Collision Space-Time
Unified Quantum Gravity
Gravity is Lorentz symmetry break down at the Planck scale.

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Abstract

We have recently presented a unified quantum gravity theory [23]. Here we extend on that work and present an even simpler version of that theory. For about hundred years, modern physics has not been able to build a bridge between quantum mechanics and gravity. However, a solution may be found here; we present our quantum gravity theory, which is rooted in indivisible particles where matter and gravity are related to collisions and can be described by collision space-time. In this paper, we also show that we can formulate a quantum wave equation rooted in collision space-time, which is equivalent to mass and energy.

The beauty of our theory is that most of the main equations that currently exist in physics are not changed (in terms of predictions), except at the Planck scale. The Planck scale is directly linked to gravity and gravity is, surprisingly, actually a Lorentz symmetry as well as a form of Heisenberg uncertainty break down at the Planck scale. Our theory gives a dramatic simplification of many physics formulas without altering the output predictions. The relativistic wave equation, the relativistic energy momentum relation, and Minkowski space can all be represented by simpler equations when we understand mass at a deeper level. This not attained at a cost, but rather a reflection of the benefit in having gravity and quantum mechanics unified under the same theory.

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 Short introduction to the incomplete mass definition in modern physics and what it truly represents

Modern physics texts talk about mass in terms of kg or pounds, which are linked to the Planck constant. This became especially clear after the kg was redefined in terms of the Planck constant in 2019, based on the Watt balance, see [1–3]. Modern physics can explain quite a bit about how energy relates to mass; however, we will claim that an important aspect of mass is missing and we will elaborate on that observation in this paper. All rest-masses, including elementary particles, can be described by the following formula

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

where $\bar{\lambda}$ is the reduced Compton wavelength, the formula is simply found by solving the Compton [4] wavelength formula $\bar{\lambda} = \frac{\hbar}{mc}$ with respect to the mass.

Less known is that this formula also holds for composite masses, such as one kg because even if a kg or other composite mass consists of several Compton wavelengths (because they consist of many particles), they are additive and the mathematical Compton wavelength of the composite mass will give the correct Compton frequency of the composite mass. Any composite mass can be written as

$$
\begin{aligned}
m &= \sum_i^N \frac{\hbar}{\bar{\lambda}_i}\frac{1}{c} = \frac{\hbar}{c}\sum_i^N \frac{1}{\bar{\lambda}_i} \\
m &= \frac{\hbar}{\frac{1}{\sum_i^N \frac{1}{\bar{\lambda}_i}}}\frac{1}{c} \\
m &= \frac{\hbar}{\bar{\lambda}}\frac{1}{c}
\end{aligned}
\tag{2}
$$

where

$$
\bar{\lambda} = \frac{\hbar}{\sum_i^N m_i c} = \frac{1}{\sum_i^N \frac{1}{\bar{\lambda}_i}} \tag{3}
$$

Standard mass as kg, we will claim at a deeper level is simply a collision ratio. One kg has the following number of internal collisions per second (the Compton frequency)

$$
f_{1,kg} = \frac{c}{\bar{\lambda}_{1,kg}} = \frac{c}{\frac{\hbar}{1\times c}} = \frac{1\times c^2}{\hbar} = 8.52\times 10^{50} \text{ collisions/second} \tag{4}
$$

For example, an electron will have the following number of internal collisions per second (Compton frequency)

$$
f_e = \frac{c}{\bar{\lambda}_e} \approx 7.76\times 10^{20} \text{ collisions/second} \tag{5}
$$

The mass of an electron in terms of kg is the number of collisions in one electron relative to the number of collisions in one kg. That is to say, a kg is a collision ratio and for an electron, this collision ratio is

$$
m = \frac{f_e}{f_{1,kg}} = \frac{7.76\times 10^{20}}{8.52\times 10^{50}} \approx 9.1\times 10^{31} \text{ kg} \tag{6}
$$

which is the known mass in kg of an electron. The same holds for a proton or any other mass. Interestingly, the reduced Compton frequency is only a deeper aspect of mass that has recently been more or less confirmed by experimental research, see [5, 6].

