

12 Formal re-derivation of Heisenberg uncertainty principle based on collision-time mass

Based on our Compton momentum operator $\hat{\bar{p}}_t = il_p^2\boldsymbol{c}\cdot\nabla$, or in the special case when only dealing with the x axis dimension we have $\hat{p} = l_p^2\boldsymbol{v}_x\frac{\partial}{\partial x}$. We can then check if our momentum and operator commute with the space operator $\hat{x}$. We should have

$$\begin{aligned}
[\hat{\bar{p}}_t, \hat{x}]\Psi &= [\hat{\bar{p}}_t\hat{x} - \hat{x}\hat{\bar{p}}_t]\Psi \\
&= \hat{\bar{p}}_t\hat{x}\Psi - \hat{x}\hat{\bar{p}}_t\Psi \\
&= l_p^2 i\boldsymbol{v}_x\frac{\partial}{\partial x}x\Psi - x\left(l_p^2 i\boldsymbol{v}_x\frac{\partial\Psi}{\partial x}\right) \\
&= l_p^2\left(xi\boldsymbol{v}_x\frac{\partial\Psi}{\partial x} + \frac{\partial x}{\partial x} - xi\boldsymbol{v}_x\frac{\partial\Psi}{\partial x}\right) = l_p^2\Psi
\end{aligned} \tag{120}$$

That is, $\hat{\bar{p}}_t$ and $\hat{x}$ as expected do not commute, just as in the case for the standard Heisenberg uncertainty principle, and we must have

$$\begin{aligned}
\Delta\bar{p}_t\Delta x &\geq |\int\Psi^*[\hat{p},\hat{x}]\Psi dx| \\
\Delta\bar{p}_t\Delta x &\geq |\int\Psi^*(l_p^2)\Psi dx| \\
\Delta\bar{p}_t\Delta x &\geq |l_p^2\int\Psi^*\Psi dx| \\
\Delta\bar{p}_t\Delta x &\geq l_p^2
\end{aligned} \tag{121}$$

This looks unfamiliar, but is nothing more mysterious than that our new mass definition is the kg mass definition multiplied by $\frac{l_p^2}{\hbar}$, so we end up with $\Delta\bar{p}_t\Delta x \geq l_p^2$ instead of $\Delta\bar{p}_t\Delta x \geq \hbar$. In the special case of the Planck mass particle we will challenge if the procedure above can be used, or at least how it should be interpreted. The Planck mass particle only has la lifetime equal to the Planck time, and the Planck time is the shortest time-interval that can exist in our theory, and the Planck length is the shortest space interval one can observe. And we are not thinking about what we can observe from the most advanced technical instruments here, but an ideal quantum observer, that even could be a single photon, or in this case even a single indivisible particle, that in our theory is the building block of all energy and matter. This particle has a diameter equal to the Planck length. The Planck mass particle is two such indivisible particles standing side by side (in a collision) for the Planck time, for then to leave each other again at the speed of light. In other words, we cannot look at change in space or change in time for a Planck mass particle, as it would already have dissolved as we went from t_p to $2t_p$, and t_p is the shortest possible time interval, and l_p the shortest length interval. We have shown that a new type of quantum frequency probability always is one for a Planck mass particle. We think it is likely that the Heisenberg uncertainty principle collapses from an uncertainty principle to a certainty principle for the

Planck mass particle. One interpretation is that the $\geq$ sign in the uncertainty principle above then simply switch (or simplify) to a equal sign, and that we in this special case of the Planck mass particle simply have

$$\begin{aligned}
\bar{p}_t l_p &\geq l_p^2 \\
m_p c \gamma l_p &\geq l_p^2 \\
\frac{\frac{l_p}{c}\frac{l_p}{l_p}}{\sqrt{1-\frac{(\Delta v)^2}{c^2}}} l_p &\geq l_p^2 \\
\frac{\frac{l_p}{c}\frac{l_p}{l_p}}{\sqrt{1-\frac{0^2}{c^2}}} l_p &\geq l_p^2 \\
l_p l_p &\geq l_p^2 \\
1 &\geq 1
\end{aligned} \tag{122}$$

And naturally we cannot have $1 \geq 1$, but only $1 = 1$. It is as if in the very limit the principle above goes from $\geq$ to just $=$, and this also means the uncertainty collapses. In terms of uncertainty this would naturally mean that we for the Planck mass particle have $\Delta \bar{p}_t \Delta x = 0$.

