Finally a Unified Quantum Gravity Theory! Collision Space-Time: The Missing Piece of Matter! Gravity is Lorentz and Heisenberg Break Down at the Planck Scale. Gravity without G

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Abstract

Based on a very simple model where mass, at the deepest level, is colliding indivisible particles and energy is indivisible particles not colliding, we get a new and simple model of matter that seems to be consistent with experiments. Gravity appears to be directly linked to collision time and also the space the collisions take up; we could call it collision space-time. This leads to a completely new quantum gravity theory that is able to explain and predict all major gravity phenomena without any knowledge of Newton's gravitational constant or the mass size in the traditional sense. In addition, the Planck constant is not needed.

Our model, combined with experimental data, strongly indicates that matter is granular and consists of indivisible particles that are colliding. Further, from experiments it is clear that the diameter of the indivisible indivisible particle is the Planck length. Our theory even predicts that there can be no time dilation in quasars, something that is consistent with observations and yet is inconsistent with existing gravity theories.

Several modern quantum gravity models indicate that Lorentz symmetry is broken at the Planck scale, but there have been no signs of this occurring, despite extensive efforts to look for Lorentz symmetry break downs. We show that Lorentz symmetry break downs indeed happen and, to our own surprise, this is actually very easy to detect. In our model, it is clear that Lorentz symmetry break down is gravity itself. This seems contradictory, as Planck energies are very high energy levels, but we show that this must be seen in a new perspective.

We also introduce a new quantum wave equation that tells us that gravity is both Lorentz symmetry break down and Heisenberg uncertainty break down at the Planck scale. Our wave equation in this sense includes gravity. For masses smaller than a Planck mass, probability will also dominate gravity; it is then a probability for Heisenberg uncertainty break down. At the Planck mass size and up, determinism dominates.

For the first time, we have a quantum theory that unifies gravity with the quantum, all derived from a very simple model about the quantum. Our theory is simple, and we show that an indivisible particle is the fundamental unit of all mass and energy – a quantity that has been missing in physics all this time. Newton was one of the last great physicists who thought that such particle was essential, but it was naturally impossible for one man to solve the entire problem. This paper stands on the shoulders of giants like Newton, Einstein, Planck, and Compton to explore these long-standing questions.

The beauty of our theory is that it keeps almost all existing and well-tested equations completely intact (unchanged) all the way to the Planck scale. Anything else would be a surprise; after all, some areas of physics have been extremely successful in predictions and have also been well-tested. Still, in our work, the Planck scale and all equations are united into one simple and powerful theory. Unlike standard physics, there are no inconsistencies in our theory. QM is unified with gravity, and even a simplified version of the Minkowski space-time is consistent with QM and gravity. A long series of mysteries in QM vanish, under our new interpretation.

Key Words: Quantum gravity, granular matter, Lorentz symmetry break down at the Planck scale, Heisenberg uncertainty break down at the Planck scale, indivisible particles, gravity and Lorentz symmetry break down.

1 Introduction to Our New Theory

We are suggesting a new model for understanding matter that leads to a simple quantum gravity theory where all major gravity phenomena can be described and predicted without any knowledge of Newton's gravitational constant. Further, for the first time, we get a quantum wave equation that is consistent and actually indirectly predicts gravity. We postulate that all matter and energy at the deepest level only consist of

- Indivisible particles moving at a constant (unknown) speed in the empty space, but standing absolute still at collision with each other.
- Empty space in which the indivisible particles can move.

When such an indivisible particle is moving it is (pure) energy and when it is colliding with another particle it is pure mass. That is, the collision itself is mass. It is a totally binary system. This simple theory seems to explain such things as "wave-particle" duality in both light and matter. For simplicity's sake, we can think of the indivisible particle as being sphere shaped. This particle is indestructible, something consistent with ancient atomist ideas, and also ideas held by Isaac Newton, who stated:

> *All these things being consider'd it seems probable to me, that God in the Beginning form'd Matter in solid, massy, hard, impenetrable, movable Particles, of such Sizes and Figures, and in such Proportion to Space, as most conduce to the End for which he form'd them; and that these primitive Particles being Solids, are incomparably harder than any porous Bodies compounded of them; even so very hard, as never to wear or break in pieces; no ordinary Power being able to divide what God himself made one in the first Creation. While the Particles continue entire, they may compose bodies of one and the same Nature and Texture in all Ages; But should they wear away, or break in pieces, the Nature of Things depending on them, would be changed. Those minute rondures, swimming in space, from the stuff of the world: the solid, coloured table I write on, no, less than the thin invisible air I breathe, is constructed out of small colourless corpuscles; the world at close quarters looks like the night sky – a few dots of stuff, scattered sporadically through and empty vastness. Such is modern corpuscularianism.*

Newton actually made a substantial number of references to ancient Greek atomists such as Lucretius, so it clearly one of his inspirational sources, although whether it played a role in his discoveries or not is unclear [1, 2]. The point is that even Newton took indivisible particles seriously as the constituents of matter and energy – an idea going back at least 2,500 years to the Greek atomists, see [3–7], for example. While several modern physicists like Scrödinger [8] also spent time studying ancient atomism, it seems like little came out of it. However, we think that modern physics gave up on atomism before investigating it adequately. As both historians of science and scientists have noted over the centuries, breakthroughs in scientific research ideas is partly about luck – stumbling over a combination of ideas and putting them together into a form that suddenly make sense also takes skills, but that is not the whole story.

The so-called wavelength in light we will claim is simply the empty space between indivisible particles traveling after each other in the same direction. Again, mass is constituted by collisions between indivisible particles, and this is the pure mass. This means mass will have two important aspects at the deepest level, namely the number of collisions in an observational time window and the length of each collision. The length of each collision can be measured as time or as length, that is in space or time. In observed elementary particles, such as electrons, we envision a minimum of two indivisible particles traveling back and forth over the reduced Compton wavelength of the particle at the speed of light and then colliding with each other at the reduced Compton time interval. An electron will, therefore, consist of this most fundamental mass that is the collision point between two building blocks of photons at the following times per second

$$f_e = \frac{c}{\bar{\lambda}} \approx 1.23 \times 10^{20} \tag{1}$$

This means the sum of the collision masses, m_x must add up to the experimentally well-known electron mass

$$\begin{aligned} \frac{c}{\bar{\lambda}_e} m_x &= m_e \approx 9.1 \times 10^{-31}\text{kg} \\ m_x &= m_e \frac{\bar{\lambda}_e}{c} \approx 7.37 \times 10^{-51} \text{ kg} \end{aligned} \tag{2}$$

We clearly see that the collision mass m_x is observational time window dependent in this model, as it is the electron mass multiplied by a time interval, namely the Compton time of the electron. The electron mass is considered to be observable time-independent. This means the collision mass, m_x must be time dependent, because one can assume we measure the mass of the electron in half a second instead of a second; then the internal frequency must be simply half of what it was in a one second observational time window, that is

$$f_e = \frac{1}{2} \frac{c}{\bar{\lambda}} \approx 1.23 \times 10^{20} \approx 3.88 \times 10^{20} \tag{3}$$

This means that in order to still have the mass as 9.1×10^{-31}kg, the collision mass must now be reduced to twice the size of what it was earlier. That is, the collision mass is observational time dependent. An interesting question is then, "If there exists a shortest possible time interval, what will the mass be then?" This is something we will return to later.

We will discover that standard mass measures such as the kg are far from optimal and we would say even a bit primitive, as they contain a limited amount of information about what exactly mass (matter) is. The reduced Compton [9] wavelength is given by

$$\bar{\lambda} = \frac{\hbar}{mc} \tag{4}$$

solved with respect to m this gives

$$m = \frac{\hbar}{\bar{\lambda}} \frac{1}{c} \tag{5}$$

This means the mass can be found if we know the Compton wavelength, the Planck constant, and the speed of light (well known). For example, [10] has shown that one can find the rest-mass energy of the electron simply by extracting the Compton wavelength through Compton scattering. This means the Compton wavelength is the only property that changes between different masses (elementary particles), as the Planck constant and the speed of light are constants. Still, the formula does not seem to give us much intuition about exactly what mass is. However, we will suggest that the Planck constant is linked to the number of collisions per second in one kg of matter.

$$f_{1kg} = \frac{c}{\bar{\lambda}} = \frac{c}{\frac{\hbar}{1\text{ kg } \times c}} = \frac{c^2}{\hbar} = 8.52 \times 10^{50} \tag{6}$$

An electron has an internal collision frequency per second of

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

Our mass definition in kg is then simply the number of collisions in a particle relative to the number of collisions in one kg. For an electron, this is

$$m_e = \frac{f_e}{f_{1kg}} = \frac{7.76 \times 10^{20}}{8.52 \times 10^{50}} \approx 9.1 \times 10^{-31}\text{kg} \tag{8}$$

In our view, kg is then simply the collision frequency ratio. In ancient times, a practical quantity of matter (a clump of matter) was chosen to standardize the quantity (weight) of mass. To do this, the mass could not be too small, as this in an age of inaccurate weights would give too much uncertainty for practical purposes. Neither would it be practical to work with too large a clump of matter, as that would be heavy to move around, and in those days, weights in the form of clumps of matter were actively used by merchants. Weight measures were used to standardize trade and to make sure one could compare prices on the same quantity. This led to the establishment of one kg as the standard for a clump of matter (an example of which has even been stored in Paris) and until recently have been the universal standard. Recently, analysis has offered the idea that the Planck constant creates the weight standard, as the Watt balance can be used to measure it very accurately. From this we can find one kg, see [11–13].

For observation time intervals considerably longer than the Compton time, the mass of elementary particles is observational time independent. For example, in half a second the number of collisions in an electron is $\frac{1}{2} \times 7.76 \times 10^{20}$, and the number of collisions in one kg will be reduced in half, so the ratio stays the same. Thus, the collision ratio is observational time independent in this case, as long as the observational time window is much longer than the Compton time. Therefore, it may look like mass is not related to time, but it is. Next let us get close to an observational time of the reduced Compton time of the electron. For example, if we are observing the electron in a time window of $1.5 \times \frac{\bar{\lambda}}{c}$, then the number of observations in the electron will still only be one, since there are only collisions at every whole reduced Compton time. However, the number of collisions in the one kg during this time window is

$$8.52 \times 10^{50} \times 1.5 \frac{\lambda_e}{c} \approx 1.64665 \times 10^{30} \tag{9}$$

That is, the observed weight of the electron will now be reduced to

$$m_e = \frac{1}{1.64665 \times 10^{30}} = 6.07 \times 10^{-31} \tag{10}$$

So, all elementary masses are observational time dependent if the observational time-interval is short enough. If we plan to observe the electron in a time interval shorter than the electron Compton time and do not know when the last time it had an internal collision, then its mass will be probabilistic. A fraction of a collision is a probability, as we only can work with integer numbers of collisions; there cannot be half a collision, there have to be N collisions, where N is an integer, or no collisions at all.

The smallest possible mass is one collision. Compared to the number of collisions in one kg, we get the collision ratio

$$m_g = \frac{f_g}{f_{1kg}} = \frac{1}{1.37 \times 10^{50}} \approx 1.17 \times 10^{-51} \text{ kg} \tag{11}$$

However, if we reduce the observational time window but keep the frequency of 1 constant, then its mass will keep increasing. A particle with frequency of only 1 is what we can call the mass gap, and it is indeed 1.17×10^{-51} kg per one second observational time window. If the observational time window is half a second, the mass gap will have twice the collision ratio above. This because only the number of collisions in one kg will be reduced. Assume for a moment the shortest possible time interval is the Planck time, then the collision frequency of the mass gap will be

$$m_g = \frac{1}{.37 \times 10^{50} \times t_p} = \frac{1}{.37 \times 10^{50} \times \frac{l_p}{c}} = 2.17 \times 10^{-8} \text{ kg} \tag{12}$$

which is the Planck mass. However, modern physics disagrees on whether the Planck time is the shortest time-interval and therefore if the Planck length is the shortest distance. Some physicists think there could be a unit smaller than the Planck length, see [14–16], while others maintain that there should be no minimum length at all – that zero is the minimum. Nevertheless, the majority of physicists seem to agree that there is a minimum length and that it likely is the Planck length [17–21]. Still, modern physics claims that the Planck units can only be found using the three so-called universal constants, namely Newton's gravitational constant G, the speed of light c, and the Planck constant. We will show that this is not the case. Since the Planck constant is linked to mass and G is linked to gravity, one already has some hint that the Planck scale is linked to mass and gravity as well as the speed of light, or even the speed of gravity, since they are considered to be the same. Recently, Haug has shown that the Planck units can be extracted from gravity experiments with no knowledge of the gravitational constant, see [22, 23]. After extensive searching through various methods of extracting the Planck length, we find that they all involve matter and gravity. In this paper, we provide deeper insight into why the Planck length can only be found from gravity and why it is, in fact, the very essence of gravity.

In our view, the kg only capture one of two important aspects of mass, namely the number of collisions, and it is, as we have shown, a collision ratio, which is a new perspective on the topic. However, even if we accept the idea that the kg definition (or any weight) definition of mass is actually a ratio of collisions, we are still missing out on the other important aspect of matter, which is how long each collision lasts and how often there are collisions as opposed to there being no collisions in a elementary particle or a given amount of matter. We will suggest that collision time is directly linked to gravity, although this not incorporated into today's mass model, it is there in the physical world. As we continue the analysis, we will see how current gravity theories are indirectly getting this aspect into their models, including the Newton model, without being aware of it.

In the next sections, we will show how a quantum theory can be built from the ground up, based on granular matter, that is to say, indivisible particles, and we explain how this is fully consistent with all major gravity phenomena. We can easily calibrate our model to gravity observations without any prior knowledge of Newton's gravitational constant and our model even correctly predicts such things as there being no time dilations in quasars, which has been observed but not explained well by current gravity theories. We will also show how Lorentz symmetry break down at the Planck scale is actually gravity. Naturally, extraordinary claims require extraordinarily good evidence, but we will offer strong support for this theory, and encourage rigorous investigation by the physics community.

2 Mass as Collision Time per Shortest Time Interval

Assume the indivisible particle has an unknown diameter of x. Since, we will claim, all matter and even the particle aspects of photons are made up of such a unit, then this diameter must be incredibly small. Also, we assume that the indivisible particle, when not colliding, moves at a speed of c. Or, more precisely, we assume that when it is not colliding, it will move at the distance of its own diameter in the same period of time that two indivisibles will spend in collision. This would explain the deeper aspects of why there is a maximum speed limit. The idea is that there is ultimately only one particle and it can move its own diameter during the period two indivisible particles spend in collision. Since this is the ultimate particle that all other particles consist of, then it must also be the fastest particle. Again, one should not confuse this with the conventional thinking about such particles. This is a massless particle, but because collisions between such particles are what we call mass, then such a particle has mass when it is colliding and is massless when it is not. It can either move or stand absolutely still, but these are the only choices. This will appear to be in conflict with well-established ideas including the relativity of simultaneity, but it is important to study the whole framework carefully without rejecting the theory prematurely.