This means the minimum size a mass that one can observe in (in terms of kg) is one collision. In terms of kg, that is

$$
m_g = \frac{1}{8.52\times 10^{50}} = \frac{1}{\frac{c^2}{\hbar}} = \frac{\hbar}{c^2} \approx 1.17\times 10^{-51} \text{ kg} \tag{7}
$$

This confirms that the Planck constant is linked to quantized energy and mass. However, the Planck constant is linked to a collision ratio definition of mass/energy that not is optimal, as it completely ignores an important aspect of any mass, namely the duration of each collision, a subject that we will return to soon.

The number of collisions in one kg is observational time dependent. If the number of collisions is observed in one kg over half a second rather than one full second, then the number of collisions is cut in half. However, then the number of collisions in an electron is also cut in half, which means that the mass in kg is typically observational window time independent. However, this only holds true for observational time windows considerably above the Compton time of the particle in question. If an electron is observed in a time window equal to half its Compton time, then the mass of the electron is, in our view, probabilistic and the predicted mass inside this time window is half of its known mass due to this probabilistic effect.

The mass-gap (one collision) is, on the other hand, in terms of kg always observational time window dependent because in order to observe the smallest mass possible we need to observe one collision no matter what the time window is; if it is below this, we have not observed any mass. However, as the numbers of collisions goes down in one kg, the shorter the time window then the collision ratio of the mass-gap will be observational time dependent. In the shortest possible time window, the mass of the mass-gap must be (we are assuming for a moment that the shortest possible time window is the Planck time)

$$
m_g = \frac{1}{8.52\times 10^{50}\frac{l_p}{c}} = \frac{c}{8.52\times 10^{50} l_p} = \frac{c\hbar}{c^2 l_p} = \frac{\hbar}{l_p}\frac{1}{c} = m_p \tag{8}
$$

That is to say, when observed in the shortest possible time interval, then the mass-gap is the Planck mass. This is an enormous mass compared to observed particle masses. However, if the same mass-gap is observed inside an observation window of one second it has a mass in kg of only 1.17×10^{-51} kg.

2 Introduction to Our New Theory

Our theory is rooted in the assumption that there ultimately only is one particle, namely an indivisible particle. Newton was one of the last physicists in modern times who held this view. In our theory, we have made the following assumptions, everything (energy and matter) consists of

- Indivisible particles that always move at the same speed or are colliding and then standing still during those collisions relative to the indivisible particles that are simply traveling along.
- Void (empty space) that the indivisible particles can travel in.

This means we have an indivisible particle with a diameter larger than zero. This diameter is unknown, but we will see that when our theory is calibrated to experimental data, it gives a value equal to the Planck length. We are saying the colliding indivisible particles stand still relative to moving indivisible particles. The question is how long they stand still, and we will see this is one Planck time (Planck second). Further, we will see that the velocity of the indivisible particle is the speed of light. This is not something we assume; this is something we find by calibrating our theory to experiments. Under our theory there only exists one pure mass, which is the collision between two indivisible particles. Non-colliding indivisible particles have no rest-mass and are moving at the speed of light.

The idea of an indivisible particle goes back to ancient Greek atomism, see for example [7–11]. Newton made a substantial number of references to atomism [12, 13] and was clearly inspired by it; whether this inspiration led to some of his discoveries we will leave up to others to consider. A series of modern physicists such as Schrödinger [14] clearly also spent time studying ancient atomism, but it is not clear what, if anything, came out of it. Still, we think that modern physics gave up on atomism before investigating it adequately. Sudden discoveries also involve a certain degree of luck – to suddenly understand how a number of pieces fits together. In this paper, we will see how the idea of an indivisible particle falls into place with other theories and helps us unite key discoveries in modern physics into a simple unified quantum gravity theory.