If we are right, this could potentially have major implications for series of interpretations in quantum mechanics. For example we would expect there to implications for entanglement and Bells theorem [99]. Bells theorem was a response against Einstein, Podolsky, and Rosen's hidden variable theory [100], where it is assumed that Bell proved that Einstein, Podolsky, and Rosen idea about hidden variable theories where wrong. However, Bells theorem is based on the we could say the hidden assumption that the Heisenberg's uncertainty principle always hold, see for example [101, 102]. If the Heisenberg uncertainty principle, when understood from a deeper perspective not is an uncertainty principle for the Planck mass particle, but becomes a certainty principle in this very limit (or alternatively simply is not valid for Planck mass particles), then we can no longer exclude the possibility for hidden variables. We think this is a path worth investigating further. After all we have clearly shown in the gravity sections in this paper, that the Planck length can easily be extracted from Newtonian gravity phenomena and only by knowing one other constant c. The Planck length we have shown is likely linked to a Planck mass particle. And we have reason to think the Planck mass particle has been misunderstood in the past. One have been searching for an enormously large particle mass, 10^{-8} kg, that is no where to be found. Well this is the mass of the Planck mass particle, but it only exist for the Planck time, and it is therefore observational time-window dependent. In terms of kg and in relation to the time unit of one second it correspond to only about 10^{-51} kg. Even in an electron we claim the Planck mass particle comes into existence at the reduced Compton frequency of the electron, that is $f_e = \frac{c}{\bar{\lambda}_e} \approx 7.76 \times 10^{20}$ times per second. That is an enormous number of times per second that we have a Heisenberg uncertainty principle likely break down, with break down we simply mean $\geq$ is limited to $=$ and that the uncertainty then disappear. However this is very hard to detect as the Heisenberg uncertainty is valid $1 - \frac{l_p}{\bar{\lambda}_e} \approx 1 - 4.1 \times 10^{-23}$ fraction of the observational time. To detect the Heisenberg uncertainty break down in a single electron would likely mean to be able to measure observable gravity effects from a single electron. This we are not able to do, but we are able to measure gravity effects from a massive amounts of protons, that again consist of elementary particles. So in our view can easily measure break down of the Heisenberg uncertainty principle, it is any observable gravity observation.

13 Is Minkowski space-time a derivative of a deeper and simpler space-time?

Our quantum wave equation $\nabla_t \psi = l_p \boldsymbol{c} \cdot \nabla \psi$, must be inconsistent with Minkowski [103] spacetime (even if we should go back to assume time was one dimensional), as our relativistic quantum wave equation only is consistent with six dimensions. An alternative would be to try to re-formulate it as a four dimensional space-time theory[6]. Actually it is not even clear if Minkowski space-time is fully consistent with standard quantum mechanics, see for example [104] for a discussion on this.

Minkowski space-time is basically given by

$$dt^2 c^2 - dx^2 - dy^2 - dz^2 = ds^2 \tag{123}$$

where the space-time interval ds^2 is invariant. It is a four dimensional space-time, with three space dimensions and one time dimension. In the case we deal with the simplified case of one dimension in space and time we have the well known relation

$$dt^2 c^2 - dx^2 = ds^2 \tag{124}$$

[6]Perhaps something like $\frac{\partial \Psi}{\partial t} = l_p \boldsymbol{c} \cdot \nabla \Psi$.

This relation is directly linked to the Lorentz transformation, as we have

$$t'^2c^2 - x'^2 = \left(\frac{t - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - tv}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 = s^2 \tag{125}$$

Next assume we now are working with two events that are distance L apart that are linked with causality. For the two events to be linked by causality information needs to be sent between them, it could be for example in the form of a bullet coming from event one and hitting event two, or a sound signal. The signal moves at speed v_2 as observed from the rest frame of L. This means the time between the cause and effect between the two events is $t = \frac{L}{v_2}$. We also have a speed v, which is the velocity of the frame where L is at rest with respect to another reference frame. From this we have

$$t'^2c^2 - x'^2 = \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \tag{126}$$

The Minkowski space-time interval is invariant because $s^2 = t'^2c^2 - x'^2$ is invariant. This naturally means it is observed to be the same, no matter what reference frame it is observed from. One why to understand why this is the case is to look at the following derivation

$$\begin{aligned}
s^2 = t'^2c^2 - x'^2 &= \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\
&= \left(\frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 - \left(\frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\
&= \frac{L^2 - 2L^2\frac{v}{v_2} + L^2\frac{v^2}{v_2^2}}{1-\frac{v^2}{c^2}} - \frac{L^2\frac{c^2}{v_2^2} - 2L^2\frac{v}{v_2} + L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\
&= \frac{L^2 + L^2\frac{v^2}{v_2^2} - L^2\frac{c^2}{v_2^2} - L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\
&= \frac{L^2\left(1 - \frac{v^2}{c^2} + \frac{v^2}{v_2^2} - \frac{c^2}{v_2^2}\right)}{1-\frac{v^2}{c^2}} \\
&= \frac{L^2\left(1 - \frac{v^2}{c^2}\right)\left(1 - \frac{c^2}{v_2^2}\right)}{1-\frac{v^2}{c^2}} \\
&= L^2\left(1 - \frac{c^2}{v_2^2}\right)
\end{aligned} \tag{127}$$