In our model, mass has two important properties. Mass is a collision, and the number of collisions per time unit will depend on the mass size. How long the collisions last, we will claim, is directly linked to gravity. As modern mass is a collision ratio only, it misses out of the central part of gravity, namely collision time. Newton and Einstein gravity must incorporate this into their gravity model using a gravity constant, which is a calibrated constant needed to get the models to fit observations, even if it is unclear what it truly represents. Further, we find some mysterious units, which are $m^3 \cdot kg^{-1} \cdot s^{-2}$. The universe did not invent such constants; it much more likely consists of fundamental building blocks, and the chance that any of these building blocks are $m^3 \cdot kg^{-1} \cdot s^{-2}$ is unlikely. Still, the gravitational constant is "clearly" universal and important in the existing gravity models, but the fact that even with all of the work completed over the past century, we have not been able to unite ideas about the quantum world and gravity. Modern gravity theory does include collision time in the theoretical model in an unnecessarily complex and perhaps unaware way; this is something we will address later in this paper. Returning to our analysis, the collision time per shortest time interval is given by

$$\tilde{m}_t = \frac{\frac{x}{c}}{\frac{\bar{\lambda}}{c}}\frac{x}{c} = \frac{x}{c}\frac{c}{\bar{\lambda}}\frac{x}{c} = \frac{x}{\bar{\lambda}}\frac{x}{c} \tag{13}$$

This will be one of our our two mass measures. The part $\frac{\frac{x}{c}}{\frac{\bar{\lambda}}{c}} = \frac{x}{\bar{\lambda}}$ is simply the percentage of the time the mass is in collision, and we have to multiply this with the time it takes to collide $\frac{x}{c}$ to find the collision time over the shortest possible time interval. Again, this is based on the assumption that the indivisible particle can travel its own diameter in the period during which two indivisible particles are in collision. Alternatively, we can express the mass

$$\tilde{m}_L = \frac{\frac{x}{c}}{\frac{\bar{\lambda}}{c}}x = \frac{x}{c}\frac{c}{\bar{\lambda}}x = \frac{x}{\bar{\lambda}}x \tag{14}$$

This is the collision time divided by the non-collision time, so it is the collision time ratio multiplied by the length of the indivisible particle. This is what we can call "collision space." Further, the mass in the form of length, divided by the mass in the form of collision time should give us the speed of light (collision space-time)

$$c = \frac{\tilde{m}_L}{\tilde{m}_t} \tag{15}$$

Our model is quite interesting because it means that mass is directly linked to space and time and therefore also to speed. We could even call it the collision space-time model of matter. Still, it is important to understand that it is always quantized, and that pure mass comes in integer units.

This theory will only hold true if one indivisible particle travels its own diameter during the period two other indivisible particles spend in collision. If, for example, an indivisible particle that is not in collision only travels half of its own diameter during the period in which two indivisible particles are colliding, then our model will be off, and will not fit observations. Whether or not our model fits observations, we will examine a bit later. In addition, our model provides insight about the speed of light; it is simply the length that an indivisible particle can travel (when not colliding) during the period two indivisible particles are spending time in collision. Here we are indirectly suggesting that this distance is the particle's own diameter. If this holds true, it must lead to a theory that fits observations.

3 Gravity Is Directly Linked to Collision Time (Length)

If our theory is right, in order to find the mass in kg we need to multiply our mass with $\frac{\hbar}{x^2}$. However, by doing this we actually lose important information; we are removing information about the diameter of the indivisible particle that we claim is essential to find the collision time (length) in any mass. And the Planck constant is needed only to make the mass into something relative to an arbitrary quantity of matter (like one kg or one pound). For example, the mass of an electron in kg must, from our model, be

$$m = \tilde{m}\frac{\hbar}{x^2} = \frac{x}{c}\frac{c}{\lambda_e}\frac{x}{c} \times \frac{h}{x^2} = \frac{h}{\lambda_e}\frac{1}{c} \approx 9.1 \text{ kg} \tag{16}$$

However, the mass as kg (or pound or any such) we will claim only takes into account the number of internal collisions in a particle; as we have seen that kg simply is a collision ratio, and it does not say anything about how long the collisions last and this the key to gravity; in fact, it is gravity. With mass as collision time, we will claim the gravity force formula should be

$$F = c^3\frac{\tilde{M}_t\tilde{m}_t}{R^2} \tag{17}$$

That is, the gravity constant is now simply the speed of light squared and the masses are the collision time per shortest time interval – the masses are now unknown since we do not know the diameter of the indivisible particle. Since the mass at a deeper level is $\tilde{m}_t = \frac{x}{\bar{\lambda}}\frac{x}{c}$, then we can rewrite the gravity formula as

$$F = c^3 \frac{\frac{x}{\bar{\lambda}_M}\frac{x}{c}\frac{x}{\bar{\lambda}_m}\frac{x}{c}}{R^2} = c\frac{\frac{x^2}{\bar{\lambda}_M}\frac{x^2}{\bar{\lambda}_m}}{R^2} \tag{18}$$

Thus, x is the unknown diameter of the particle, c is the speed of light (and gravity), and $\bar{\lambda}_M$ and $\bar{\lambda}_m$ are the reduced Compton wavelength of the small and the large masses. We have a simple quantum gravity model, so far in the non-relativistic world, in a later section we will add relativistic effects to it. We will claim all the parameters in the model can be found without knowledge of G or $\hbar$, and as we will show later, even without knowledge of c.

4 Finding the Parameters for our Gravity Model

In our gravity formula described in the last section, we need to find the unknown diameter of the indivisible particle and the reduced Compton wavelength of the small and large masses. To do this, we first measure the Compton length of an electron by Compton scattering and find it is $\bar{\lambda}_e \approx 3.86 \times 10^{-13}$ m. We are not going to measure gravity only on an electron, but this helps us finding the reduced Compton wavelength for large masses. Further, the cyclotron frequency is linearly proportional to the reduced Compton frequency. Conducting a cyclotron experiment, one can find the reduced Compton frequency ratio between the proton and the electron. For example, [24] measured it to be about (see also [25])

$$\frac{\frac{c}{\bar{\lambda}_P}}{\frac{c}{\bar{\lambda}_e}} = \frac{f_P}{f_e} = 1836.152470(76) \tag{19}$$

.

In fact, they measured the proton-electron mass ratio this way and not the mass in kg. Interestingly, the reduced Compton frequency is only a deeper aspect of mass that has recently been more or less confirmed by experimental research, see [26, 27]. Theoretically, it is no surprise that $\frac{f_P}{f_e} = \frac{m_P}{m_e}$. This also holds true in our mass definition

$$\begin{aligned} \frac{f_P}{f_e} &= \frac{\tilde{m}_P}{\tilde{m}_e} \\ \frac{f_P}{f_e} &= \frac{\frac{x^2}{\bar{\lambda}_P}\frac{1}{c}}{\frac{x^2}{\bar{\lambda}_e}\frac{1}{c}} = \frac{\bar{\lambda}_e}{\bar{\lambda}_P} \end{aligned} \tag{20}$$

That is, we can find the Compton length of an electron and also a proton without any knowledge of $\hbar$, or traditional mass measures such as kg. Now, to find the Compton frequency and the reduced Compton length in larger amounts of matter we just need to count the amounts of protons and electrons in them. Twice the mass has twice the Compton frequency.

We will claim that the diameter of the indivisible particle is directly linked to the time it takes for collisions and that the collision space-time is what we call gravity. We must therefore perform a gravity measure to calibrate our model. After we have calibrated the model once, it should give us the one and unknown diameter of the indivisible particle x. We should then be able to predict all other known gravity phenomena based on the model.

To calibrate the model, we will use a Cavendish apparatus first developed by Henry Cavendish, [28]. Assume we count 3×10^{26} number of protons and add them in a clump of matter. This clump of matter we will divide in two and use as two large balls in the Cavendish apparatus. We now know that the Compton frequency in the large balls in the Cavendish apparatus are approximately $1836.15 \times 1.5 \times 10^{26} = 2.13 \times 10^{50}$ per second. The reduced Compton length must then be $\bar{\lambda}_M = \frac{f}{c} = \frac{2.13 \times 10^{50}}{c} \approx 1.4 \times 10^{-42}$ m. This Compton wavelength is even smaller than the Planck length, something that we soon will understand is physically impossible. But it is important to be aware we are working with a composite mass consisting of many elementary particles. Even though a composite mass does not have one physical Compton wavelength (it has many), such masses can mathematically be aggregated in the following way

$$\bar{\lambda} = \frac{\hbar}{\sum_{i=1}^{N} m_i c} = \frac{1}{\frac{1}{\bar{\lambda}_i} + \frac{1}{\bar{\lambda}_{i+1}} + \frac{1}{\bar{\lambda}_n}} \tag{21}$$

So, we can find the reduced Compton length of any mass by direct measurements of elementary particles and then counting the number of such particles in a larger mass. However, there is still an unknown parameter, namely the diameter of our suggested indivisible particles. Combining our new theory of matter and gravity with a torsion balance (Cavendish apparatus), we can measure the unknown diameter of the indivisible particle. We have that

$$\kappa\theta \tag{22}$$

where κ is the torsion coefficient of the suspending wire and θ is the deflection angle of the balance. We then have the following well-known relationship

$$\kappa\theta = LF \tag{23}$$

where L is the length between the two small balls in the apparatus. Further, F can be set equal to our gravity force formula, but with a Compton view of matter and therefore no need for Newton's gravitational constant, this is important to help us bypass the need for the Planck constant as well. Our Newton-equivalent gravity formula is equal to

$$F = c^3 \frac{\tilde{M}_t \tilde{m}_t}{R^2} = c^3 \frac{\frac{x^2}{\lambda_M}\frac{1}{c}\frac{x^2}{\lambda_m}\frac{1}{c}}{R^2} \tag{24}$$

where x is unknown. This means we must have

$$\kappa\theta = Lc^3 \frac{\tilde{M}\tilde{m}}{R^2} \tag{25}$$

We also have that the natural resonant oscillation period of a torsion balance is given by

$$T = 2\pi\sqrt{\frac{I}{\kappa}} \tag{26}$$

Further, the moment of inertia I of the balance is given by

$$I = \tilde{m}\left(\frac{L}{2}\right)^2 + \tilde{m}\left(\frac{L}{2}\right)^2 = 2\tilde{m}\left(\frac{L}{2}\right)^2 = \frac{\tilde{m}L^2}{2} \tag{27}$$

this means we have

$$T = 2\pi\sqrt{\frac{\tilde{m}L^2}{2\kappa}} \tag{28}$$

and when solved with respect to κ, this gives

$$\begin{aligned} \frac{T^2}{2^2\pi^2} &= \frac{\tilde{m}L^2}{2\kappa} \\ \kappa &= \frac{\tilde{m}L^2}{2\frac{T^2}{2^2\pi^2}} \\ \kappa &= \frac{\tilde{m}L^2 2\pi^2}{T^2} \end{aligned} \tag{29}$$

Next, in equation 25 we are replacing κ with this expression

$$\begin{aligned} \frac{\tilde{m}_t L^2 2\pi^2}{T^2}\theta &= Lc^3 \frac{\tilde{M}_t \tilde{m}_t}{R^2} \\ \frac{L^2 2\pi^2}{T^2}\theta &= Lc^3 \frac{\tilde{M}_t}{R^2} \end{aligned} \tag{30}$$

Next remember our mass definition is $\tilde{M}_t = \frac{x^2}{\lambda}\frac{1}{c}$, which we now replace in the equation above and solving with respect to the unknown diameter of the particle, we get

$$\begin{aligned} \frac{L^2 2\pi^2}{T^2}\theta &= Lc^3 \frac{\frac{x^2}{\lambda}\frac{1}{c}}{R^2} \\ \frac{L^2 2\pi^2}{T^2}\theta &= Lx^2 \frac{\frac{c^2}{\lambda}}{R^2} \\ \frac{L 2\pi^2 R^2}{T^2 \frac{c^2}{\lambda}}\theta &= x^2 \\ x &= \sqrt{\frac{L2\pi^2 R^2}{T^2\frac{c^2}{\lambda}}\theta} \\ x &= \sqrt{\frac{L2\pi^2 R^2\theta}{T^2 f_C c}} \end{aligned} \tag{31}$$

where f_C is the reduced Compton frequency of the mass in question, that we earlier have shown how to find. Experimentally, one will find that x must be the Planck length and that the standard error in measurements is half of that of using Newtonian theory (finding G) in combination with Cavendish. Today one have access to small Cavendish apparatuses with built in fine electronics that can be used to do quite accurate measurements of x, and it is clear that x is close to the Planck length.

5 History and Deeper Insight into the Newton Gravity Constant

Before returning to our new quantum gravity theory, we will take a closer look at the Newtonian theory. Despite the fact that Newton himself actually never introduced or used a gravitational constant, today the so-called Newton gravitational constant, also known as big G, seems almost holy and untouchable. Newton's [29] gravity formula was simply

$$F = \frac{Mm}{R^2} \tag{32}$$

That is, that the gravity force is proportional to the masses multiplied divided by the square root of the center to center distance. Other physicists have had similar ideas, including Robert Hooke. The gravity constant was first indirectly measured in 1798 by Cavendish using a torsion balance apparatus, also known as Cavendish apparatus [28]. Cavendish used this to measure the weight of the Earth. And in 1873, the Newton gravity formula as it is known today was first formally described by Cornu and Baille [30] using the Newton constant, namely

$$F = f\frac{Mm}{R^2} \tag{33}$$

In the 1890s, the gravity constant was first called G, but many physicists still called it f in the early 1900s, see, for example, [31]. The gravity constant is, in modern physics, actually a constant that is found by calibrating the Newton model to fit observations. However, the gravity constant is heavily dependent on the definition of mass and our understanding (or we could even say our lack of understanding) of the nature of mass. It is a parameter that captures what one missed and this is fully understandable, as one has to start someplace. Still, in our view, little progress has been achieved since the time of Newton in understanding gravity at a deeper level. General relativity simply adapted the gravitational constant from Newtonian gravity.

Besides being a parameter needed to calibrate the Newtonian formula (and GR) to fit data the Newton gravity constant gives little intuition. That the constant does not seem to vary naturally indicates that it is related to something at a deeper level that is unchangeable. But could it really be something fundamental that exist in nature that is $m^3 \cdot kg^{-1} \cdot s^{-2}$?

In several papers, [32–34] we have suggested that the Newton gravity constant is a composite constant of the form

$$G = \frac{l_p^2 c^3}{\hbar} \tag{34}$$

This can be found simply by solving the Planck [35, 36] length formula $l_p = \sqrt{\frac{G\hbar}{c^3}}$ of Planck with respect to G. It is then easy to think this is just creating a circular problem, as from the Planck formula we need G in order to find the Planck length. However, as we have shown, the Planck length plays an essential role in matter and energy, and it can be found without any knowledge of G and the Planck constant [22, 23, 37]. In gravity we can do without both the gravity constant and the Planck constant. The gravity constant is only needed when one wants to go from gravity, which is a property of mass, namely the collison time (length) between indivisible particles.

The standard mass definition model is incomplete, the gravity constant that is embedded contains the Planck constant, the Planck length, and the speed of light. The Planck constant is actually needed to get rid of the Planck constant embedded in the mass to perform gravity calculations, the Planck length needs to be introduced, and the speed of gravity c, which is the speed of the indivisible particle. This we claim is done without modern physics knowing about it.

6 Performing other Gravity Predictions

Now that we have found that x is the Planck length, we can use our gravity model to predict other gravity phenomena. In our new quantum gravity theory, for example, the gravity acceleration field is found by

$$
\begin{aligned}
\tilde{m}a &= c^3\frac{\tilde{M}\tilde{m}}{R^2} \\
a &= \frac{c^3}{R^2}\tilde{M} \\
g = a &= c^3\frac{l_p^2}{\bar{\lambda}c} = \frac{c^2}{R^2}l_p\frac{l_p}{\bar{\lambda}}
\end{aligned} \tag{35}
$$

Similarly, we can derive all other major gravity phenomena. Table 1 shows our gravity theory for our two different mass definitions and its prediction side by side with Newton's gravity theory. As we can see, the models are identical at a deeper level for anything that can be measured, despite the force formulas itself is different. Again, in the Newton theory one must understand that G is a composite constant needed to get the Planck constant out of the mass and to get the Planck length into the mass. Our new theory, on the other hand, has a much deeper understanding of mass and can do this directly when building our theory up from a quantum understanding of mass. This is essential when we later will address issues in quantum mechanics. It is important to keep in mind that so far, we have not taken relativistic effects into account. The results below are, therefore, only weak field approximations in several cases, such as for escape velocity.