Under this model, an electron will be in a pure mass state at its Compton periodicity. The electron is in a Planck mass state $\frac{c}{\bar{\lambda}_e} \approx 7.76 \times 10^{20}$ times per second. Each of these Planck mass events only lasts for one Planck second, so the mass of the electron in terms of kg will be

$$m = \frac{c}{\bar{\lambda}_e} m_p t_p = \frac{c}{\bar{\lambda}_e} \frac{\hbar}{l_p} \frac{1}{c} \frac{l_p}{c} = \frac{\hbar}{\bar{\lambda}_e} \frac{1}{c} \approx 9.1 \times 10^{31} \text{ kg} \tag{9}$$

This mass measure, however, still misses an important part of the aspect of mass, i.e., how long each collision lasts gets lost in the equation. This because the Planck length cancels out, and because we are getting out the mass as collision frequency. This is no surprise, as mass as kg is a collision ratio that tells nothing about the collision duration.

3 The Missing Piece in the Standard Mass Definition

We have seen that mass in terms of kg is a collision ratio. However, our current mass measure says nothing about the length of each collision or the length of all collisions aggregated. That is, mass consists of two important aspects: the number of collisions and also the length of time these collisions last (the duration). Standard physics only notes the number of collisions in form of a collision ratio and has not incorporated collision time into the mass model. In addition, modern physics is not really aware that the current mass definition is actually a collision ratio.

3.1 Mass definition: mass as collision time

In our new the theory, mass is defined as collision time over the shortest possible time interval can be shown as

$$\tilde{m} = t_p \frac{l_p}{\bar{\lambda}} = \frac{l_p}{c} \frac{l_p}{\bar{\lambda}} \tag{10}$$

where t_p is the Planck time. We are not hypothesizing that this is the Planck time; it could be an unknown time $\frac{x}{c}$, but when our mass model is calibrated to gravity (based on our own quantum gravity model), we find that the shortest time is the Planck time and the shortest length is the Planck length. The factor $\frac{l_p}{\bar{\lambda}} = \frac{t_p}{\frac{\bar{\lambda}}{c}}$ is the percent of time a given particle is in collision state.

Thus, all masses are collisions between indivisibles, and the essential factor for gravity is how long this collision lasts. For a Planck mass particle, this collision lasts for one Planck second per Planck second, $\tilde{m} = t_p \frac{l_p}{l_p} = t_p$. Every observable elementary particle goes in and out of the Planck mass state at the Compton frequency and therefore has a collision time per Planck second of less than a Planck second per Planck second.

3.2 Energy definition: energy as collision length

Energy is collision length per shortest time interval.

$$\tilde{E} = l_p \frac{l_p}{\bar{\lambda}} \tag{11}$$

and we have

$$\tilde{E} = \tilde{m}c \tag{12}$$

and naturally

$$\tilde{m} = \frac{\tilde{E}}{c} \tag{13}$$

This simply means that mass is collision time, energy is collision length, and the speed of light is collision length, divided by collision time. The speed of light is space-time, it is collision length divided by collision time.

$$\frac{\tilde{E}}{\tilde{m}} = c = \frac{\tilde{L}}{\tilde{T}} \tag{14}$$

Some physicists may assume that this must be wrong because we do not have c^2. However, we will show that in fact c^2 is not needed. This does not imply that Einstein's $E = mc^2$ is wrong; it simply means that it can be simplified further when one truly understands mass from this alternative perspective.

3.3 Mass is collision time and energy is collision length

Remarkably, all mass can be described as collision time and all energy as collision length. Further, collision length divided by collision time is the speed of light. This theory even defines the speed of light. The speed of light is simply how far an indivisible particle that is not colliding with another particle can move while two other indivisible particles are colliding. The question is: Whether the indivisible particle travels one diameter or more or less than one diameter of an indivisible particle. We will see the answer is that it travels one diameter during the time two other indivisible particles are in collision. In other words, the speed of the indivisible particles in terms of using its own diameter as unit is one.

Since all is built from indivisible particles, nothing can travel faster than an indivisible particle, so it is no surprise that its speed is the speed of light. Also, keep in mind that the collision itself is mass, so non-colliding indivisible particles have zero mass when they are moving.