That is v is falling out of the equation, and the Minkowski space-time interval interval therefore is proven invariant. For a given signal speed v_2 between two events, the space-time interval is the same from every reference frame. From this we can also see why it is necessary to square the time and space intervals to get rid of the v, and thereby to get an invariant space-time interval. Just hypothetically we can see what happens if we do not square the time and space intervals, we would get

$$\begin{aligned}
s = t'c - x' &= \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right) c - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right) \\
&= \frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{L\frac{c}{v_2} - L\frac{v}{c} - L + L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}}
\end{aligned} \tag{128}$$

That is v will not go away and the space-time interval s would then not be invariant, that is $ds = dtc - dx$ is in general not invariant, only $ds^2 = dt^2c^2 - dx^2$. In the special case where the signal between the two causal events is always moving at $v_2 = c$, then things simplify considerably. In this special case, we have

$$\begin{aligned}
s^2 = t'^2c^2 - x'^2 &= \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\
&= \left(\frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 - \left(\frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\
&= \frac{L^2 - 2L^2\frac{v}{c} + L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} - \frac{L^2\frac{c^2}{c^2} - 2L^2\frac{v}{c} + L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\
&= 0
\end{aligned} \tag{129}$$

Already in 1960, Rindler[7] [105] showed that the Minkowski space-time could be simplified from $dt^2c^2 - dx^2 - dy^2 - dz^2 = ds^2$ to $dt^2c^2 - dx^2 - dy^2 - dz^2 = 0$ when dealing with light signals, and also in the moving system $dt'^2c^2 - dx'^2 - dy'^2 - dz'^2 = 0$, see also [106]. This is compatible with what we have shown above. This further means that we for the special case of a signal sent by a light beam must have

$$dt^2c^2 - dx^2 - dy^2 - dz^2 = dt'^2c^2 - dx'^2 - dy'^2 - dz'^2 \tag{130}$$

Actually in the case $v_2 = c$, that is the speed of the signal between two events that are connected by causality we can speculate that the squaring of the space and time intervals are not needed, as we also have

$$\begin{aligned}
s = t'c - x' &= \frac{\frac{L}{c} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} = 0
\end{aligned} \tag{131}$$

In other words, we do not need to square the space interval and the time interval to have an invariant space-time interval when the two events are linked by causality through light signals. An important question is if dropping the squaring of space and time intervals leads to any other inconsistencies, so this part of our paper we admit is more of a philosophical speculation. And if it even is needed for us to get a fully consistent theory to get rid of the squaring is not clear at this point.

Next let us replace L with the reduced Compton-wavelength, as this is the distance indivisible particles travel inside particles at the speed of light and then collide, in other words internally in matter at the very quantum level we only have causality events linked at the speed of light, this gives

$$\begin{aligned}
t'c - x' &= \frac{\frac{\bar{\lambda}}{c} - \frac{\bar{\lambda}}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} = 0
\end{aligned} \tag{132}$$

In the special case of a Planck mass particle, we have $\bar{\lambda} = l_p$ and further we have $v = 0$ since v_{max} for a Planck mass particle is zero. This gives

$$\begin{aligned}
t'c - x' &= 0 \\
\frac{\frac{\bar{l_p}}{c} - \frac{l_p}{c^2} \times v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{l_p - \frac{l_p}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} &= 0 \\
\frac{l_p - \frac{l_p}{c} \times 0}{\sqrt{1-\frac{0^2}{c^2}}} - \frac{l_p - \frac{l_p}{c} \times 0}{\sqrt{1-\frac{0^2}{c^2}}} &= 0 \\
t_pc - l_p &= 0 \\
t_pc &= l_p
\end{aligned} \tag{133}$$

[7] And perhaps others had showed the same long before him?

Which simply means our theory also on this is consistent with the Planck scale. Again the reason for we always have $v = 0$ for the Planck mass particle is that it only can be observed directly from itself. It last one Planck time, and its "radius" is the Planck length, it can only "communicate" with itself and only be observed from one of the two indivisible particles that are part of the Planck mass particle, and that stand next to each other in a collision. The Planck mass particle is always the same, it is invariant, but due to very special reasons as we have discussed through this paper.

In six dimensional space-time our theory is likely leading to

$$cdt_x + cdt_y + cdt_z - dx - dy - dz = 0 \tag{134}$$

or an alternative to be investigated if it is compatible with our theory is the six dimensional space-time as suggested for by example by Cloe [87] in 1977:

$$dx^2 - dy^2 - dz^2 - c^2dt_x^2 + c^2dt_y^2 + c^2dt_z^2 = 0 \tag{135}$$

An important point mentioned by is that, while x, y and z are observable separately, it is often be thought that the quantity $t = \sqrt{t_x^2 + t_y^2 + t_z^2}$ is observable only in one time measurement t. The drawback of this interpretation as pointed out by Cole, is that if the transformations for the six co-ordinates x, y, z, t_x, t_y, t_z are linear, then the transformations for the quantities x, y, z and t become nonlinear. In other words it seems to lead to simplification to add two time dimensions.