	Modern "Newton"	**Alternative-1**	**Alternative-2**
Mass seen as	Compton frequency relative to Compton frequency kg	Collision time per shortest time interval	Collision space per shortest time interval
Mass mathematically	$M = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}$	$\tilde{M}_t = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}$	$\tilde{M}_L = l_p\frac{l_p}{\bar{\lambda}}$
Gravity constant	$G = \frac{l_p^2 c^3}{\hbar}$	$\tilde{G}_t = c^3$	$\bar{G}_L = c^2$
Non "observable" predictions:			
Gravity force	$F = G\frac{Mm}{R^2}$	$\tilde{F} = c^3\frac{\tilde{M}_t\tilde{m}_t}{R^2}$	$\bar{F} = c^2\frac{\tilde{M}_L\bar{m}_L}{R^2}$
Gravity force	$F = \frac{\hbar c}{R^2}\frac{l_p}{\bar{\lambda}_M}\frac{l_p}{\bar{\lambda}_m}$	$\tilde{F} = \frac{c}{R^2}\frac{l_p^2}{\bar{\lambda}_M}\frac{l_p^2}{\bar{\lambda}_m}$	$\bar{F} = \frac{c^2}{R^2}\frac{l_p^2}{\bar{\lambda}_M}\frac{l_p^2}{\bar{\lambda}_m}$
Observable predictions:			
Gravity acceleration	$g = c^2\frac{l_p}{R^2}\frac{l_p}{\bar{\lambda}}$	$g = c^2\frac{l_p}{R^2}\frac{l_p}{\bar{\lambda}}$	$g = c^2\frac{l_p}{R^2}\frac{l_p}{\bar{\lambda}}$
Orbital velocity	$v_o = c\sqrt{\frac{l_p}{R}\frac{l_p}{\bar{\lambda}}}$	$v_o = c\sqrt{\frac{l_p}{R}\frac{l_p}{\bar{\lambda}}}$	$v_o = c\sqrt{\frac{l_p}{R}\frac{l_p}{\bar{\lambda}}}$
Escape velocity	$v_e = c\sqrt{2\frac{l_p}{R}\frac{l_p}{\bar{\lambda}}}$	$v_e = c\sqrt{2\frac{l_p}{R}\frac{l_p}{\bar{\lambda}}}$	$v_e = c\sqrt{2\frac{l_p}{R}\frac{l_p}{\bar{\lambda}}}$
Time dilation	$T_R = T_f\sqrt{1-\frac{v_e^2}{c^2}}$	$T_R = T_f\sqrt{1-\frac{v_e^2}{c^2}}$	$T_R = T_f\sqrt{1-\frac{v_e^2}{c^2}}$
Gravitational redshift	$z(r) = \frac{l_p}{r}\frac{l_p}{\bar{\lambda}}$	$z(r) = \frac{l_p}{r}\frac{l_p}{\bar{\lambda}}$	$z(r) = \frac{l_p}{r}\frac{l_p}{\bar{\lambda}}$
Deflection	$\delta = 2\frac{l_p}{r}\frac{l_p}{\bar{\lambda}}$	$\delta = 4\frac{l_p}{r}\frac{l_p}{\bar{\lambda}}$	$\delta = 4\frac{l_p}{r}\frac{l_p}{\bar{\lambda}}$
Schwarzschild radius	$r_s = 2l_p\frac{l_p}{\bar{\lambda}}$	$r_s = 2l_p\frac{l_p}{\bar{\lambda}} = 2\tilde{M}_t$	$r_s = 2l_p\frac{l_p}{\bar{\lambda}} = 2\tilde{M}_L c$
Energy	$E = Mc^2$	$E = \tilde{M}_t c^2$	$\bar{E} = \tilde{M}_L c^2$

Table 1: The table shows Newton's gravitational force in addition to two alternative Newton-type theories, but with different gravitational constants that all predict the same results.

Note that our mass definition is closely linked to the Schwarzschild radius. This is no coincidence. However, we will claim that the Schwarzschild radius is grossly misunderstood in standard physics. It is said represent a radius of a black hole, but it actually represents the collision time ratio multiplied by the Planck length. The Schwarzschild radius is a very key component of mass and gravity; it is the essence of all mass, and even if the collision point has mathematical properties identical to a black hole, it has little to do with the standard interpretation of black holes.

If our theory is right, then the Schwarzschild radius should easily be extracted by observing gravity with no knowledge off G and the Planck constant.

7 Finding the Mass (Schwarzschild radius) of Any Particle without Knowing G or $\hbar$ (and thereby also being able to predict all gravity phenomena without G)

The Schwarzschild radius can be found from the Schwarzschild metric of Einstein's field equation, see [38–40] and is normally given as

$$r_s = \frac{2GM}{c^2} \tag{36}$$

Newton weak field gravity theory gives an identical radius, as pointed out by Michell in 1784, see [41]. However, the standard derivation from Newton of a radius where the escape velocity is c must be wrong, as it is derived from a kinetic energy of the form $\frac{1}{2}mv^2$, which can only hold when $v << c$. We will show that our new quantum theory gives a relativistic Schwarzschild radius identical to GR, but with a very different interpretation.

As we know, GR adopted G from Newtonian theory, but, as we have claimed, G is only needed to get the Planck constant out of the mass, and to get the Planck length into the mass. This means that G is not required to perform gravity calculations/predictions; it is only needed when we are working with a definition of mass that does not incorporate the collision time between indivisible particles. The Schwarzschild radius can be found directly for cosmological-sized objects simply by

$$r_s = 2g\frac{R^2}{c^2} \tag{37}$$

where the gravitational acceleration g, the radius from the center of the gravitational object (for example from Earth), and the speed of light can be found totally independent of any knowledge of G, or even any knowledge of our traditional mass measure M. When the Schwarzschild radius is found, all known gravity phenomena can be found from it. Only when we want to return to our incomplete mass measure do we need G. Otherwise, G is never needed. It is the Planck length that is essential for gravity and it is inside the mass, as mass consists of indivisible particles with a diameter equal to the Planck length that are in a collision with each other. Many physicists will likely say this way of finding the Schwarzschild radius experimentally without knowledge of G is obvious, but examining it in greater detail leads to many interesting insights in other areas.

We can even extract the mass (the Schwarzschild radius) of the Earth directly from a beam of light in the gravitational field with no knowledge of G, the Planck constant, or the traditional mass measure, as recently published by [42]

$$r_s = 2g\frac{R^2}{c^2} = 2l_p\frac{l_p}{\bar{\lambda}} = \frac{R_L R_h(\lambda_h - \lambda_L)}{(\lambda_h R_h - \lambda_L R_L)} \tag{38}$$

where λ_h and λ_L are the wavelength of a beam of light moving towards or away from earth as observed from radii R_L and R_h ($R_h > R_L$). This also correspond the the mass of the gravity objects as described by collision time

$$\tilde{m}_t = g\frac{R^2}{c^3} = \frac{r_s}{2c} = \frac{l_p}{\bar{\lambda}}\frac{l_p}{c} = \frac{1}{2c}\frac{R_L R_h(\lambda_h - \lambda_L)}{(\lambda_h R_h - \lambda_L R_L)} \tag{39}$$

That is the collision time, that is our mass definition is simply its Schwarzschild radius divided by $2c$. This is no coincidence.

8 Our Gravity Model Is a Deterministic and Probabilistic Model

For example, half the Schwarzschild radius for any mass is given by

$$\frac{1}{2}r_s = l_p\frac{l_p}{\bar{\lambda}} \tag{40}$$

when we are considering a Planck mass particle, then $\bar{\lambda} = l_p$, and half the Schwarzschild radius is then the Planck length. This, we claim, is the diameter of the indivisible particle, and it is the radius of the Planck mass particle that consists of two colliding indivisible particles. The collision lasts for one Planck second and the two indivisible particles colliding must be observed inside that time period. Its half Schwarzschild radius is, therefore, the Planck length, and it is something physical and real, even if it is not possible to measure directly with current technology. Indirectly we measure it all the time, as it is what we call gravity. It is mostly likely a shielding effect, so gravity could indeed be a push shielding gravity, but this is not what we will discuss much in this paper as there also exist other possible interpretations. That is, the push is the collision, but the collision also hinders any indivisible particle to go through the collision moment, so it is also a shielding gravity.

For an electron, we have $\bar{\lambda} = \bar{\lambda}_e$, the reduced Compton wavelength of the electron is enormous compared to the Planck length, and we claim the electron must consist of at a minimum two indivisible particles moving back and forth over the reduced Compton wavelength of the electron and colliding every Compton time periodicity; the collision itself lasts for one Planck second. This means that particles with mass lower than a Planck mass also have half a Schwarzschild radius equal to the Planck length, but that this half a Schwarzschild radius comes in and out of existence. If we observe an electron in any given Planck second, we do not know if it is in a collision state or not before we complete the observation. That is, particles with mass less than a Planck mass will have a probabilistic Schwarzschild radius. When $\frac{l_p}{\bar{\lambda}} < 1$, this should be interpreted a probability for having a Schwarzschild radius inside one Planck second. All known observable elementary particles have a mass much smaller than a Planck mass and therefore a probabilistic Schwarzschild radius and a probabilistic gravity. When $\frac{l_p}{\bar{\lambda}} > 1$, this means we have to work with a composite mass. The integer part of $\frac{l_p}{\bar{\lambda}}$ is the number of full Planck masses we have, something that leads to deterministic gravity, while the remaining fraction (if any) is a probabilistic part. For any mass considerably larger than a Planck mass, gravity will be deterministic, and for a mass close to a Planck mass, it will be partly deterministic and partly probabilistic, while for a mass much smaller than a Planck mass such as a proton or an electron, probability will dominate. These are not mystical quantum mechanics probabilities, instead these are simple and logical frequency probabilities.

The special case of $\frac{l_p}{\bar{\lambda}} = 1$ is for a Planck mass particle, but then it only lasts for one Planck second, as well as for aggregations of elementary particles where the mass reaches the Planck mass. Again, the reduced Compton wavelength of a composite mass is given by $\bar{\lambda} = \frac{\hbar}{\sum_{i=1}^{N} m_i c} = \frac{1}{\frac{1}{\bar{\lambda}_i} + \frac{1}{\bar{\lambda}_{i+1}} + \frac{1}{\bar{\lambda}_n}}$.

This gives us quite useful information. Since we do not know the exact Planck mass, we do not know if any sizable mass $m >> m_p$ is an exact integer, or an integer plus a fraction. It is likely to be an integer plus a fraction, but the larger the mass is, the smaller the fraction part will be relative to the integer number. This means that to measure the Planck length (Planck mass) accurately, one way is to use a very large mass, something we can partly do with a Cavendish apparatus. A one kg lead ball is indeed a very large mass compared to the Planck mass.

9 Relativistic Model

To explain a series of gravity phenomena, we need to extend our gravity model to take relativistic effects into account. Our atomist model follows the standard relativistic model [6], with a few exceptions that we will come to soon. For example, the relativistic energy mass relation is given by

$$\begin{aligned} E &= \frac{\tilde{m}_t c^2}{\sqrt{1-\frac{v^2}{c^2}}} \\ E &= \frac{\frac{l_p^2}{\bar{\lambda}}\frac{1}{c}c^2}{\sqrt{1-\frac{v^2}{c^2}}} \\ E &= \frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}c \end{aligned} \tag{41}$$

That is, energy is now m^2 per second. This is not too different than the modern physics' mass energy relation that is

$$\begin{aligned} E &= \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} \\ E &= \frac{\frac{\hbar}{\bar{\lambda}}\frac{1}{c}c^2}{\sqrt{1-\frac{v^2}{c^2}}} \\ E &= \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}c \end{aligned} \tag{42}$$

However, back to our equation

$$E = \frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}c \tag{43}$$

As the indivisible particles cannot contract, but the distance between them can, namely $\bar{\lambda}$, this means the maximum length contraction is (until the Compton wavelength) the Planck length. This means we must have

$$l_p \leq \bar{\lambda}\sqrt{1-\frac{v^2}{c^2}} \tag{44}$$

solved with respect to v this gives

$$v \leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} \tag{45}$$

This is the same maximum velocity of matter that has been suggested by Haug [22, 32, 43–45]. We basically get the same maximum velocity for escape velocity, however surprising this may be.

10 Relativistic Gravity Model

The relativistic gravity model when working with two gravitational objects and observing it from the the gravity object M itself is

$$F = c^3 \frac{\tilde{M}_t \frac{\tilde{m}_t}{\sqrt{1-\frac{v^2}{c^2}}}}{r^2} \tag{46}$$

A similar Newton equivalent formula was suggested in 1981 and 1986 by Bagge [46] and Phillips [47]. This formula was soon forgotten, as it only predicted half of Mercury's precession, see also [48–53]. However, the formula in our view can only hold in a two reference frame system, such as observing the Moon from the Earth or the Earth from the Moon, not when observing for example the Sun and Mercury from Earth. When we are observing the Precession of Mercury from Earth we have to do with three reference frames, and we then suggest we must have

$$F = c^3 \frac{\frac{\tilde{M}_t}{\sqrt{1-\frac{v_M^2}{c^2}}} \frac{\tilde{m}_t}{\sqrt{1-\frac{v^2}{c^2}}}}{r^2\left(1-\frac{v_M^2}{c^2}\right)} = c^3 \frac{\tilde{M}_t \frac{\tilde{m}_t}{\sqrt{1-\frac{v^2}{c^2}}}}{r^2\left(1-\frac{v_M^2}{c^2}\right)^{3/2}} \tag{47}$$

where v is the velocity of the small mass relative to the large mass as observed from the large mass, and v_M is the velocity of the large mass relative to the observation frame. It is natural that the radius must contract, as seen from a third reference frame. This is likely only an approximation, because there would be no length contraction if the two gravity objects moves parallel as observed from the third reference frame (Earth) as there is no length contraction in the perpendicular direction. This will actually lead to elliptic orbits.

Still, formula 47 seems to predict the correct precession of Mercury as shown recently by [54]. Relativistic extensions of Newton have been completed before, but these solutions have only predicted half of Mercury's precession. Formula 46 only holds if the gravitation observations are observed from one of the gravity objects. In case we observe two masses from a third reference frame, such as observing the Sun's effect on Mercury as observed from the Earth, then formula 47 must be used. And this actually (after lengthy calculations) seems to give the correct precession of Mercury (something that should be checked carefully by others), that is $\delta = \frac{6\pi l_p^2}{\lambda c^2 a(1-e^2)}$. What earlier papers have not taken into account is that the distance from center to center between the two gravity objects is contracted as seen from a third reference frame. Other researchers have, in the past, used a similar formula to 46 and shown that it only predicts half of the precession of Mercury.

There could be additional adjustments, but our model seems to be consistent with the actual precession of Mercury.

11 Finding the Compton frequency of Cosmological Size Objects without Knowing the Planck Constant or Newton's Gravitational Constant G

As described in the previous section, we know how to find the Compton frequency of a clump of matter. We simply first find the electron Compton wavelength by Compton scattering. Next, we find the proton's Compton frequency relative to the electron by a cyclotron. Now we know the Compton frequency of the proton. Next, we pack a series of protons together in a clump of mass; discovering exactly how to do this at a practical level is naturally challenging, but not impossible.

Next we find the Schwarzschild radius of this packed proton mass using a Cavendish apparatus.

$$r_s = 2\tilde{m}_t c = \frac{L 2\pi^2 R^2 \theta}{T^2 c^2} \tag{48}$$

Now that we know the Schwarzschild radius and the Compton frequency of a macroscopic object. Next we find the Schwarzschild radius of the Earth by

$$r_{s,E} = 2g\frac{r^2}{c^2} \tag{49}$$

where g is the gravitational acceleration at the surface of the Earth, and r is the radius of the Earth, both can be found without any knowledge of the gravity constant, or $\hbar$, or even without any knowledge of gravity; these are simple observables. And the Compton frequency of the Earth is

$$f_E = \frac{r_{s,E}}{r_{s,m}} f_m \tag{50}$$

where f_E is the reduced Compton frequency of the Earth, and f_m is the reduced Compton frequency in one of the large lead balls in the Cavendish apparatus. So, the main point is that we can find the Compton frequency of any clump of matter, from the quantum world such as electrons to cosmological objects without any knowledge of G or the Planck constant. This naturally indicates the Compton frequency plays a very central role in matter.

12 Bending of Light

In 1881 and 1884, Soldner predicted the following deflection of light, based on Newton's classical mechanics (see [55, 56])

$$\delta_S = \frac{2Gm}{c^2r} \tag{51}$$

In 1911, Einstein obtained the same formula for the bending of light when he derived it from Newtonian gravitation, see [57]. But Einstein went naturally forward with GR in 1916, and the angle of deflection in Einstein's general relativity theory [40] is twice what one gets from Newtonian gravity

$$\delta_{GR} = \frac{4Gm}{c^2r} \tag{52}$$

The solar eclipse experiment of Dyson, Eddington, and Davidson performed in 1919 confirmed [58] the idea that the deflection of light was very close to that predicted by Einstein's general relativity theory. That is 1.75 arc-seconds compared to the 0.875, as predicted by Soldner's 1884 formula.[1] This was one of the main reasons general relativity took off and partly replaced or rather extended Newtonian gravitation. A draw back with general relativity theory is that it is very complex and it does not seem to be consistent with the quantum world.