3.4 Relativistic extension

The diameter of an indivisible particle cannot undergo any length contraction and will be invariant. However, the Compton wavelength, which is the average distance between indivisible particles, can undergo standard length contraction. This means the relativistic energy is given by

$$\tilde{E} = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{l_p^2}{\bar{\lambda}}\frac{1}{c}c}{\sqrt{1-\frac{v^2}{c^2}}} = l_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{15}$$

This is not that different than Einstein's [15] special relativity theory, where we have

$$E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{\hbar}{\bar{\lambda}}\frac{1}{c}c^2}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\hbar c}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{16}$$

But still there is a major difference, as special relativity theory has not incorporated the diameter of the indivisible particle and therefore has not incorporated the Planck scale.

Further, the relativistic kinetic energy is given by

$$\tilde{E}_k = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} - mc = l_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} - l_p \frac{l_p}{\bar{\lambda}} \tag{17}$$

In the case $v << c$, the formula above can be approximated by the first series of a Taylor series expansion, which gives

$$\tilde{E}_k \approx \frac{1}{2}\tilde{m}\frac{v^2}{c} = \frac{1}{2}\frac{l_p^2}{\bar{\lambda}}v^2 \tag{18}$$

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 reaches the Planck length. This means we must have

$$l_p \leq \bar{\lambda}\sqrt{1-\frac{v^2}{c^2}} \tag{19}$$

solved with respect to v this gives

$$v \leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} \tag{20}$$

This is the same maximum velocity of matter that has been suggested by Haug [16–20]. We basically get the same maximum velocity for escape velocity, however surprising this may be. For any observed elementary particle, such as the electron, this predicts a maximum velocity considerably higher than what one can achieve at the Large Hadron Collider, for example, but it is still below the speed of light. The formula gives an interesting special case for the Planck mass particle. For a Planck mass particle, the reduced Compton wavelength is equal to the Planck length, and this gives a maximum velocity of

$$v_{max} = c\sqrt{1-\frac{l_p^2}{l_p^2}} = 0 \tag{21}$$

That is, the maximum velocity of a Planck mass particle is zero. This at first seems absurd, until one realizes that the Planck mass particle is the collision point between two indivisible particles. The Planck mass particle is a photon-photon collision, and even from standard physics it is well known that this can create mass, or it is mass, see [21, 22]. However, the collision only lasts for one Planck second before it dissolves into energy again. We will see how this actually can be measured from gravity experiments.

It is worth mentioning that special relativity theory is not consistent with any minimum length, such as the Planck length. In SR, one can take any length L and just move it at a speed close enough to c so that its contracted length is shorter than the Planck length. As we will see, this also means that SR cannot be consistent with gravity, and therefore under SR one needs a separate theory for that.

3.5 Gravity theory

In a weak field, we have a non-relativistic formula that gives the same numerical predictions as Newton, but it has a much more intuitive gravitational constant, namely c^3 rather than G, that is we have

$$\tilde{F} = c^3\frac{\tilde{M}\tilde{m}}{r^2} \tag{22}$$

This can be written as

$$\tilde{F} = c^3\frac{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}_M}\frac{l_p}{c}\frac{l_p}{\bar{\lambda}_m}}{r^2} \tag{23}$$

This model offers all the same predictions as Newton gravity theory see table 1, except it also gives the correct bending of light, see [23]. We will soon show how to calibrate the gravity formula, and this gives us l_p as the Planck length with no knowledge of G or $\hbar$ required.

4 Finding the Diameter of the Indivisible Particle

Our mass definition is

$$\tilde{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}} \tag{24}$$

As the diameter of the indivisible particle is important for the collision time (and we will claim gravity is rooted in collision time), we need to find l_p from gravity observations. That it is actually the Planck length is more than a hypothesis, because we can just as well say it has a unknown value x and then use gravity observations to find what length it is. We find it to be the Planck length and we describe the process in this section.

In addition, we need to find $\bar{\lambda}$ without knowing the traditional mass. Even if we are working with a proton, to do this, we will 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 on an electron only, but this helps us to find the reduced Compton wavelength for large masses. 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])

$$\frac{\frac{c}{\bar{\lambda}_P}}{\frac{c}{\bar{\lambda}_e}} = \frac{f_P}{f_e} = 1836.152470(76) \tag{25}$$

.