One interpretation of the space-time interval always being equal to zero is that internally in elementary particles all communication and causal events are connected by indivisible particles moving at the speed of light.

In our model we are operating with the relativistic energy Compton momentum relation, which is given by

$$\boldsymbol{E} = \bar{\boldsymbol{p}}_t \tag{136}$$

Which correspond to the following relativistic wave equation

$$\begin{aligned} \nabla_t \Psi &= l_p \boldsymbol{c} \cdot \nabla \Psi \\ \boldsymbol{i}\frac{\partial \Psi}{\partial t_x} + \boldsymbol{j}\frac{\partial \Psi}{\partial t_y} + \boldsymbol{k}\frac{\partial \Psi}{\partial t_z}\Psi &= l_p \boldsymbol{v}_x \frac{\partial \Psi}{\partial x} + l_p \boldsymbol{v}_y \frac{\partial \Psi}{\partial y} + l_p \boldsymbol{v}_z \frac{\partial \Psi}{\partial z}\Psi \end{aligned} \tag{137}$$

So we possibly have the following space-time at the deepest level of reality (needed to describe collision space-time)

$$dx - dy - dz = cdt_x + cdt_y + cdt_z \tag{138}$$

Again we do not think it should be looked as six dimensions, but as double-three dimensional, where we not can observe space without motion, and motion requiers time. If we move for example only in the y direction, then time also have to move in the y direction. That is y in the space directly linked directly to t_y. Collision-space and collision-time are two sides of the same coin, it is nothing more than three dimensions plus motion, but mathematically it can be perhaps best described as a six dimensional (3+3) theory.

14 Summary

We have claimed that the Compton wavelength is the true matter wave and that the de Broglie wavelength is simply a mathematical function of this deeper reality. Further that the standard momentum is also just a mathematical function of what we have coined the Compton momentum. This has led to a unnecessarily complex theory, also the de Broglie wavelength and the standard momentum we have argued not can be mathematically defined for rest-mass particles, $v = 0$, so anything that is built on standard momentum, such as standard quantum mechanics and the Heisenberg uncertainty principle cannot be valid to say anything about rest-mass particles.

We have also shown that standard physics indirectly used two different mass definitions. There is in our view an embedded more correct mass definition in gravity theory that one gets from multiplying the kg mass with G. In all non-gravity parts of physics, one is using an incomplete mass definition, and this also makes it impossible to unify gravity and quantum mechanics, before this is understood and fixed, as we have attempted to started to do in this paper. When this is done it seems that we get a deeper and simpler theory, we can from this theory derive "all" the most well-known formulas in physics, but it can then be shown that many of them are unnecessarily complex, and that they often not can describe rest-mass particles. On the other hand, the new and deeper theory is fully consistent with also rest-mass particles. Rest-mass particles are of essence to understanding gravity from a quantum perspective, as it seems like gravity is directly linked to absolute rest, that we have in the Planck mass particle.

	Standard physics: derivatives of deeper reality:	**Deeper reality :**	**Relation :**
Matter wave	$\bar{\lambda}_b$ de Broglie wavelength	$\bar{\lambda}$ Compton wavelength	$\bar{\lambda} = \bar{\lambda}\frac{c}{v}$
Relativistic mass	$m = \frac{\hbar}{\bar{\lambda}_b}\frac{1}{v}\gamma$	$\bar{m} = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}\gamma$	$m = \bar{m}$
Rest mass	$m = \frac{\hbar}{\bar{\lambda}_b}\frac{1}{v}$ Not valid for $v = 0$	$\bar{m} = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}$	$m \neq \bar{m}$
Momentum	$p = mv\gamma$ de Broglie momentum	$p_t = \bar{m}\gamma$ Compton momentum	$p = p_t\frac{v}{c}$
Energy momentum relation	$E^2 = p^2c^2 + m^2c^4$	$\bar{E} = \bar{p}_t = \bar{m}c\gamma$	"see sec X
Space-time	$dtc^2 - dx^2 - dy^2 - dz^2 = ds^2$	$dt_x + dt_y + dt_z = dx + dy + dz$	see sec X
Relativistic wave equation	$\frac{\partial^2\psi}{\partial t^2} = \nabla^2\psi + \frac{m^2c^2}{\hbar^2}\psi$ Klein-Gordon	$\nabla_t\psi = l_p\boldsymbol{c}\cdot\nabla\psi$ Haug	see sec X
Newton gravity	$F = G\frac{Mm}{R^2}$	$F = c^3\frac{M\bar{m}}{R^2}$	
Number of universal constants	$G, \hbar, c$	l_p, c	

Table 8: The table shows a summary of how our theory leads to simplification of series of equations/relationships, and still our theory is compatible with the standard equations, but we have shown that many of the standard equations not are compatible with such things as rest-mass particles, that do not include all the formulas to the left in this table. Well, only the Newton gravity formula is actually fully valid for rest-mass particles, in the left side column, while all the equations in the right-side column is valid also for particles at rest.