It is important here to have the history of Newton theory clear in mind. Newton never derived or presented a gravity constant, as we discussed in section 5. The gravity constant was something one needed to calibrate the Newton model to observable gravity phenomena. When first calibrated to one phenomena, one knows the value of G and one can then use the Newtonian gravity model to predict other observations. The gravity constant was calibrated indirectly first time by Cavendish in 1798, [28]. This experiment involved small and large lead balls, in other words how standard matter react on standard matter, what we will call matter-matter experiments. Several similar experiments were performed subsequently and it seemed sure that G was a constant, since the constant calibrated to a Cavendish apparatus, for example, then could be used to predict planetary objects velocities and more. An interesting question to ask that we not have seen raised before is: "What if Newton's formula first had been calibrated to a matter-light experiment?", that is what would the value of G be, if it was first calibrated to an experiment involving a gravity object (matter) and light? Then G would have twice the value of what it has today.

Then one would have mainly two choices. Either one had to assume Newton was off for matter-matter experiments by a factor of $\frac{1}{2}$ and one then would have to invent a new theory that adjusted Newton for matter-matter interactions. This theory would possibly have similarities with GR, but would need to bend space-time outward from the gravity object to compensate for a too large G (calibrated to matter-light) and now used to predict matter-matter phenomena.

Alternatively one could say that Newton's formula needed two constants, one for matter-light interactions and one for matter-matter. This would mean there was something special with photons that not existed in matter. This we know never happened. Historically, one did a lot of matter-matter experiments and got used to the finding that the gravity constant did not need any adjustment. In other words, G was, by the late 1800s, considered a universal constant. Something that is true as long as we work with matter-matter. Measuring light bending was much more complex and happened more than 200 years after the first matter-matter experiment (the Cavendish experiment of 1798). And when light bending first was accurately measured, one already had an extension theory, namely GR that then was favored. But neither Newton's theory nor GR are derived from the quantum aspects of matter. Our theory even though it is very simple, is so. Further, the key components of a theory should not be affected by simply what was measured firsts.

We have said that all mass is related to the Planck mass particle. So, no matter if it is a proton or an electron or any other particle with rest-mass, this means they consist of Planck mass particles. The only difference is the frequency of Planck mass events happen in different particles, that again depends on the Compton frequency. The Planck mass event itself does, however. consist of two light particles colliding. That is our very defintion of mass. This naturally make the light particle, the indivisible particle, special compared to matter. The light particle has rest-mass at collision, but since two such particles are needed for a collision, they each only contribute to half the Planck mass. And this mass only lasts for one Planck second. This clearly points towards the idea that there is a 2-factor of some sort in difference between matter and light. It is therefore not illogical to assume when we work with matter, light interaction that we have a different gravity constant that is off by 2 relative to the gravity factor used for matter-matter interactions,

[1] In 1881, Soldner calculated the light deflection to be 0.84 arc-seconds based on less accurate knowledge of the mass of the Sun and speed of light than we have today.

We are not alone in thinking that double light deflection has something to do with the fact that photons are a special form in relation to mass, rather than bending of space-time. For example, Sato and Sato [59] have suggested that it looks like the 2 factor (double of Newton) in observed light deflection likely would be due to an unknown property of the photon rather than the bending of space-time. However, they do not seems to have a good explanation for why, while we do seem to have a good explanation of why the photon is related to a 2 factor in gravity compared to mass-matter experiments. And if one accepts this view, then we can take our model that has no gravity constant in it and calculate the correct bending of light. In fact, we have a gravity constant it is c^3 when working with the collision-time definition of mass, and it would be $2c^3$ working with matter-light. A full derivation is shown below.

The relationship between the angle β of the asymptote to the hyperbole of eccentricity ϵ is given by

$$\cos(\beta) = \frac{1}{\epsilon} \tag{53}$$

and the angle of deflection of light in Newton's theory must be given by (see Figure 1.)

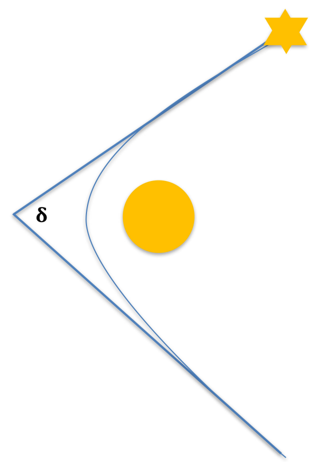

Figure 1: This figure illustrate the bending of light around the Sun. The figure is strongly exaggerated for illustration purpose.

In other words, we need to find the orbital eccentricity. The orbital eccentricity for deflection of light calculations must be given by

$$\epsilon = \sqrt{1 + \frac{2EL^2}{c^6 \tilde{M}_S^2 \tilde{m}^3}} \tag{54}$$

be aware we are here using our mass definition and our energy definition. And we have to understand how this particular form of eccentricity comes into being. Pay particular attention to the 2 factor in the formula. This type of orbital eccentricity can be found from

$$h^2 = c^3 \tilde{M} a(1 - \epsilon^2) \tag{55}$$

where h is the specific angular momentum, $h = \frac{L}{\tilde{m}}$, and a is the is the length of the semi-major axis. Solved with respect to the eccentricity ϵ, we get

$$\epsilon = \sqrt{1 - \frac{h^2}{c^3 \tilde{M} a}} \tag{56}$$

Next we will use the argument that the gravitational energy can be described as[2]

$$E = -\frac{c^3 \tilde{M} \tilde{m}}{2a} \tag{57}$$

Again we see the 2 factor, which basically corresponds to the energy for low velocity orbital objects (somehow similar to the kinetic energy approximation of $E \approx \frac{1}{2}mv^2$). Putting this energy formula into formula 56, we get the known formula 54 (well here on a slightly different form as we do not need G).

[2] See for example http://scienceworld.wolfram.com/physics/Eccentricity.html

$$\begin{aligned}
\epsilon &= \sqrt{1-\frac{h^2E}{c^3\tilde{M}aE}} \\
\epsilon &= \sqrt{1+\frac{h^2E}{c^3\tilde{M}a\frac{2c^3\tilde{M}\tilde{m}}{2a}}} \\
\epsilon &= \sqrt{1+\frac{2h^2E}{c^6\tilde{M}^2\tilde{m}}} = \sqrt{1+\frac{2EL^2}{c^6\tilde{M}^2\tilde{m}^3}}
\end{aligned} \tag{58}$$

However, for a photon we claim that it must be wrong to use the gravitational energy formula above and thereby the eccentricity formula above, because it is rooted in low velocity objects. Instead, we should use the following version when dealing with "orbital" velocity objects moving at significant speed compared to that of light. A photon is clearly doing so, as it moves at the speed of light, therefore, in this case we must have

$$E = -\frac{c^3\tilde{M}\tilde{m}}{a} \tag{59}$$

This gives an eccentricity formula of

$$\epsilon = \sqrt{1+\frac{Eh^2}{4c^6\tilde{M}^2\tilde{m}}} = \sqrt{1+\frac{EL^2}{4c^6\tilde{M}^2\tilde{m}^3}} \tag{60}$$

We will claim that the energy to be used in the formula when dealing with bending of light must be the photon rest-mass energy minus the gravitational energy.

$$E = \tilde{m}c^2 - 2c^3\frac{\tilde{M}\tilde{m}}{R} \tag{61}$$

This lies in contrast to the kinetic energy approximation that only holds for low velocities, which is used in an otherwise very interesting paper [3] by Soares [60]:

$$E = \frac{1}{2}\tilde{m}c^2 - c^3\frac{\tilde{M}\tilde{m}}{R} \tag{62}$$

Since $\frac{1}{2}mc^2$ is a kinetic energy formula approximation for very low velocity, it should not be used in this context where we deal with photons. Further, we claim that the (full) exact kinetic energy formula cannot be used for photons either.

$$E = \frac{\tilde{m}c^2}{\sqrt{1-\frac{v^2}{c^2}}} - \tilde{m}c^2 - c^3\frac{\tilde{M}\tilde{m}}{R} \tag{63}$$

Setting $v = c$, we would get an infinite kinetic energy. So, both the kinetic energy approximation (that only holds for low velocities) and the full kinetic energy formula does not seem to make sense when we work with photons. The kinetic energy formula is made for something that has rest-mass in its normal constitution, and not for light. Here we are considering a photon that is traveling at the speed of light, but we will claim it is actually the rest-mass energy of the photon that is relevant, which is $E = mc^2$. This is simply because for a photon all of the rest-mass energy is actually kinetic energy. The kinetic energy for a photon is, according to atomism, the very collision point between indivisible (light) particles, where the collision lasts for one Planck second. The collision is only changing the direction of the light particle. That is to say, the kinetic energy of light is a special case because all the rest-mass energy in a light particle is its kinetic energy as well.

Further, we have the angular momentum of the photon, which is

$$L = \tilde{m}cR \tag{64}$$

this gives

$$\begin{aligned}
\epsilon &= \sqrt{1+\frac{EL^2}{2c^6\tilde{M}^2\tilde{m}\tilde{m}^2}} \\
\epsilon &= \sqrt{1+\frac{\left(\tilde{m}c^2-2c^3\frac{\tilde{M}\tilde{m}}{R}\right)\tilde{m}^2c^2R^2}{4c^6\tilde{M}^2\tilde{m}^3}} \\
\epsilon &= \sqrt{1+\frac{\left(c^2-2c^3\frac{\tilde{M}}{R}\right)c^2R^2}{4c^6M^2}}
\end{aligned} \tag{65}$$

[3] To a large degree we have based our calculations on this paper by Soares.

Since for the Sun we must have $2c^3\frac{\tilde{M}_s}{R} << c^2$, (keep in mind the mass in terms of collision time of the Sun is given by $\tilde{M}_s = \frac{l_p^2}{\lambda_M c}$) and we have

$$\epsilon \quad \approx \quad \sqrt{1+\frac{c^4R^2}{4c^6\tilde{M}_S^2}} = \sqrt{1+\frac{R^2}{4c^2\tilde{M}_S^2}} \tag{66}$$

and since $\frac{c^4R^2}{4c^6\tilde{M}_S^2} >> 1$, we can approximate this very well as

$$\epsilon \approx \frac{R}{2c\tilde{M}_s} \tag{67}$$

The bending of light is given by

$$\delta = \pi - 2\arccos\left(\frac{2c\tilde{M}_S}{R}\right) \tag{68}$$

Further, we can expand $\arccos(y)$ since $y = \frac{c\tilde{M}_S}{R} << 1$ using a Taylor series expansion, this gives

$$\arccos(y) = \frac{\pi}{2} - \arcsin(y) = \frac{\pi}{2} - \left(y - \frac{y^3}{6} + \frac{3y^5}{40} + \cdots\right) \tag{69}$$

Using only the first part of the Taylor series expansion, we get

$$\delta \approx \pi - 2\left(\frac{\pi}{2} - \frac{2c\tilde{M}_S}{R}\right) = \frac{4c\tilde{M}_S}{R} \tag{70}$$

The mass of the Sun in terms of collision time is given by

$$M_s \approx 0.000004924193812 \text{ seconds} \tag{71}$$

This gives a deflection of a light beam

$$\delta \approx= \frac{4c \times 0.000004924193812}{696342000} \approx 0.000008480 \tag{72}$$

If we multiply this by $\frac{648000}{\pi}$ we get 1.75 arc-seconds, which is the same as GR predicts and that has confirmed with a series of experiments, with some room for measurements errors.

13 Escape Velocity

The Newton escape velocity is normally derived from the following equation

$$\frac{1}{2}mv^2 - G\frac{Mm}{r} = 0 \tag{73}$$

solved with respect to v this gives

$$v = \sqrt{\frac{2GM}{r}} \tag{74}$$

This is the same escape velocity one gets from general relativity theory, see [61]. Still, when deriving the Newton escape velocity, one is using a kinetic energy approximation $\frac{1}{2}mv^2$ that only holds when the speed of the small mass is much less than the speed of light $v << c$. As the speed v will approach c in a very strong gravitational acceleration field, this formula cannot hold for a strong gravitational acceleration field when derived from the Newton formula. To do that, we need to look at the kinetic energy for high velocities, and then we need to take into account special relativity in the kinetic energy formula, something we will look at in the next section.

Since $E_k \approx \frac{1}{2}v^2$ is an approximate kinetic energy that only holds when $v << c$ and is used to derive the Newton escape velocity, we can conclude this must be an approximate escape velocity that only holds in the weak field limit. In other words, the Newton escape velocity formula should always be written as

$$v \approx \sqrt{\frac{2GM}{r}} \tag{75}$$

It is interesting that GR supposedly gives exactly the same escape velocity as the Newton weak field approximation. Is it not a bit strange that GR is not even slightly different than a weak field approximation when it supposedly also holds for very strong gravitational fields? We will not answer this here, but we will show how we may be able to properly derive the Newton escape velocity to hold for a strong gravitational field, and then it is different than what is given by GR and naturally also different then the weak field Newton approximation.

Newton Escape velocity that also holds for a strong gravitational field

To get a Newton escape velocity to hold for strong gravitational fields, we must use a kinetic energy formula that is valid when v is close to c; this can naturally only happen if we use a relativistic theory. The exact Einstein kinetic energy formula [62] is given by

$$E_k = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2 \tag{76}$$

The question is whether or not this can be combined with the Newton gravity theory and also if the Newton gravity formula then needs to be modified from a relativistic point of view. We will claim the escape velocity in a two reference frame system must be found from

$$F = G\frac{M\frac{m}{\sqrt{1-\frac{v^2}{c^2}}}}{r^2} \tag{77}$$

or in our equivalent quantum model

$$F = c^3\frac{\tilde{M}\frac{\tilde{m}}{\sqrt{1-\frac{v^2}{c^2}}}}{r^2} \tag{78}$$

These two are identical, except our formula is directly linked to the quantum world, and therefore helps us understand gravities link to the Planck scale. Thus we get the following equation[4]

$$\frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2 - G\frac{M\frac{m}{\sqrt{1-v^2/c^2}}}{r} = 0 \tag{79}$$

Solved with respect to v, this gives

$$v = \sqrt{\frac{2GM}{r} - \frac{G^2M^2}{c^2r^2}} \tag{80}$$

(See the full derivation in the Appendix.)

This can also be rewritten as

$$v = \sqrt{\frac{2GM}{r} - \frac{\left(\frac{1}{2}r_s\right)^2 c^2}{r^2}} = \sqrt{\frac{2GM}{r} - \frac{r_s^2c^2}{4r^2}} \tag{81}$$

This formula is structurally different from the standard weak field Newton escape velocity, and it is also clearly different from the GR escape velocity. The difference is the term $-\frac{\left(\frac{1}{2}r_s\right)^2c^2}{r^2}$, which is very small as long as $r >> r_s$. In other words, in weak gravitational fields, the standard Newton (or GR formulation) will naturally do. However, when setting $r = \frac{1}{2}r_s$, we have an escape velocity of c.

$$v = \sqrt{\frac{2GM}{\frac{GM}{c^2}} - \frac{c^2r_s^2}{4\left(\frac{1}{2}r_s\right)^2}} = c \tag{82}$$

But here we have one more constraint that is easy to forget, namely that the formula is derived from equation 79. The mass will become infinite in two places if $v = c$, so it cannot be allowed that $r = \frac{1}{2}r_s$; we must have $r > \frac{1}{2}r_s$ for any mass. This means that no traditional mass can be at half of the Schwarzschild radius. This means we must have masses only at radius $r > \frac{1}{2}r_s$, but, we may ask, "How close can a mass be relative to half of this radius?"

This brings us back to another debate, namely how far can v approach c?

$$v = \sqrt{\frac{4GM}{r} - \frac{c^2r_s^2}{r^2}} \tag{83}$$

We will suggest the maximum relativistic mass any elementary particle can take is the Planck mass, which gives us

[4] In a recent working paper, Haug attempted to derive a Newton relativistic escape velocity simply by setting $\frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2 - G\frac{Mm}{r} = 0$, and solving with respect to v. We are now convinced that this particular method was not sufficient, as we think the small mass in the gravitational formula also must be made relativistic, which we have done in this paper.

$$
\begin{aligned}
m_p &= \frac{m}{\sqrt{1-\frac{v_e^2}{c^2}}} \\
m_p &= \frac{m}{\sqrt{1-\frac{\sqrt{\frac{4GM}{r}-\frac{c^2r_s^2}{r^2}}^2}{c^2}}} \\
m_p &= \frac{m}{\sqrt{1-\frac{\frac{4GM}{r}-\frac{c^2r_s^2}{r^2}}{c^2}}} \\
\frac{\hbar}{l_p}\frac{1}{c} &= \frac{\frac{\hbar}{\bar{\lambda}}\frac{1}{c}}{\sqrt{1-\frac{\frac{4GM}{r}-\frac{c^2r_s^2}{r^2}}{c^2}}} \\
\frac{1}{l_p} &= \frac{\frac{1}{\bar{\lambda}}}{\sqrt{1-\frac{\frac{4GM}{r}-\frac{c^2r_s^2}{r^2}}{c^2}}} \\
\sqrt{1-\frac{\frac{4GM}{r}-\frac{c^2r_s^2}{r^2}}{c^2}} &= \frac{l_p}{\bar{\lambda}} \\
1-\frac{\frac{4GM}{r}-\frac{c^2r_s^2}{r^2}}{c^2} &= \frac{l_p^2}{\bar{\lambda}^2} \\
\frac{\frac{4GM}{r}+\frac{c^2r_s^2}{r^2}}{c^2} &= 1-\frac{l_p^2}{\bar{\lambda}^2}
\end{aligned}
\tag{84}
$$

assume also $M = m_p$ (the smallest possible gravitational mass); this gives $r = \frac{l_p\bar{\lambda}}{\bar{\lambda}+l_p}$. Now replacing this r back in the escape velocity formula and having $M = m_p$, we get

$$
v = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} \tag{85}
$$

This is the same maximum velocity of matter that has been suggested by Haug in a series of papers [22, 32, 44, 63]. Further, in the special case of a Planck mass particle, we have $\bar{\lambda} = l_p$, which gives a maximum velocity for Planck mass particles of zero. Haug has suggested that the Planck mass particle is the collision point between photons. In addition, we will argue that the value of G should have twice its normal value when dealing with photons. One can argue for this in several ways. Traditional Newton calculations on light bending are off by a factor of 2 relative to experiments (and relative to GR). However, Newton never suggested a gravitational constant. If we calibrated the Newton formula first to mass light experiments rather than matter experiments, we would have twice the value of G as we do today. So, for a moment assume G has twice the value of the G given today, this gives the solution

$$
v = \sqrt{\frac{4GM}{r}-\frac{4c^2r_s^2}{r^2}} = 0 \tag{86}
$$

Now, when $r = \frac{1}{2}r_s$, we get $v = 0$. This means that we have two important solutions for so-called black holes. At half the Schwarzschild radius, there are only Planck mass particles and they cannot move. They are standing absolutely still, but only for one Planck second before bursting into energy. There is also a solution of $v = c$.

On a particle level, we claim we must have that the gravitational mass is a Planck mass, as only collision time gives gravity. This means we have

$$
c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} = \sqrt{\frac{2Gm_p}{r}-\frac{c^2\left(\frac{1}{2}r_s\right)^2}{r^2}} = \sqrt{\frac{2Gm_p}{r}-\frac{c^2r_s^2}{4r^2}} \tag{87}
$$

Solved with respect to r this gives

$$
r = \frac{l_p\bar{\lambda}}{l_p+\bar{\lambda}} > l_p \tag{88}
$$

That is, non-Planck mass particles can never be closer to a Planck mass than this radius, and they then have an escape velocity equal to our earlier suggested maximum velocity for matter, which is below the speed of light. Further, in the special case where the particle escaping is a Planck mass particle, then we have the following equation

$$c\sqrt{1-\frac{l_p^2}{l_p^2}}=\sqrt{\frac{2G\frac{1}{2}m_p}{r}-\frac{c^2\left(\frac{1}{2}r_s\right)^2}{r^2}} \tag{89}$$

Solved with respect to r, this gives $r = 1/2l_p$. But if the gravity model is calibrated to light-matter (photons plus matter), then $G = 2G$ (light), and in this case the solution to the formula above is $r = l_p$. So, the speed very close to the Schwarzschild radius (off a Planck mass particle) is very close to c and at the Schwarzschild radius it is zero. This explains why no time dilation exists in quasars. Quasars are, in our view, not holes – they are spheres where matter is maximally packed as Planck masses. The indivisible particles in a Planck mass particle have no distance between them and when such particles are packed together, the indivisible spheres stand still. At the surface of a quasar, the mass is standing still and cannot undergo time dilation, but also it is likely that mass is converted into energy all the time, therefore, so-called black holes should be very bright objects.

This should also be seen in light of the Planck acceleration, which is given by

$$a=\frac{c^2}{l_p}\approx 5.56\times 10^{51}\ m/s^2 \tag{90}$$

In 1984, Scarpetta predicted this as the maximum acceleration possible, [64], something also suggested by [65]:

> *"the 'Planck acceleration' is both the maximum acceleration for an elementary particle in free space and also the surface gravity of a black hole with minimum mass m_p" – Falla and Landsberg, 1994*

However, as pointed out by [66], this enormous acceleration means that one will reach the speed of light after one Planck second, $a_p t_p = c$. Yet nothing with mass can travel at the speed of light, so nothing that still has mass after acceleration can undergo such rapid acceleration. In general, modern physics is compatible with such an acceleration without modifications. No mass can move at the speed of light, as it would give infinite relativistic mass that would require infinitely much energy to get there. On the other hand, a Planck mass particle that is consistent with being two light particles in our calculations (that is indivisible particles in collision for one Planck second before dissolving into light) is fully consistent with this view.

Interestingly, the minimum Rindler horizon is approximately the same as the minimum distance a standard particle can have to a Planck mass particle (without itself becoming a Planck mass particle), see [67].

Escape velocity as seen from third observer

The escape velocity as seen from a third reference frame moving relative to m and M must be different than the escape velocity as seen from m or M, and it must be

$$v=\frac{\sqrt{G}\sqrt{M}\sqrt{-\frac{GM}{R(c-\mathrm{vM})^2}-\frac{2GM}{R(c-\mathrm{vM})(c+\mathrm{vM})}-\frac{GM}{R(c+\mathrm{vM})^2}+\frac{4c}{c-\mathrm{vM}}+\frac{4c}{c+\mathrm{vM}}}}{2\sqrt{R}}\approx\sqrt{\frac{2GM}{r}}\frac{1}{\sqrt{1-\frac{v_M^2}{c^2}}} \tag{91}$$

As the orbital velocity is $v_o \approx \frac{v_e}{\sqrt{2}}$, this means the galaxy arm orbital velocity will be considerably larger than predicted by standard theory when the whole galaxy is moving relative fast relative to the Earth. In other words, when v_M is significant.

14 Finding the speed of gravity (light) from gravity observations only

Haug [42] have recently shown that the speed of gravity (light) can be found from gravity observations only in a very simple way. One of his solitions is simply to solve the following eqution with respect to c

$$
\begin{aligned}
\frac{T_h}{T_L} &= \frac{\sqrt{1-\frac{\frac{2GM}{c^2}}{R_h}}}{\sqrt{1-\frac{\frac{2GM}{c^2}}{R_L}}} \\
\frac{T_h^2}{T_L^2} &= \frac{1-\frac{\frac{2GM}{c^2}}{R_h}}{1-\frac{\frac{2GM}{c^2}}{R_L}} \\
\frac{T_h^2}{T_L^2} &= \frac{c^2-\frac{2GM}{R_h}}{c^2-\frac{2GM}{R_L}} \\
T_h^2c^2-\frac{2GM}{R_L}T_h^2 &= T_L^2c^2-\frac{2GM}{R_h}T_L^2 \\
T_h^2c^2-T_L^2c^2 &= \frac{2GM}{R_L}T_h^2-\frac{2GM}{R_h}T_L^2 \\
c &= \frac{\sqrt{2v_{o,L}^2T_h^2-2v_{o,h}^2T_L^2}}{\sqrt{T_h^2-T_L^2}} \qquad (92)
\end{aligned}
$$

This means also that when calculated from our new escape velocity we must have

$$c=\frac{r_hr_L(T_h-T_L)}{\tilde{M}(r_HT_h-r_LT_L)} \qquad (93)$$

and if calculated from the standard escape velocity one get

$$c=\frac{r_hr_L(T_h^2-T_L^2)}{\tilde{M}(r_HT_h^2-r_LT_L^2)} \qquad (94)$$

15 Gravity is Lorentz Symmetry Break Down at the Planck Scale

Several quantum gravity theories predict Lorentz symmetry break down at the Planck scale, but they have not been able to give observable predictions. One of the reasons for this is that the Planck scale is assumed to be an extremely high energy level at which we are not even close to performing experiments right now. As a recent review article [68] on the possibility for Lorentz symmetry breaking in relation to quantum gravity predictions and experiments noted:

> *In conclusion, though no violation of Lorentz symmetry has been observed so far, an incredible number of opportunities still exist for additional investigations.*

Modern physics has not incorporated collision time in their definition of mass. It has been added externally and without specific awareness of it through Newton's gravitational constant, which is calibrated to gravity experiments. In this way, collision time is indirectly incorporated into the mass model, but not in a deliberate or conscious way. As we have shown, gravity is directly linked to the Planck scale. It is also linked to collision time (length) in the mass over the shortest time interval. Modern physics has not understood that gravity itself is Lorentz symmetry break down at the Planck scale and interpretations have missed out on several important aspects of the Planck scale. In addition, it has not been noted that gravity could actually be the Lorentz symmetry break down in matter. The Planck mass particle in terms of kg is observational time dependent, this means we should be looking for a very low energy (which is gravity) and not very high energy. In fact, the very high energies can only be observed at the Planck time scale. The Planck second, the Planck mass, and the Planck energy are invariant across reference frames. This because the Planck mass always stands still and only can be directly observed inside one Planck second.

Further, quantum mechanics has not incorporated the Planck scale in any way. As we soon will show, in our new quantum mechanics the Heisenberg uncertainty principle breaks down inside the Planck scale. That is, inside a Planck time interval there is not particle wave duality; at this time interval it can only be a collision between two indivisible particles (conditional on that one are observing mass inside this time interval), which are collision time, and which are also gravity. We will show this in our derivations in a section below. We have unified gravity with our quantum model and shown how, based on only a simple model of matter that takes collision time into account, we are able to get the correct gravity predictions at any level, from elementary particles to the cosmological scale. In the next section, we show how this is consistent with a new quantum mechanics.

How can we be sure gravity is the Planck scale? We have given a gravity theory that only requires an unknown length x, plus the Compton wavelength and the speed of gravity (light). When calibrated to gravity phenomena, the length x is equal to the Planck length. We are in no way dependent on G, and it is not possible to calculate G from our theory – for that one need the mass definitions of modern physics that we claim is a bit primitive. This is also why we do not need the Planck constant in our mass definition. Our theory requires less information and is less complicated, but all gravity phenomena are clearly rooted in the Planck length, that again has to do with collision time of indivisible particles. Our theory is only rooted in the quantum realm, and the Planck length (and thereby the Planck mass) plays an essential role – the Planck mass is not needed in kg, but in mass as collision length or collision time.

16 New Quantum Mechanics

Here we will introduce a new quantum wave equation that also gives gravity without understanding the importance of collision time and taking into account that one ultimately has a collision time.

The Klein–Gordon equation is often better known in the form (dividing by $\hbar^2$ and c^2 on both sides):

$$\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\Psi - \nabla^2\Psi + \frac{m^2c^2}{\hbar^2}\Psi = 0 \tag{95}$$

The Klein–Gordon equation has strange properties, such as energy squared, which is one of several reasons that Schröedinger did not like it that much. We have argued length for that one should make a wave equation from the Compton wavelength rather than the de Broglie wavelength [69, 70]. Today, matter has two wavelengths, the de Broglie version, which is a hypothetical wavelength and the Compton wavelength. The Compton wavelength has been measured in many experiments and we can find the traditional kg mass from that plus the Planck length and the speed of light. We cannot find the rest-mass from the de Broglie wavelength, as this length is infinite for a rest-mass. The relation between these two waves, even in a relativistic model, is simply $\bar{\lambda}_B = \bar{\lambda}_c\frac{c}{v}$. To switch from de Broglie to Compton leads to a new momentum definition, where we have rest-mass momentum, kinetic momentum, and total momentum. The traditional relativistic momentum definition is rooted in the de Broglie wavelength (actually the de Broglie wavelength is rooted in an old, non-optimal definition of momentum), that is

$$p = \frac{mv}{\sqrt{1-\frac{v^2}{c^2}}} \tag{96}$$

while our momentum rooted in the measured Compton wavelength is given by

$$p_t = \frac{mc}{\sqrt{1-\frac{v^2}{c^2}}} \tag{97}$$

and the rest-mass momentum is given by $p_r = mc$ and the kinetic momentum by

$$p_k = \frac{mc}{\sqrt{1-\frac{v^2}{c^2}}} - mc \tag{98}$$

This gives us a new and simpler relativistic energy momentum relation, that both gives the same correct output, but one is much simpler mathematically, which is key to obtaining a simpler and fully correct wave equation. The old energy momentum relation rooted in de Broglie wavelength is given by

$$E = \sqrt{p^2c^2 - m^2c^4} \tag{99}$$

while our new energy momentum relation is given by

$$E = p_k c - mc^2 \tag{100}$$

They are identical, except that a standard physics version goes through the de Broglie wavelength (i.e., a nonexistent wavelength that is a derivative of the physical Compton wavelength). The math, therefore, gets unnecessarily complex and lacks intuition, which has led to many different interpretations in standard QM of the same equations. Our theory is much more straightforward and is fully consistent with our gravity theory.

This in turn leads to a simpler relativistic energy momentum relation than the standard one and also to a new wave equation, see [71] for details. In fact, this gives the same wave equation that we have derived before, but now we show that the Heisenberg collapse at the Planck scale that we found before is directly linked to gravity.

If we use our new momentum definition and its corresponding relativistic energy–momentum relation, we get

$$
\begin{aligned}
E &= \mathbf{p}_k c + \tilde{m}c^2 \\
E &= \left(\frac{\tilde{m}c}{\sqrt{1-\frac{\mathbf{v}^2}{c^2}}} - \tilde{m}c \right) c + \tilde{m}c^2 \\
E &= \left(\frac{\tilde{m}c}{\sqrt{1-\frac{\mathbf{v}^2}{c^2}}} \right) c \\
E &= \mathbf{p}_t \mathbf{c}
\end{aligned}
\tag{101}
$$

where $\mathbf{v}$ is the particle's three-velocity. Now we can substitute E and $\mathbf{p}_t$ with corresponding energy and momentum operators and get a new relativistic quantum mechanical wave equation

$$
-l_p^2 \frac{\partial \Psi}{\partial t} = -l_p^2 \nabla \cdot (\Psi \mathbf{c}) \tag{102}
$$

where $\mathbf{c} = (c_x, c_y, c_z)$ would be the light velocity field. Interestingly, the equation has the same structural form as the advection equation, but here for quantum wave mechanics. Dividing both sides by $\hbar$, we can rewrite this as

$$
-\frac{\partial \Psi}{\partial t} = -\nabla \cdot (\Psi \mathbf{c}) \tag{103}
$$

The light velocity field should satisfy (since the velocity of light is constant and incompressible)

$$
\nabla \cdot \mathbf{c} = 0 \tag{104}
$$

that is[5]. The light velocity field is a solenoidal, which means we can rewrite our wave equation as

$$
\frac{\partial \Psi}{\partial t} - \mathbf{c} \cdot \nabla \Psi = 0 \tag{105}
$$

So, in the expanded form, we have

$$
\frac{\partial \Psi}{\partial t} - c_x \frac{\partial \Psi}{\partial x} - c_y \frac{\partial \Psi}{\partial y} - c_z \frac{\partial \Psi}{\partial z} = 0 \tag{106}
$$

The equation above is only for a single particle. In the more general case, we have

$$
i l_p^2 \frac{\partial}{\partial t} |\Psi\rangle = \hat{H}_H |\Psi\rangle \tag{107}
$$

where $\hat{H}_H$ basically is the Hamilton operator, but with one big difference compared to the Schrödinger solution: In our model, we cannot use the standard momentum to get to the kinetic energy in the way Schrödinger does, which is why we have marked our Hamilton operator with a different notation (H with ˆ as subscript).