15 Conclusion

We have discussed how the Compton wavelength likely is the real matter wavelength, and how the de Broglie wavelength likely just is a mathematical function (derivative) of the Compton wavelength. We have also shown how the standard momentum must be consistent and also can be derived from the de Broglie wavelength. In contrast to the Compton wavelength, the de Broglie wavelength is not mathematical valid for rest-mass particles, and we claim also the standard momentum is not valid for rest-mass particles. Quantum mechanics, including the Heisenberg uncertainty principle, has its foundation in the standard momentum and or the de Broglie wavelength. Much of our existing theory can therefore say nothing about rest mass particles. We have however introduced a new momentum that is directly linked to the Compton wavelength and is fully valid also for rest-mass particles. In addition, we have shown that physics uses two mass definitions without being aware of it. On gravity theory they are using a more complete mass definition that consist of G multiplied by M (without understanding it), while in the rest of physics one is using an incomplete mass definition. We must both switch to the Compton wavelength from the de Broglie wavelength and to the kg mass to a new mass definition that already is embedded in existing gravity physics to have a chance to unify gravity with quantum mechanics. We have tried to do so in this paper. This seems to lead also to a simplification of quantum mechanics. We get a quantum mechanics that seems to be six dimensional, three dimensions in space and their correspondent three dimensions in time. Our new and deeper understanding of mass and gravity also makes us able to extract the Planck length and also the speed of gravity directly from observable gravity phenomena without any prior knowledge to other constants. It seems like the three universal constants, G, $\hbar$ and c can be replaced with l_p and c. All masses can be seen as a Planck mass multiplied by a quantum probability for the particle to be in a collision state, the same with energy. In our theory mass is collision-time and energy is collision-length.

References

[1] Joshua C. Gregory. *A Short History of Atomism.* London, A & Black, 1931.

[2] A. K. Mishra. Atomism in ancient greece and india. *Ambix journal*, 8(2):98.

[3] G. S. Kirk, J. E. Raven, and M. Schofield. *The Presocratic Philosophers.* Second Edition, Cambridge University Press, 1983.

[4] C.C.W. Taylor. *The Atomists: Leucippus and Democritus, Fragments and Translation with Commentary.* University of Toronto Press, 1999.

[5] E. G. Haug. *Unified Revolution, New Fundamental Physics.* Oslo, E.G.H. Publishing, 2014.

[6] Andrew Pyle. *Atomism and it's Critics.* Bristol, Thoemmes Press, 1995.

[7] E. Schrödinger. *Nature and the Greeks and Science and Humanism.* Cambridge University Press, 1954.

[8] B. Dorminey. *Distant Wanderers: The Search for Planets Beyond the Solar System.* Copernicus, 2002.

[9] de. L. Broglie. Waves and quanta. *Nature*, 112:540, 1923. URL https://www.nature.com/articles/112540a0.

[10] de. L. Broglie. Recherches sur la thorie des quanta. *PhD Thesis (Paris)*, 1924.

[11] I Newton. *Philosophiae Naturalis Principia Mathematica*. London, 1686.

[12] I Newton. *Opticks*. London, 1704.

[13] M. Jammer. *Concepts of Mas in Contemporary Physics and Philosophy*. Princeton University Press, 2000.

[14] B. P. Kibble, J. H. Sanders, and A. H. Wapstra. A measurement of the gyromagnetic ratio of the proton by the strong field method. *Atomic Masses and Fundamental Constants*, 5:545, 1975.

[15] M. Stock. The watt balance: determination of the planck constant and redefinition of the kilogram. *Philosophical Transactions of the Royal Society*, 369:3936–3953, 2011. URL https://doi.org/10.1098/rsta.2011.0184.

[16] I. A. Robinson and S. Schlamminger. The watt or kibble balance: a technique for implementing the new si definition of the unit of mass. *Metrologia*, 53(5):A46, 2016. URL https://doi.org/10.1088/0026-1394/53/5/A46.

[17] A. H. Compton. A quantum theory of the scattering of x-rays by light elements. *Physical Review*, 21(5): 483, 1923. URL https://journals.aps.org/pr/abstract/10.1103/PhysRev.21.483.

[18] de. L. Broglie. *An introduction to the Study of Wave Mechanics*. Metheum & Co., Essex, 1930.

[19] H. Chauhan, S. Rawal, and R. K. Sinha. Wave-particle duality revitalized: Consequences, applications and relativistic quantum mechanics. *https://arxiv.org/pdf/1110.4263.pdf*, 2011.

[20] A. I. Lvovsky. *Quantum Physics: An Introduction Based on Photons*. Springer, 2018.

[21] Max Born. *The Restless Universe*. Harper & Brothers, New York, 1936.

[22] E. G. Haug. Derivation of a relativistic compton wave. *Under review . https://vixra.org/abs/2002.0523*, 2020.