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

$$
\psi = e^{i(kx - \omega t)} \tag{108}
$$

However, in our theory $k = \frac{2\pi}{\lambda_c}$, where λ_c is the relativistic Compton wavelength and not the de Broglie wavelength, as in standard wave mechanics. Due to this, we have

$$
k = \frac{p_t}{l_p^2} = \frac{\frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2} = \frac{2\pi}{\lambda_c} \tag{109}
$$

So, we can also write the plane wave solution as

$$
e^{i\left(\frac{p_t}{l_p^2} x - \frac{E}{l_p^2} t\right)} \tag{110}
$$

where p_t is the total relativistic momentum as defined earlier. Our quantum wave function is rooted in the Compton wavelength instead of the de Broglie wavelength. For formality's sake, we can look at the momentum and energy operators and see that they are correctly specified

[5] For people not familiar or rusty in their vector calculus, we naturally have $\nabla \cdot (\Psi \mathbf{c}) = \Psi \nabla_x c_x + \Psi \nabla_y c_y + \Psi \nabla_z c_z + c_x \nabla_x \Psi + c_y \nabla_y \Psi + c_z \nabla_z \Psi = \Psi \nabla \cdot \mathbf{c} + \mathbf{c} \cdot \nabla \Psi$. For an incompressible flow such as we have, the first term is zero because $\nabla \cdot \mathbf{c} = 0$. In other words, we end up with $\nabla \cdot (\Psi \mathbf{c}) = \mathbf{c} \cdot \nabla \Psi$

$$\frac{\partial\psi}{\partial x} = \frac{ip_t}{l_p^2} e^{i\left(\frac{p_t}{l_p^2}x - \frac{E}{l_p^2}t\right)} \tag{111}$$

This means the momentum operator must be

$$\hat{\mathbf{p}}_t = -il_p^2\nabla \tag{112}$$

and for energy we have

$$\frac{\partial\psi}{\partial t} = \frac{-iE}{l_p^2} e^{i\left(\frac{p_t}{l_p^2}x - \frac{E}{l_p^2}t\right)} \tag{113}$$

and this gives us a Energy (time) operator of

$$\hat{E} = -il_p^2\frac{\partial}{\partial t} \tag{114}$$

The momentum and energy operator are the same as under standard quantum mechanics. The only difference between the non-relativistic and relativistic wave equations is that in a non-relativistic equation we can use

$$k = \frac{p_t}{l_p^2} = \frac{\tilde{m}c}{l_p^2} = \frac{2\pi}{\lambda_c} \tag{115}$$

instead of the relativistic form $p_t = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}}$. This is because the first term of a Taylor series expansion is $p_t \approx mc$ when $v << c$.

17 Our New Relativistic Energy Momentum Relation is Consistent with the Schrödinger Equation

Our energy momentum relation is

$$\tilde{E} = \tilde{p}_t c = \frac{\tilde{m}cc}{\sqrt{1-\frac{v^2}{c^2}}} \tag{116}$$

We can also write this as

$$\begin{aligned}\tilde{E} &= \frac{\tilde{m}c^2}{\sqrt{1-\frac{v^2}{c^2}}} - \tilde{m}c^2 + \tilde{m}c^2 \\ \tilde{E} &= E_k + \tilde{m}c^2\end{aligned} \tag{117}$$

and when $v << c$ then $E_k = \frac{\tilde{m}c^2}{\sqrt{1-\frac{v^2}{c^2}}} - \tilde{m}c^2$ can be approximated by the first term of a Taylor series expansion: $E_k \approx \frac{1}{2}\tilde{m}v^2$, this gives

$$\begin{aligned}\tilde{E} &\approx \frac{1}{2}\tilde{m}v^2 + \tilde{m}c^2 \\ \tilde{E} &\approx \frac{p^2}{2\tilde{m}} + \tilde{m}c^2\end{aligned} \tag{118}$$

where p now is the “standard” momentum $p = \tilde{m}v$. Replacing $\tilde{E}$ with the energy operator and p with the momentum operator we get

$$\begin{aligned}il_p^2\frac{\partial\Psi}{\partial t} &\approx \left(\frac{i^2l_p^4}{2\tilde{m}}\nabla^2 + \tilde{m}c^2\right)\Psi \\ i\frac{\partial\Psi}{\partial t} &\approx \left(\frac{l_p^2}{2\tilde{m}}\nabla^2 + \frac{\tilde{m}c^2}{l_p^2}\right)\Psi\end{aligned} \tag{119}$$

Bear in mind that $\tilde{m} = \frac{l_p}{c}\frac{l_p}{\lambda}$ and we can rewrite the equation above as

$$i\frac{\partial\Psi}{\partial t} \approx \left(\frac{\bar{\lambda}c}{2}\nabla^2 + \frac{c}{\bar{\lambda}}\right)\Psi \tag{120}$$

This we will see is identical to the Schrödinger equation [72]. The clear connection to the Schrödinger equation is first seen when we use the standard mass measure

$$\begin{aligned} E &= \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} \\ E &= \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2 + mc^2 \\ E &\approx \frac{1}{2}mv^2 + mc^2 \\ E &\approx \frac{p^2}{2m} + mc^2 \end{aligned} \tag{121}$$

Replacing E with the energy operator and p with the momentum operator, we get

$$\begin{aligned} i\hbar\frac{\partial\Psi}{\partial t} &\approx -\left(\frac{i^2\hbar^2}{2m}\nabla^2 + mc^2\right)\Psi \\ i\hbar\frac{\partial\Psi}{\partial t} &\approx \left(\frac{\hbar^2}{2m}\nabla^2 + mc^2\right)\Psi \\ i\frac{\partial\Psi}{\partial t} &\approx \left(\frac{\hbar}{2m}\nabla^2 + \frac{mc^2}{\hbar}\right)\Psi \end{aligned} \tag{122}$$

This is the Schrödiger equation, and recalling that $m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}$, we can rewrite this further as

$$i\frac{\partial\Psi}{\partial t} \approx \left(\frac{\bar{\lambda}c}{2}\nabla^2 + \frac{c}{\bar{\lambda}}\right)\Psi \tag{123}$$

Comparing equation 120 and 123, we see that they are identical. Our new way of writing the energy momentum relation also leads to the Schrödinger equation when $v << c$. Still, our new relativistic wave equation, $\frac{\partial}{\partial t}\Psi = c\nabla\Psi$ does not necessarily give the same predictions as the Schrödinger equation because it is rooted in the Compton wavelength and not the de Broglie wavelength, which we get when using the traditional momentum. This can be seen clearly, since we can also write an approximation for the case $v << c$ with our new momentum as

$$\begin{aligned} \tilde{E} &= \frac{\tilde{m}c^2}{\sqrt{1-\frac{v^2}{c^2}}} - \tilde{m}c^2 + \tilde{m}c^2 \\ \tilde{E} &= E_k + \tilde{m}c^2 \\ \tilde{E} &\approx \frac{1}{2}\tilde{m}v^2 + \tilde{m}c^2 \\ \tilde{E} &\approx cp_k + \tilde{m}c^2 \end{aligned} \tag{124}$$

where $p_k = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} - \tilde{m}c \approx \frac{1}{2}\frac{\tilde{m}v^2}{c}$ when $v << c$. This gives a wave equation off the form

$$\begin{aligned} il_p^2\frac{\partial\Psi}{\partial t} &\approx \left(cil_p^2\nabla + \tilde{m}c^2\right)\Psi \\ \frac{\partial\Psi}{\partial t} &\approx \left(c\nabla + \frac{\tilde{m}c^2}{il_p^2}\right)\Psi \end{aligned} \tag{125}$$

Further, taking into account that $\tilde{m} = \frac{l_p^2}{\bar{\lambda}}\frac{1}{c}$, we can rewrite this as

$$\frac{\partial\Psi}{\partial t} \approx \left(c\nabla + \frac{c}{i\bar{\lambda}}\right)\Psi \tag{126}$$

and this we see is different from the Schrödinger equation. In addition, we should also remember that the momentum in the wave function should now be the Compton momentum and not the de Broglie momentum.

18 Gravity is Breakdown of the Heisenberg Uncertainty Principle at the Planck Scale

This is the most important missing part of modern wave mechanics, that the wave equation breaks down is the only place where the Planck length can enter quantum mechanics, and it is where the Heisenberg uncertainty principle breaks down and also where Lorentz symmetry breaks down. As we have shown earlier in this paper, gravity is directly linked to the Planck length, which is the collision space-time of mass. This means gravity is the Heisenberg break down and the Lorentz symmetry break down.

In the first part of our paper, we have shown that gravity is directly linked to a minimum length, and experimentally this length is the Planck length. The Planck length in relation to mass is essential for the collision length and collision time of indivisible particles. So, gravity in a wave equation must be the Planck mass particles in the wave equation. So, then something special should happen at the Planck scale. We have already from our previous analysis claimed that the Planck length, the Planck time, and the Planck mass must be invariant, because it is the only particle that stands absolutely still. We can only observe a Planck mass particle from the Planck mass particle itself. That is, it can only be observed when it is at rest relative to itself. But what does this lead to in our wave equation?

Our plane wave function is given by

$$\Psi = e^{i\left(\frac{p_t}{l_p^2}x-\frac{E}{l_p^2}t\right)} \tag{127}$$

the total momentum p_t is given by

$$p_t = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{l_p^2}{\bar{\lambda}}\frac{1}{c}c}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{128}$$

Then we can rewrite the wave function as

$$\Psi = e^{i\left(\frac{\frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2}x-\frac{\frac{l_p^2 c}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2}t\right)} = e^{i\left(\frac{1}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}x-\frac{c}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}t\right)} \tag{129}$$

Next we have $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$, and in the case of a Planck mass particle, we have $v_{max} = c\sqrt{1-\frac{l_p^2}{l_p^2}} = 0$. Further, as explained earlier, the Planck mass particle (a photon–photon collision) only lasts for one Planck second, and has a fixed "size" (reduced Compton wavelength) equal to the Planck length. This means that in order to observe a Planck mass particle, we must have $x = l_p$ and $t = \frac{l_p}{c}$. This gives

$$\Psi = e^{i\left(\frac{1}{l_p}l_p-\frac{c}{l_p}\frac{l_p}{c}\right)} = e^{i\times 0} = 1 \tag{130}$$

That is, the Ψ is always equal to one in the special case of the Planck mass particle, see also [73]. This means if we derive the Heisenberg uncertainty principle from this wave function, in the special case of a Planck mass particle it breaks down and we get a certainty instead of an uncertainty. This certainty lasts the whole of the Planck particle's life time, which is one Planck second.

This is fully consistent with our wave equation; when $\Psi = 1$, we must have

$$\begin{aligned}\frac{\partial\Psi}{\partial t} &= c_x\frac{\partial\Psi}{\partial x}+c_y\frac{\partial\Psi}{\partial y}+c_z\frac{\partial\Psi}{\partial z}\\ \frac{\partial 1}{\partial t} &= c_x\frac{\partial 1}{\partial x}+c_y\frac{\partial 1}{\partial y}+c_z\frac{\partial 1}{\partial z}\end{aligned} \tag{131}$$

which means there can be no change in the wave equation (in relation to the Planck mass particle), which would also mean no uncertainty. Basically particle-wave duality breaks down inside the Planck scale. The Planck mass particle is the collision between two photons and it only lasts for one Planck second. While all other particles are vibrating between energy and Planck mass at their Compton frequency, the Planck mass is just Planck mass, it is actually the building block of all other masses. This is a revolutionary view, but a conceptually simpler one that removes a series of strange interpretations in quantum mechanics, such as spooky action at a distance.

We can also derive this more formally. Since $\Psi = 1$, for a Planck mass particle we must have

$$\frac{\partial\Psi}{\partial x} = 0 \tag{132}$$

Thus, the momentum operator must be zero for the Planck mass particle. Therefore, we must have

$$\begin{aligned}[\hat{p},\hat{x}]\Psi &= [\hat{p}\hat{x}-\hat{x}\hat{p}]\Psi \\ &= \left(-0\times\frac{\partial}{\partial x}\right)(x)\Psi-(x)\left(-0\times\frac{\partial}{\partial x}\right)\Psi \\ &= 0\end{aligned} \tag{133}$$

That is, $\hat{p}$ and $\hat{x}$ commute for the Planck particle, but do not commute for any other particle. For formality's sake, the uncertainty in the special case of the Planck particle must be

$$\begin{aligned}\sigma_p\sigma_x &\geq \frac{1}{2}\left|\int\Psi^*[\hat{p},\hat{x}]\Psi dx\right| \\ &\geq \frac{1}{2}\left|\int\Psi^*(0)\Psi dx\right| \\ &\geq \frac{1}{2}\left|-0\times\int\Psi^*\Psi dx\right| = 0\end{aligned} \tag{134}$$

In the special case of the Planck mass particle, the uncertainty principle collapses to zero. In more technical terms, this implies that the quantum state of a Planck mass particle can simultaneously be a position and a momentum eigenstate. That is, for the special case of the Planck mass particle we have certainty. In addition, the probability amplitude of the Planck mass particle will be one $\Psi_p = e^0 = 1$. However, we have claimed the Planck mass particle only lasts for one Planck second. We think the correct interpretation is that if one observes a Planck mass particle, then one automatically also knows it's momentum, since the particle (according to our maximum velocity formula) must stand still, so it only has rest-mass momentum. In other words, for this and only this particle, one knows the position and momentum at the same time. All particles other than the Planck mass particle will have a wide range of possible velocities for v, which leads to the uncertainty in the uncertainty principle.

Again, the breakdown of the Heisenberg uncertainty principle at the Planck scale is easily to detect, from our analyses in this paper we know that it must be gravity. Modern physics have totally missed out of this. They have their gravity theory on one hand, and they have their quantum theory on the other hand, and they have been thinking break down at the Planck scale is something special happening outside this system. They have for close to 100 years tried to unify QM with gravity but with basically no success. In our theory we see gravity is the break down at the Planck scale. We have derived our whole theory from the Planck scale, naturally combined with some key concepts from giants like Newton, Einstein, Compton, and many more. Still, for the first time in history we have a unified theory.

19 Revised Heisenberg Uncertainty Principle

Table 2 summarize our new uncertainty principle compared to the old one. As we do not need the Planck constant in our theory, but we have claimed the Planck length is the true essence in matter and energy, it is no big surprise the Planck length is seen where the Planck constant normally is observed. Further we can see how everything is basically related to only space and time. For example, rest-mass momentum is the same as collision length, and therefore the same as one of our two mass definitions, namely collision length. That is the space taken up in forms of collision in form of a length.

There is only length and time in our uncertainty principle. This is the beauty of it. In our theory, there is only space and time, but there is collision time and non-collision time – there is space with collision and no collisions, which again are only indivisible in the void, either moving or colliding. And modern physics has only at the quantum level captured the collision frequency, not the collision time, or collision length. Collision length divided by collision time is the speed of light, and the speed of light is collision space-time.

There is collision time and no collision time, and there is collision length (space) and non-collision (space). The collision time interval for an elementary particle with reduced Compton wavelength $\bar{\lambda}$ is given by

$$\frac{l_p}{c} \geq \tilde{m}_t \geq \frac{l_p}{c}\frac{l_p}{\bar{\lambda}} \tag{135}$$

This simply means that if one plans to observe an electron, for example, in a Planck second observational time window, then either one finds it in collision state, and this collision state lasts one Planck second, so that is the maximum collision time in a Planck second. If one does not observe it in a collision state, then the probability for it to be in such a collision state is $\frac{l_p}{\bar{\lambda}}$, and therefore the collision time is an expected collision time of $\frac{l_p}{c}\frac{l_p}{\bar{\lambda}}$. This is, however, not an observable collision time, as it is shorter than the Planck time, and in our theory we can have no length shorter than a Planck length and no time shorter than the Planck time. Further, it is only when the electron (or any other particle) is in its collision state that this is observable gravity. This corresponds to the left side of the inequality above, and it corresponds to the situation where we have Lorentz symmetry and Heisenberg uncertainty break down. The break down in the Heisenberg principle simply means the uncertainty suddenly switches to determinism. But the determinism in an electron only lasts inside one Planck second. This also means things cannot change inside one Planck second, as we have an observation resolution directly linked to the smallest building blocks. We are not necessarily talking about what can be done in the future with the most advanced apparatus, but about the theoretical limits that are linked to reality. But the beauty is that by understanding the smallest building blocks we have a unified consistent quantum gravity theory where predictions are identical to the gravity phenomena we actually are observing.

	Revisited Uncertainty Principle	**Standard Uncertainty Principle**
Momentum position uncertainty	$\Delta p_t \Delta x \geq l_p^2$	$\Delta p \Delta x \geq \hbar$
Kinetic momentum	$l_p - l_p \frac{l_p}{\bar{\lambda}} \geq p_k \geq 0$	$\Delta p \geq \frac{\hbar}{\Delta x}$ gives $\infty \geq p \geq 0$
Total momentum	$l_p \geq p_t \geq l_p \frac{l_p}{\bar{\lambda}}$	$\Delta p \geq \frac{\hbar}{\Delta x}$ gives $\infty \geq p \geq 0$
Position uncertainty	$\bar{\lambda} \geq x \geq l_p$	$\Delta x \geq \frac{\hbar}{\Delta p}$ gives $0 \leq x \leq \infty$
Energy time uncertainty	$\Delta E \Delta t \geq l_p^2$	$\Delta E \Delta t \geq \hbar$
Energy	$l_p c \geq E \geq l_p c \frac{l_p}{\bar{\lambda}}$ Pauli Objection solved	$0 \leq E \leq \infty$ Pauli Objection not solved
Time	$\frac{\bar{\lambda}}{c} \geq t \geq \frac{l_p}{c}$ Time between Planck events	$\Delta t \geq 0$ $\infty \geq t \geq 0$ Pauli Objection not solved
Kinetic energy	$c\left(l_p - \frac{l_p^2}{\bar{\lambda}}\right) \geq E_k \geq 0$	Undefined ? $\Delta E \geq \frac{\hbar}{\Delta t}$ Pauli Objection not solved
Mass as collision time	$\frac{l_p}{c} \geq \tilde{m}_t \geq \frac{l_p}{\bar{\lambda}} \frac{l_p}{c}$ Length of collision time	Missing
Mass as collision length (space)	$l_p \geq \tilde{m} \geq l_p \frac{l_p}{\bar{\lambda}}$ space extension of collision	Missing
Velocity	$0 \leq v \leq c\sqrt{1 - \frac{l_p^2}{\bar{\lambda}^2}}$	$v < c$
Trans-Planckian crisis	No	Yes

Table 2: The table shows the Revisited Uncertainty Principle and the Standard Uncertainty Principle.

It is also clear one can never get a unified theory based on the existing Heisenberg uncertainty fundamentals, that naturally are directly linked to today's quantum mechanics. Modern physics will not be able to incorporate the Planck scale without modifying Heisenberg's uncertainty principle, something they are partly aware of as they have looked into several extensions of the uncertainty principle in the hope of incorporating gravity, see for example [74, 75]. Still, the missing piece seems to entail incorporating collision time in the mass, that then automatically will change the uncertainty principle. This keeps the uncertainty principle unchanged inside a large range, but gives upper and lower bounds.

20 Implications of the Breakdown of the Heisenberg Uncertainty Principle at the Planck Scale

That the Heisenberg uncertainty principle breaks down at the Planck scale could have multitude of implications of interpretations of quantum mechanics. For example, Bells [76] theorem and the evidence running contrary to the idea that local hidden variable theories [77] cannot exist is based on the assumption that Heisenberg's uncertainty principle always holds, see [78, 79]. Further, our theory means wave-particle duality breaks down at the Planck scale. Also, such things as negative energies, negative mass, and negative probabilities seem to be totally forbidden in our new theory.

De Broglie, with his theory of matter waves that was essential for developing the standard quantum theory, shared Einstein's skepticism towards the type of probability interpretations usedvin standard QM. In his own words,

> "*We have to come back to a theory that will be way less profoundly probabilistic. It will introduce probabilities, a bit like it used to be the case for the kinetic theory of gases if you want, but not to an extent that forces us to believe that there is no causality*" – Louis de Broglie, 1967

This is exactly what our new theory has done. For example, our Schwarzschild radius for masses smaller than a Planck mass particle is now directly linked to a frequency probability given by : $P = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$, of a Planck mass event occurring in any given Planck second. It looks like the probability can go above unity as v approaches c, which does not make sense. However, this is not the case, as we have shown the maximum velocity of any elementary particle is $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. This gives a maximum probability is unity for any elementary particle,

$$\begin{aligned}
P &= \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}} \\
P &= \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}} \\
P &= \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{c^2\left(1-\frac{l_p^2}{\bar{\lambda}^2}\right)}{c^2}}} \\
P &= \frac{l_p}{l_p} = 1
\end{aligned} \tag{136}$$

This is again the frequency probability for observing a Planck mass event for an elementary particle with reduced Compton wavelength of $\bar{\lambda}$ inside one Planck second. For a composite masses, it is different, here as shown previously, before the Compton frequency inside one Planck second can become higher than 1. That is, $\frac{l_p}{\bar{\lambda}}$ for a composite mass can be higher than 1. This simply means that the integer part is the number of certain Planck events and the fraction is a probability. In other words, the number of collisions we know must happen plus the probability for one uncertain event to happen. The maximum velocity of a composite mass is limited by the heaviest fundamental particles in the composite mass.

This means our theory for single elementary particles build from minimum two indivisible particles can also be written as a Planck mass event probability theory, Table 3 summarizes some of the many formulas we have discussed in this paper.

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

Table 3: 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 $m_{\mathbf{P}}$.

This fits perfectly with our uncertainty principle. Again the $\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$ part in the formulas in the table should be seen as a frequency probability of a Planck mass event. This probability is for a rest-mass $\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{0^2}{c^2}}} = \frac{l_p}{\bar{\lambda}}$. And for a mass moving at its maximum velocity $\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}} = 1$. This defines a range of values for all elementary particles. And a probability of unity is directly linked to Lorentz symmetry break down and that the Heisenberg uncertainty principle collapses and becomes a certainty principle inside one Planck second. This simply means if one observes a Planck mass particle inside a Planck second, then it is a Planck mass particle in collision state. Unlike all other particles, the Planck mass particle cannot be in and out of collision state. When it is not in collision state, it is energy, but then it is not a Planck mass particle. While all other masses other than the Planck mass particles switch between energy and mass, the Planck mass particle is only mass, but it only lasts for one Planck second. This again is gravity; it is collision time. Our theory has no mystical probabilities; we are back to frequency probabilities, and everything in our model has logical, simple, and mechanical explanations.

21 Minkowski Space-Time is Unnecessarily Complex at the Quantum Level

Our wave equation should be consistent with relativity theory, since it is a relativistic wave equation. As pointed out by Unruh [80], for example, time in standard quantum mechanics plays a role in the interpretation distinct from space, in contrast with the apparent unity of space and time encapsulated in Minkowski space-time [81]. This has been a challenge in standard QM: why is it not fully consistent with Minkowski space-time? According to Unruh, whether or not Minkowski space-time is compatible with quantum theory is still an open question. From our new relativistic wave equation, we have good reason to think this may provide the missing bridge to the solution. This is something we will investigate further here. Minkowski space-time is given by

$$dt^2c^2 - dx^2 - dy^2 - dz^2 = ds^2 \tag{137}$$

where the space-time interval ds^2 is invariant. Or, if we are only dealing with one space dimension, we have

$$dt^2c^2 - dx^2 = ds^2 \tag{138}$$

This is directly linked to the Lorentz transformation (space-time interval) by

$$t'^2c^2 - x'^2 = \left(\frac{t - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - tv}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 = s^2 \tag{139}$$

Assume we are working with only two events that are linked by causality. Each event takes place in each end of a distance L. Then for the events to be linked, a signal must travel between the two events. This signal moves at velocity v_2 relative to the rest frame of L, as observed in the rest frame. This means $t = \frac{L}{v_2}$. In addition, we have the speed v, which is the velocity of the frame where L is at rest with respect to another reference frame. That is, we have

$$t'^2c^2 - x'^2 = \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \tag{140}$$

The Minkowski space-time interval is invariant. This means it is the same, no matter what reference frame it is observed from. To look more closely at why this is so, we can do the following calculation

$$
\begin{aligned}
t'^2c^2 - x'^2 &= \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\
&\left(\frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 - \left(\frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\
&\frac{L^2 - 2L^2\frac{v}{v_2} + L^2\frac{v^2}{v_2^2}}{1-\frac{v^2}{c^2}} - \frac{L^2\frac{c^2}{v_2^2} - 2L^2\frac{v}{v_2} + L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\
&\frac{L^2 + L^2\frac{v^2}{v_2^2} - L^2\frac{c^2}{v_2^2} - L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\
&\frac{L^2\left(1 - \frac{v^2}{c^2} + \frac{v^2}{v_2^2} - \frac{c^2}{v_2^2}\right)}{1-\frac{v^2}{c^2}} \\
&\frac{L^2\left(1 - \frac{v^2}{c^2}\right)\left(1 - \frac{c^2}{v_2^2}\right)}{1-\frac{v^2}{c^2}} \\
&L^2\left(1 - \frac{c^2}{v_2^2}\right)
\end{aligned} \tag{141}
$$

We can clearly see that v is falling out of the equation, and that the Minkowski interval therefore is invariant. For a given signal speed v_2 between two events, the space-time interval is the same from every reference frame. We can also see that it is necessary to square the time and space intervals to get rid of the v and get an invariant interval. If we did not square the time and space intervals, we would get

$$
\begin{aligned}
t'c - x' &= \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right) c - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right) \\
&= \frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{L\frac{c}{v_2} - L\frac{v}{c} - L + L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}}
\end{aligned} \tag{142}
$$

The v will not go away if we do not square the time transformation and length transformation. That is $ds = dtc - dx$ is in general not invariant. However, the squaring is not needed in the special case where the causality between two events is linked to the speed of light; that is, a signal goes with the speed of light from one side of a distance L to cause an event at the other side of L. In this case, we have

$$
\begin{aligned}
t'c - x' &= \frac{\frac{L}{c} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} = 0
\end{aligned} \tag{143}
$$

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 follow causality and where the events are caused by signals traveling at the speed of light. We are not talking about the velocity of the reference frames relative each other to be c (which would cause the model to blow up in infinity), but the velocity that causes one event at each side of the distance L to communicate. And in our Compton model of matter, every elementary particle is a Planck mass event that happens at the Compton length distance apart at the Compton time. Each Planck mass event is linked to the speed of light and the Compton wavelength of the elementary particle in question. This means in terms of space-time (only considering one dimension), for elementary particles we must always have

$$
\begin{aligned}
t'c - x' &= \frac{\frac{\bar{\lambda}}{c} - \frac{\bar{\lambda}}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} = 0
\end{aligned} \tag{144}
$$

That is, inside elementary particles there are Planck mass events every Compton time, and these events, we can say, follow causality; they cannot happen at the same time. Two light particles must each travel over a distance equal to the Compton length between each event. The Planck mass events inside an elementary particle follow causality and are linked to the speed of light, which is why we always have $v_2 = c$ at the deepest quantum level. However, two electrons can, at the same time, travel at velocity $v \leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$ relative to each other.

Or, in three space dimensions (four dimensional space-time), we should have

$$
dtc - dx - dy - dz = 0 \tag{145}
$$

The Minkowski space-time is unnecessarily complex for the quantum world. Space-time in the quantum world is a simplified special case of Minkowski space-time, where no squaring is needed and where the space-time interval always is zero. What does this mean? This means time, which is equivalent to mass, is linked to the ultimate building block of light, that in an elementary particle (mass) keeps traveling back and forth at the speed of light, but when it is colliding with another light particle, both light particles are standing still for one Planck second. This also means that mass can be seen as a Compton clock.

In the special case of a Planck mass particle, we have $\bar{\lambda} = l_p$ and also $v = 0$ because v_{max} for a Planck mass particle is zero. Again, this is simply because two light particles stand absolutely still for one Planck second during their collision, which gives

$$
\begin{aligned}
t'c - x' &= 0 \\
\frac{\frac{\bar{l}_p}{c} - \frac{l_p}{c^2} \times v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{l_p - \frac{l_p}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} &= 0 \\
\frac{l_p - \frac{l_p}{c} \times 0}{\sqrt{1-\frac{0^2}{c^2}}} - \frac{l_p - \frac{l_p}{c} \times 0}{\sqrt{1-\frac{0^2}{c^2}}} &= 0 \\
t_p c - l_p &= 0
\end{aligned} \tag{146}
$$

This means our theory is consistent with the Planck scale. It simply means that time at the most fundamental level is a Planck mass event. As we have claimed before, the Planck mass event has a radius equal to the Planck length and it only lasts for one Planck second.

New space-time operator and space-time wave equation

Further, we can define the following space-time operators (instead of the d'Alembert's operator used in Minkowski space-time) that should be fully consistent with our simplified space-time geometry:

$$
\frac{1}{c}\frac{\partial}{\partial t} - \frac{\partial}{\partial x} - \frac{\partial}{\partial y} - \frac{\partial}{\partial z} \tag{147}
$$

That is, we have

$$
\frac{1}{c}\frac{\partial}{\partial t} - \nabla \tag{148}
$$

where ∇ is the 3-dimensional Laplacian. This gives us a wave equation for the wave $u(x, t)$ of the form

$$
\frac{1}{c}\frac{\partial}{\partial t}u - \nabla u = 0 \tag{149}
$$

22 Electromagnetism and Gravity

From our theory it is clear exactly why gravity is different than electromagnetism all the way to the Planck scale. Electromagnetism is how many collisions one has per time unit, and gravity is how long the collisions lasts in space and time. However, at the Planck scale they are the same, because then how long the collision lasts is also the time between each collision. Only for Planck mass particles packed in a maximum dense fashion next to each other this can happen; that is, inside a Schwarzschild body we find electromagnetism and gravity are united and the same.

However, in general, gravity is not electromagnetism, again gravity is how long each collision between the indivisible particles takes, and electromagnetism is how many collisions per time unit. Except from the special case of Schwarzschild densely packed bodies, that is Planck mass particles lying next to each other, they are not the same.

Our theory is a full unification of the understanding of electromagnetism and gravity at the deepest level. For the first time we have a quantum wave equation derived from quantum that is also consistent with gravity. And gravity is indeed unexpectedly the break down of Lorentz symmetry and also the Heisenberg uncertanity principle at the Planck scale.

23 Unified Summary

- Mass has two important properties, the number of internal collisions and the length such collisions lasts. The standard mass measure such as kg only has incorporated the number of collisions, and this is even hidden in a collision ratio that modern physics is not aware of. The number of collisions is closely linked to energy, and the missing collision time (collision space-time) is closely linked to gravity.
- Our theory predicts that the building blocks of photons, that we claim are indivisible particles, stand still for one Planck second when colliding. This gives a breakdown of Lorentz symmetry at the Planck scale. This break in Lorentz symmetry is easy to detect, as it is what is known as gravity. Modern physics has misunderstood the Planck scale and has not been able to make this connection. There have been extensive searches for breakdown of the Planck scale even at low energies, but it has not been proposed (to our knowledge) that gravity itself is the Lorentz symmetry break down.
- Heisenberg's uncertainty principle also breaks down at the Planck scale, and this is directly linked to Lorentz symmetry break down. It is easily detectable, as this is gravity. All gravity observations are Heisenberg uncertainty break downs at the Planck scale. Our new quantum wave equation framework is fully consistent with this. Standard quantum mechanics is incompatible with gravity as it misses both Lorentz symmetry and Heisenberg's uncertainty principle break downs.
- A long series of known gravity phenomena can be predicted without any knowledge of the Newton gravitational constant or any knowledge of traditional mass sizes. We do not need Newton's gravitational constant or the Planck constant. The gravitational constant is a composite constant that contains the Planck length, the Planck constant, and the speed of light. The Planck constant embedded in the Newton constant is needed to get rid of the Planck constant in the standard incomplete mass definition. The fact that the gravitational constant has the Planck length to incorporate is needed to get collision time back into the mass. While the convention in physics has been to work with a constant that is empirically calibrated, there is another way to see things. It is when one first understands there is an indivisible particle at the depth of reality that one fully realizes this.
- Modern physics assumes incorrectly that Newton gravity moves instantaneously. Even if Newton suggested this on some occasions, it is not what the Newton formula says. The Newton formula in modern use has the Newton gravity constant that contains embedded the speed of light (gravity). Recently, we have shown how the speed of light (gravity) easily can be found only from a series of standard gravity observations [42].
- We have presented a fully unified theory, which unites the deepest quantum aspects of mass with gravity. It gives us a quantum wave equation that is consistent with gravity and shows that observed gravity is a breakdown of Lorentz symmetry and Heisenberg uncertainty principle at the Planck scale. We have been observing Planck scale break down all the time. Modern physics has mistakenly thought that gravity is one thing and the quantum world is something separate and that one should find Planck scale break down in some other "place/way" – instead we maintain that gravity itself is Lorentz symmetry break down, and, as we have shown, it is also a break down in Heisenberg uncertainty.
- We now have a theory where our quantum mechanics are consistent with gravity; we have also, for the first time, a theory where a simplification of Minkowski space time is consistent with QM. And further, we have an extended Newtonian gravity. To what degree it is consistent with every aspect of GR we are not sure at this time, but our theory seems to predict the precession of Mercury correctly, it predicts the bending of light correctly, and it predicts that there is no time dilation for quasars, also correctly.