[23] P. J. E. Peebles. *Quantum Mechanics*. Princeton University Press, 1992.

[24] Albert Einstein. Ist die trägheit eines körpers von seinem energieinhalt abhängig? *Annalen der Physik*, 323(13):639–641, 1905.

[25] G. P. Thomson and A Reid. Diffraction of cathode rays by a thin film. *Nature*, 119:890, 1927. URL https://doi.org/10.1038/120802a0.

[26] C. Davisson and L. H. Germer. Diffraction of electrons by a crystal of nickel. *Physical Review*, 30(705): 705, 1927. URL https://doi.org/10.1103/PhysRev.30.705.

[27] J. Jennings. *Miscellanea in Usum Juventutis Academicae*. Northampton: R. Aikes & G. Dicey., 1721.

[28] David Bohem. *The Special Theory of Relativity*. Routledge, 1965.

[29] Jacob Gravesande, Willem. *Mathematical Elements of Physicks, prov'd by Experiments: Being an Introduction to Sir Isaac Newton's Philosophy... Made English, and illustrated with 33 copper-plates, Revis'd and corrected, by Dr. John Keill.* London, 1720.

[30] D. Bernoulli. Commentarii. *Commentarii Acad. Sci. Imperialis Petropolitanae*, 8(99), 1741.

[31] G. G. Coriolis. *Du Calcul de l'Effet des Machines*. Carilian-Goeury, Paris, 1829.

[32] J. V. Poncelet. *Introduction á la mécanique industrielle, physique ou expérimentale*. Carilian-Goeury, Paris, 1829.

[33] E. Schrödinger. An undulatory theory of the mechanics of atoms and molecules. *Physical Review*, 28(6): 104–1070, 1926. URL https://doi.org/10.1103/PhysRev.28.1049.

[34] W. Heisenberg. Über den anschaulichen inhalt der quantentheoretischen kinematik und mechanik. *Zeitschrift für Physik*, (43):172–198, 1927. URL https://doi.org/10.1007/BF01397280.

[35] E. H.. Kennard. Zur quantenmechanik einfacher bewegungstypen. *Zeitschrift für Physik*, (44):326–352, 1927.

[36] C. Huygens. *Horologium oscillatorium sive de motu pendularium*. 1673.

[37] E. G. Haug. The huygens formula is exact for a very large angle: The moon-earth system as a gigantic pendulum clock. *Working paper Norwegian University of Life Sciences*, 2020.

[38] K. Simonyi. *The Cultural History of Physics*. CRC Press, 2010.

[39] J. Milstrom. *The Hunt for Earth Gravity*. Springer, 2018.

[40] I. B. Cohen. Newton's determination of the masses and densities of the sun, jupiter, saturn, and the earth. *Archive for History of Exact Sciences*, 53(1):83, 1998. URL https://doi.org/10.1007/s004070050022.

[41] A. Cornu and J. B. Baille. Détermination nouvelle de la constante de l'attraction et de la densité moyenne de la terre. *C. R. Acad. Sci. Paris*, 76, 1873.

[42] J. G. Stoney. On the physical units of nature. *The Scientific Proceedings of the Royal Dublin Society*, 3, 1883.

[43] M. Planck. *Natuerliche Masseinheiten*. Der Königlich Preussischen Akademie Der Wissenschaften, 1899.

[44] M. Planck. *Vorlesungen über die Theorie der Wärmestrahlung*. Leipzig: J.A. Barth, p. 163, see also the English translation "The Theory of Radiation" (1959) Dover, 1906.

[45] A. S. Eddington. *A Mathematical Theory of Relativity*. Cambridge University Press, 1922.

[46] P. W. Bridgman. *Dimensional Analysis*. New Haven: Yale University Press, 1931.

[47] T. Padmanabhan. Planck length as the lower bound to all physical length scales. *General Relativity and Gravitation*, 17, 1985. URL https://doi.org/10.1007/BF00760244.

[48] R. J. Adler. Six easy roads to the planck scale. *American Journal of Physics*, 78(9), 2010. URL https://doi.org/10.1119/1.3439650.

[49] S. Hossenfelder. Can we measure structures to a precision better than the planck length? *Classical and Quantum Gravity*, 29, 2012. URL https://doi.org/10.12942/lrr-2013-2.

[50] H. Okawa, K. Nakao, and M. Shibata. Is super-planckian physics visible? scattering of black holes in 5 dimensions. *Physical Review D*, 83, 2011. URL https://doi.org/10.1103/PhysRevD.83.124008.

[51] A. Unzicker. *The Mathematical Reality: Why Space and Time Are an Illusion*. Independently published, 2020.

[52] E. G. Haug. The gravitational constant and the planck units. a simplification of the quantum realm. *Physics Essays*, 29(4):558, 2016. URL https://doi.org/10.4006/0836-1398-29.4.558.

[53] G. Gräff, H. Kalinowsky, and J. Traut. A direct determination of the proton electron mass ratio. *Zeitschrift fr Physik A Atoms and Nuclei*, 297(1), 1980. URL https://link.springer.com/article/10.1007/BF01414243.

[54] P. Becker. The new kilogram definition based on counting the atoms in a ^{28}si crystal. *Contemporary Physics*, 53:461, 2012. URL https://doi.org/10.1080/00107514.2012.746054.

[55] G. et. al. Bartl. A new ^{28} si single crystal: Counting the atoms for the new kilogram definition. *Metrologica*, 54:693, 2017. URL https://doi.org/10.1088/1681-7575/aa7820.

[56] O. Wang, Z. W. and. Toikkanen, F. Yin, Z.Y. Li, B. M Quinn, and R. E. Palmer. Counting the atoms in supported, monolayer-protected gold clusters. *J. Am. Chem. Soc.*, 132:2854, 2010. URL https://pubs.acs.org/doi/pdf/10.1021/ja909598g.

[57] E. G. Haug. Collision space-time: Unified quantum gravity. *Physics Essays*, 33(1):46, 2020. URL https://doi.org/10.4006/0836-1398-33.1.46.

[58] E. G. Haug. Finding the planck length multiplied by the speed of light without any knowledge of g, c, or h, using a newton force spring. *Journal Physics Communication*, 33:46, 2020. URL https://doi.org/10.1088/2399-6528/ab9dd7.

[59] J. Michell. On the means of discovering the distance, magnitude &c.of the fixed stars, in consequence of the diminution of the velocity of their light, in case such a diminution should be found to take place in any of them, and such other data should be procured from observations. *Philosophical Transactions of the Royal Society*, 74, 1784.

[60] E. G. Haug. Proof that newton gravity moves at the speed of light and not instantaneously (infinite speed) as thought! *Research-gate, in for review with journal.*, 2020. URL https://doi.org/10.13140/RG.2.2.21917.13282.

[61] M. J. Duff, L. B. Okun, and G. Veneziano. Trialogue on the number of fundamental constants. *Journal of High Energy Physics*, 2002, 2002. URL ttps://doi.org/10.1088/1126-6708/2002/03/023.

[62] P. Langacker. *Can the Laws of Physics Be Unified?* Princeton University Press, 2017.

[63] E. Schrödinger. Über die kräftefreie bewegung in der relativistischen quantenmechanik. *Sitzungsberichte der Preuischen Akademie der Wissenschaften. Physikalisch-mathematische Klasse*, 1930.

[64] Albert Einstein. On the electrodynamics of moving bodies. *Annalen der Physik, English translation by George Barker Jeffery 1923*, (17), 1905.

[65] E. G. Haug. Modern physics incomplete absurd relativistic mass interpretation. and the simple solution that saves einstein's formula. *Journal of Modern Physics*, 9(14), 2018.

[66] E. G. Haug. Does special relativity lead to a trans-planckian crisis? *Applied Physics Research*, 12(1), 2020.

[67] E. G. Haug. The ultimate limits of the relativistic rocket equation. the planck photon rocket. *Acta Astronautica*, 136, 2017.

[68] E. G. Haug. Deriving the maximum velocity of matter from the planck length limit on length contraction. *http://vixra.org/abs/1612.0358*, 2016.

[69] L. Motz. Gauge invariance and the structure of charged particles. *Il Nuovo Cimento*, 26(4), 1962. URL https://doi.org/10.1007/BF02781795.

[70] L. Motz. A gravitational theory of the mu meson and leptons in general. *Rutherford Observatory, Columbia University*, 1966.

[71] L. Motz. The quantization of mass. *Rutherford Observatory, Columbia University*, 1971.

[72] M.A. Markov. Elementary particles of maximally large masses (quarks and maximons). *Soviet Physics JPT*, 24(3), 2014. URL http://www.jetp.ac.ru/cgi-bin/dn/e_024_03_0584.pdf.

[73] S. S. De. Quantum creation of highly massive particles in the very early universe. *International Journal of Theoretical Physics*, 2001.

[74] S. Hawking. Gravitationally collapsed objects of very low mass. *Monthly Notices of the Royal Astronomical Society*, 152, 1971.

[75] L. Motz and J. Epstein. The gravitational charge $1/2\sqrt{\hbar c}$ as a unifying principle in physics. *Il Nuovo Cimento*, 51(1), 1979.

[76] G. M. Obermair. Primordial planck mass black holes (ppmbhs) as candidates for dark matter? *Journal of Physics, Conference Series*, 442, 2013.

[77] J. H. Macgibbon. Can planck-mass relics of evaporating black holes close the universe? *Nature*, 329, 1987.

[78] V.I. Dokuchaev and Y. N. Eroshenko. Black hole atom as a dark matter particle candidate. *Advances in High Energy Physics*, 2014, 2014.