Even if not fully investigated yet, it seems that our model has the same challenges in explaining the rotation of galaxy arms as the standard gravity model. That is, we either need dark matter like the standard model or we need some adjustment to our theory. It is interesting in this respect that there exist several new Newtonian-like gravity models that fits galaxy rotations without dark matter, see for example [82–84].

It is also unclear to what degree our model is compatible or in conflict with general relativity theory. What we know is our model gives all the same predictions as the Newton model in weak gravitational fields. However, even in a weak field, our theory due to small relativistic corrections give small differences. For a strong gravity field, our model goes beyond Newton. Our model predicts the correct bending of light, and it seems to predict the correct precession of Mercury.

Most importantly, our model gives a simple quantum model that is consistent with gravity. As a minimum we think this framworke is worth exploring further.

24 Conclusion

We have, based on a new theory of mass, shown how the quantum scale and cosmological scale are connected. Gravity is the collision space-time of indivisible particles. There exists an indivisible particle with diameter equal to the Planck length. The mass gap is observational time dependent. Modern physics' definition of mass only indirectly has the numbers of collisions in the mass, and there seems to be a lack of awareness about of this, even if recent research clearly points in this direction. Modern physics only get this indirectly by having to rely on a gravitational constant that is almost mystical and not understood at deeper level by its theorists and practitioners. This mode of thinking actually masks what is really going on in reality. From our new and deeper understanding of mass, it is clear that gravity itself is the Lorentz symmetry break down at the Planck scale.

Lorentz symmetry break down at the Planck scale is therefore everywhere and has been observed, because it is gravity.

We have also derived a new quantum wave equation rooted in our model of matter. This model shows that Lorentz symmetry as well as the Heisenberg's uncertainty principle breaks down at the Planck scale. This break down at the Planck scale is gravity. The Lorentz symmetry break down at the Planck scale actually happens at every Compton time in elementary particles, but this break down only lasts for one Planck second. Our model is built from the quantum and gives exactly the same same gravity predictions as standard gravity theory, with the exception that Planck mass particles and quasars cannot have time-dilation. No time dilation in quasars has been observed, but this is not consistent with existing gravity theories. Finally, based on our insight into matter, we have shown that at the quantum scale, Minkowski space-time can be simplified (but not replaced); this makes our new quantum mechanics fully consistent with a simplified Minkowski space-time.

References

[1] R. E. Schofield. Atomism from Newton to Dalton. *American Journal of Physics*, 49(211), 1981.

[2] Alan Chalmers. *Newton's Atomism and its Fate.* Volume 279 of the series Boston Studies in the Philosophy of Science: in the Book: The Scientists Atom and the Philosophers Stone, Springer, 2009.

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

[4] L. L. Whyte. *Essay on Atomism: From Democritus to 1960.* Wesleyan Univ. Press, 1961.

[5] Andrew Phyle. *Atomism.* Thoemmes Press, Bristol England, 1995.

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

[7] C. Grellard and A. Robert. *Atomism in Late Medieval Philosophy and Theology.* Koninklijke Brill, 2009.

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

[9] A. H. Compton. A quantum theory of the scattering of x-rays by light elements. *Physical Review. 21 (5):*, 21(5), 1923.

[10] S. Prasannakumar, S. Krishnaveni, and T. K. Umesh. Determination of rest mass energy of the electron by a Compton scattering experiment. *European Journal of Physics*, 33(1), 2012.

[11] 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, 1975.

[12] 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.

[13] I. A. Robinson and S. Schlamminger. First determination of the Planck constant using the LNE watt balance. *Forthcoming, Metrologia*, 2016.

[14] W. H. Zurek. Sub-Planck structure in phase space and its relevance for quantum decoherence. *Nature*, 412, 2001.

[15] G. S. Agarwal and P. K. Pathak. Mesoscopic superposition of states with sub-Planck structures in phase space. *Phys. Rev. A*, 70, 2004.

[16] S. Ghosh, U. Roy, C. Genes, and D. Vitali. Sub-Planck-scale structures in a vibrating molecule in the presence of decoherence. *Phys. Rev. A*, 79, 2009.

[17] T. Padmanabhan. Planck length as the lower bound to all physical length scales. *General Relativity and Gravitation*, 17, 1985.

[18] Mark Garman. Charm school. *In Over the Rainbow, Risk Publications*, 2(3), 1995.

[19] R. J. Adler. Six easy roads to the Planck scale. *American Journal of Physics*, 78(9), 2010.

[20] S. Hossenfelder. Can we measure structures to a precision better than the Planck length? *Classical and Quantum Gravity*, 29, 2012.

[21] A. Farag, M. Mohammed A., Khalil, and E. C. Vagenas. Minimal length in quantum gravity and gravitational measurements. *EPL*, 112(2), 2015.

[22] E. G. Haug. Can the Planck length be found independent of big G ? *Applied Physics Research*, 9(6), 2017.

[23] E. G. Haug. Finding the Planck length independent of Newton's gravitational constant and the Planck constant: The Compton clock model of matter. *https://www.preprints.org/manuscript/201809.0396/v1*, 2018.

[24] R.S. Van Dyck, F.L. Moore, D.L. Farnham, and P.B. Schwinberg. New measurement of the proton-electron mass ratio. *International Journal of Mass Spectrometry and Ion Processes*, 66(3), 1985.

[25] 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.

[26] S. Lan, P. Kuan, B. Estey, D. English, J. M. Brown, M. A. Hohensee, and Müller. A clock directly linking time to a particle's mass. *Science*, 339, 2013.

[27] D. Dolce and Perali. On the Compton clock and the undulatory nature of particle mass in graphene systems. *The European Physical Journal Plus*, 130(41), 2015.

[28] H. Cavendish. Experiments to determine the density of the earth. *Philosophical Transactions of the Royal Society of London, (part II)*, 88, 1798.

[29] Isaac Newton. *Philosophiae Naturalis Principia Mathematica*. London, 1686.

[30] 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.

[31] D. Isaachsen. *Lærebog i Fysikk*. Det Norske Aktieforlag, 1905.

[32] E. G. Haug. The gravitational constant and the Planck units. A simplification of the quantum realm. *Physics Essays Vol 29, No 4*, 2016.

[33] E. G. Haug. Planck quantization of Newton and Einstein gravitation. *International Journal of Astronomy and Astrophysics*, 6(2), 2016.

[34] E. G. Haug. Newton and Einstein's gravity in a new perspective for Planck masses and smaller sized objects. *International Journal of Astronomy and Astrophysics*, 2018.

[35] Max Planck. *Natuerliche Masseinheiten*. Der Königlich Preussischen Akademie Der Wissenschaften, p . 479., 1899.

[36] Max 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.

[37] E. G. Haug. Planck mass measured totally independent of big G utilising McCulloch-heisenberg newtonian equivalent gravity. *preprints.org*, 2018.

[38] K. Schwarzschild. Über das gravitationsfeld eines massenpunktes nach der einsteinschen theorie. *Sitzungsberichte der Deutschen Akademie der Wissenschaften zu Berlin, Klasse fur Mathematik, Physik, und Technik*, page 189, 1916.

[39] K. Schwarzschild. über das gravitationsfeld einer kugel aus inkompressibler flussigkeit nach der einsteinschen theorie. *Sitzungsberichte der Deutschen Akademie der Wissenschaften zu Berlin, Klasse fur Mathematik, Physik, und Technik*, page 424, 1916.

[40] Albert Einstein. Näherungsweise integration der feldgleichungen der gravitation. *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften Berlin*, 1916.

[41] 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.

[42] E. G. Haug. Extraction of the speed of gravity (light) from gravity observations only. *International Journal of Astronomy and Astrophysics*, 9, 2019.

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

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

[45] E. G. Haug. Does Heisenberg's uncertainty principle predict a maximum velocity for anything with rest-mass below the speed of light ? *viXra:1801.0218*, 2018.

[46] E. R. Bagge. Relativistic effects in the solar system. *Atomkernenergie-Kerntechnik*, 39, 1981.

[47] T. E. Phipps. Mercury's precession according to special relativity. *American Journal of Physics*, 54(3), 1986.

[48] T. Chow. On relativistic Newtonian gravity. *European Journal of Physics*, 13(4), 1992.

[49] P. C. Peters. Comment on "Mercury's precession according to special relativity". *American Journal of Physics*, 55, 1986.

[50] T. E. Phipps. Response to "comment on 'Mercury's precession according to special relativity'". *American Journal of Physics*, 55, 1986.

[51] T. Biswas. Minimally relativistic Newtonian gravity. *American Journal of Physics*, 56, 1988.

[52] P. C. Peters. Comment on "Minimally relativistic Newtonian gravity". *American Journal of Physics*, 56, 1988.

[53] S. K. Ghosal and P. Chakraborty. Relativistic Newtonian gravity: an improved version. *European Journal of Physics*, 56(6), 1991.

[54] E. G. Haug. Relativistic Newtonian gravitation that gives the correct prediction of mercury precession. *http://vixra.org/pdf/1808.0679v2.pdf*, 2018.

[55] L. Soldner. On the deflection of a light ray from its rectilinear motion, by the attraction of a celestial body at which it nearly passes by. *Berliner Astronomisches Jahrbuch:*, 1881.

[56] L. Soldner. On probability theory and probabilistic physics – axiomatics and methodology. *Foundations of Physics*, 3(4), 1884.

[57] Albert Einstein. Über den einfluss der schwercraft auf die ausbreitung des lichtes. *Annalen der Physik*, 4, 1911.

[58] F. Dyson, A. Eddington, and C. Davidson. A determination of the deflection of light by the sun's gravitational field, from observations made at the total eclipse of may 29, 1919. *Philosophical Translation Royal Society*, 1920.

[59] M. Sato and H. Sato. Light bending by gravity: Back to space and time from spacetime. *Physics Essays*, 29, 2016.

[60] Domingos S. L. Soares. Newtonian gravitational deflection of light revisited. *Working Paper version 4*, 2009.

[61] A. T. Augousti and A. Radosz. An observation on the congruence of the escape velocity in classical mechanics and general relativity in a Schwarzschild metric. *European Journal of Physics*, 376:331–335, 2006.

[62] Albert Einstein. Zur elektrodynamik bewegter körper. *Annalen der Physik*, (17), 1905.

[63] 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.

[64] G. Scarpetta. *Letter Nuovo Cimento,*, 51, 1984.

[65] D. F. Falla and P. T. Landsberg. Black holes and limits on some physical quantities. *European Journal of Physics*, 15, 1994.

[66] E. G. Haug. Charged particle radiation power at the Planck scale. *http://vixra.org/pdf/1604.0228v2.pdf*, 2016.

[67] E. G. Haug. A minimum Rindler horizon when accelerating? *http://vixra.org/pdf/1810.0015v1.pdf*, 2018.

[68] A. Hees and et al. Tests of Lorentz symmetry in the gravitational sector. *Universe*, 2(4), 2017.

[69] de. L. Broglie. Waves and quanta. *Nature*, 112(540), 1923.

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

[71] E. G. Haug. Better quantum mechanics? Thoughts on a new definition of momentum that makes physics simpler and more consistent. *http://vixra.org/pdf/1812.0430*, 2018.

[72] E. Schrödinger. An undulatory theory of the mechanics of atoms and molecules. *Physical Review*, 28(6): 104–1070, 1926.

[73] E. G. Haug. Revisiting the derivation of Heisenberg's uncertainty principle: The collapse of uncertainty at the Planck scale. *preprints.org*, 2018.

[74] F. Ahmadi and F. Vali. The radius of the Schwarzschild black-hole in noncommutative space with gup. *Physics Procedia*, 22, 2011.

[75] S. Gangopadhyay and A. Dutta. Generalized uncertainty principle and black hole thermodynamics. *General Relativity and Gravitation*, 46, 2014.

[76] J. S. Bell. On the Einstein Podolsky Rosen paradox. *Physics*, 1, 1964.

[77] Albert Einstein and N. Rosen. The particle problem in the general theory of relativity. *Phys. Rev.*, (48), 1935.

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

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

[80] W. G. Unruh. *Chapter: Minkowski Space-Time and Quantum Mechanics, in the bool Minkowski Spacetime: A Hundred Years Later, Edited by V. Petkov.* Springer, 2009.

[81] Hermann 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.

[82] M. Milgrom. A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis. *Astrophysical Journal.*, 270, 1983.

[83] M. E. McCulloch. Quantised inertia from relativity and the uncertainty principle. *EPL (Europhysics Letters)*, 115(6), 2016.

[84] M. E. McCulloch. Galaxy rotations from quantised inertia and visible matter only. *Astrophys Space Science*, 362, 2017.

Appendix

Deriving the Escape Velocity in Relativistic Newton Mechanics

$$
\begin{aligned}
\frac{mc^2}{\sqrt{1-v^2/c^2}} - mc^2 - G\frac{M\frac{m}{\sqrt{1-v^2/c^2}}}{r} &= 0 \\
1 - \sqrt{1-v^2/c^2} - \frac{GM}{c^2 r} &= 0 \\
\sqrt{1-v^2/c^2} &= 1 - \frac{GM}{c^2 r} \\
1 - v^2/c^2 &= \left(1 - \frac{GM}{c^2 r}\right)^2 \\
1 - v^2/c^2 &= 1 - 2\frac{GM}{c^2 r} + \frac{G^2 M^2}{c^4 r^2} \\
v^2/c^2 &= \frac{2GM}{c^2 r} - \frac{G^2 M^2}{c^4 r^2} \\
v^2 &= \frac{2GM}{r} - \frac{G^2 M^2}{c^2 r^2} \\
v &= \sqrt{\frac{2GM}{r} - \frac{G^2 M^2}{c^2 r^2}} \qquad (150)
\end{aligned}
$$

Deriving the escape velocity in our quantum mass model is basically the same as the one above, but then without G

$$
\begin{aligned}
\frac{\tilde{m}c^2}{\sqrt{1-v^2/c^2}} - \tilde{m}c^2 - c^2\frac{\tilde{M}\frac{\tilde{m}}{\sqrt{1-v^2/c^2}}}{r} &= 0 \\
1 - \sqrt{1-v^2/c^2} - \frac{c^2\tilde{M}}{c^2 r} &= 0 \\
\sqrt{1-v^2/c^2} &= 1 - \frac{\tilde{M}}{r} \\
1 - v^2/c^2 &= \left(1 - \frac{\tilde{M}}{r}\right)^2 \\
1 - v^2/c^2 &= 1 - 2\frac{\tilde{M}}{r} + \frac{\tilde{M}^2}{r^2} \\
v^2/c^2 &= \frac{2\tilde{M}}{r} - \frac{\tilde{M}^2}{r^2} \\
v^2 &= \frac{2c^2\tilde{M}}{r} - \frac{c^2\tilde{M}^2}{r^2} \\
v &= c\sqrt{\frac{2\tilde{M}}{r} - \frac{\tilde{M}^2}{r^2}} \\
v &= c\sqrt{\frac{r_s}{r} - \frac{r_s^2}{4r^2}} \qquad (151)
\end{aligned}
$$