[79] Quintero J. Gilles G.T. Spavieri, G. and Rodriguez M. A survey of existing and proposed classical and quantum approaches to the photon mass. *The European Physical Journal D*, 61:1, 2011.

[80] O. J. Pike, F. Mackenroth, E. G. Hill, and Rose S. J. A photon–photon collider in a vacuum hohlraum. *Nature Photonics*, 8, 2014.

[81] Paul Dirac. The physical interpretation of quantum mechanics. *Proc. Roy. Soc. London*, (A 180):1–39, 1942.

[82] W. Pauli. Die allgemeinen prinzipien der wellenmechanik. *Nachdruck aus Handbuch Der Physic Band V, Springer, Berlin*, 1958.

[83] Richard P. Feynman. Negative probability. *First published in the book Quantum Implications : Essays in Honour of David Bohm, by F. David Peat (Editor), Basil Hiley (Editor) Routledge & Kegan Paul Ltd, London & New York*, pages 235–248, http://kh.bu.edu/qcl/pdf/feynmanr19850a6e6862.pdf, 1987.

[84] Andrei Yu. Khrennikov. *Interpretations of Probability*. Coronet Books, 1999.

[85] Andrei Yu. Khrennikov. Bell's inequality: Physics meets probability. *arXiv:0709.3909*, 2007.

[86] Espen G. Haug. Why so negative to negative probabilities? *Wilmott Magazine Sep/Oct*, 2004.

[87] E.A.B. Cole. Superluminal transformations using either complex space-time or real space time symmetry. *Nuovo Cimento B*, 40:171, 1977. URL https://doi.org/10.1007/BF02776784.

[88] P. T. Pappas. Physics in six dimensions: An axiomatic formulation. *Lettere al Nuovo Cimento*, 22:601, 1978.

[89] E. A. B. Cole. Particle decay in six-dimensional relativity. *Journal of Physics A: Mathematical and General*, 13:109, 1980. URL https://doi.org/10.1088/0305-4470/13/1/012.

[90] E. A. B. Cole. Comments on the use of three time dimensions in relativity. *Physics Letters A*, 76:371, 1980. URL https://doi.org/10.1016/0375-9601(80)90734-3.

[91] E.A.B. Cole. Gravitational effects in six-dimensional relativity. *Nuovo Cimento B*, 55:269, 1980. URL https://doi.org/10.1007/BF02739160.

[92] G. Ziino. Three-dimensional time and thomas precession. *Lett. Nuovo Cimento*, 31:629, 1981. URL https://doi.org/10.1007/BF02777968.

[93] S. A. Buchanan and E. A. B. Cole. Space-time transformations in six-dimensional special relativity. *Journal of Physics A: Mathematical and General*, 15:255, 1982. URL https://doi.org/10.1088/0305-4470/15/6/001.

[94] E. A. B. Cole. A proposed observational test of six-dimensional relativity. *Journal of Physics A: Mathematical and General*, 85:282, 1983. URL https://doi.org/10.1016/0375-9601(83)90019-1.

[95] J. B. Boyling and E. A. B. Cole. Six-dimensional dirac equation. *International Journal of Theoretical Physics*, 32:801, 1993. URL https://doi.org/10.1007/BF00671667.

[96] P. A Lanciani. Model of the electron in a 6-dimensional spacetime. *Foundations of Physics*, 29:251, 1999. URL https://doi.org/10.1023/A:1018825722778.

[97] G. A. J. Sparling. Germ of a synthesis: space?time is spinorial, extra dimensions are time-like. *Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences*, 463, 2007. URL https://doi.org/10.1098/rspa.2007.1839.

[98] L. Susskind. *Quantum Mechanics, The Theoretical Minimum*. Basic Books, 2014.

[99] J. S. Bell. On the einstein podolsky rosen paradox. *Physics*, 1, 1964.

[100] Albert Einstein, B. Podolsky, and N. Rosen. Can quantum mechanical description of physical reality be considered complete? *Phys. Rev.*, (47):777–780, 1935.

[101] M. Clover. Bell's theorem: a new derivation that preserves heisenberg and locality. *arXiv:quant-ph/0409058*, 2005.

[102] M. Clover. Bell's theorem: A critique. *arXiv:quant-ph/0502016*, 2005.

[103] H. Minkowski. Space and time. *A Translation of an Address delivered at the 80th Assembly of German Natural Scientists and Physicians, at Cologne, 21 September, in the book "The Principle of Relativity", Dover 1923*, 1908.

[104] W. G. Unruh. *Chapter: Minkowski Space-Time and Quantum Mechanics, in the book Minkowski Spacetime: A Hundred Years Later, Edited by V. Petkov*. Springer, 2009. URL https://www.springer.com/gp/book/9789048134748.

[105] Wolfgang Rindler. *Special Relativity*. Oliver and Boyd, 1960.

[106] Wolfgang Rindler. *Relativity, Special, General and Cosmology, Second Edition*. Oxford University Press, 2006.