In fact, they measured the proton-electron mass ratio this way and not the mass in kg. Theoretically, it is no surprise that $\frac{f_P}{f_e} = \frac{m_P}{m_e}$. This also holds true in our mass definition

$$\begin{aligned} \frac{f_P}{f_e} &= \frac{\tilde{m}_P}{\tilde{m}_e} \\ \frac{f_P}{f_e} &= \frac{\frac{l_p^2}{\bar{\lambda}_P}\frac{1}{c}}{\frac{l_p^2}{\bar{\lambda}_e}\frac{1}{c}} = \frac{\bar{\lambda}_e}{\bar{\lambda}_P} \end{aligned} \tag{26}$$

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 to find this diameter. 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, [26]. 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

$$\bar{\lambda} = \frac{\hbar}{\sum_{i=1}^{N} m_i c} = \frac{1}{\frac{1}{\bar{\lambda}_i} + \frac{1}{\bar{\lambda}_{i+1}} + \frac{1}{\bar{\lambda}_n}} \tag{27}$$

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

$$\kappa\theta \tag{28}$$

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

$$\kappa\theta = LF \tag{29}$$

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

$$F = c^3 \frac{\tilde{M}_t \tilde{m}_t}{R^2} = c^3 \frac{\frac{x^2}{\bar{\lambda}_M}\frac{1}{c}\frac{x^2}{\bar{\lambda}_m}\frac{1}{c}}{R^2} \tag{30}$$

where x is unknown. This means we must have

$$\kappa\theta = Lc^3 \frac{\tilde{M}\tilde{m}}{R^2} \tag{31}$$

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

$$T = 2\pi\sqrt{\frac{I}{\kappa}} \tag{32}$$

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

$$I = \tilde{m}\left(\frac{L}{2}\right)^2 + \tilde{m}\left(\frac{L}{2}\right)^2 = 2\tilde{m}\left(\frac{L}{2}\right)^2 = \frac{\tilde{m}L^2}{2} \tag{33}$$

this means we have

$$T = 2\pi\sqrt{\frac{\tilde{m}L^2}{2\kappa}} \tag{34}$$

and when solved with respect to κ, this gives

$$\begin{aligned}
\frac{T^2}{2^2\pi^2} &= \frac{\tilde{m}L^2}{2\kappa} \\
\kappa &= \frac{\tilde{m}L^2}{2\frac{T^2}{2^2\pi^2}} \\
\kappa &= \frac{\tilde{m}L^2 2\pi^2}{T^2}
\end{aligned} \tag{35}$$

Next, in equation 31 we replace κ with this expression

$$\begin{aligned}
\frac{\tilde{m}_t L^2 2\pi^2}{T^2}\theta &= Lc^3\frac{\tilde{M}_t\tilde{m}_t}{R^2} \\
\frac{L^2 2\pi^2}{T^2}\theta &= Lc^3\frac{\tilde{M}_t}{R^2}
\end{aligned} \tag{36}$$

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

$$\begin{aligned}
\frac{L^2 2\pi^2}{T^2}\theta &= Lc^3\frac{\frac{x^2}{\bar{\lambda}}\frac{1}{c}}{R^2} \\
\frac{L^2 2\pi^2}{T^2}\theta &= Lx^2\frac{\frac{c^2}{\bar{\lambda}}}{R^2} \\
\frac{L 2\pi^2 R^2}{T^2\frac{c^2}{\bar{\lambda}}}\theta &= x^2 \\
x &= \sqrt{\frac{L 2\pi^2 R^2}{T^2\frac{c^2}{\bar{\lambda}}}\theta} \\
x &= \sqrt{\frac{L 2\pi^2 R^2\theta}{T^2 f_C c}}
\end{aligned} \tag{37}$$

where f_C is the reduced Compton frequency of the mass in question, which we have shown how to find previously. 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 in combination with Cavendish. Today we 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.

4.1 Escape velocity

Remember that $E_k = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} - \tilde{m}c$ can be approximated by a Taylor expansion $E_k \approx \frac{1}{2}\frac{mv^2}{c}$; this means the escape velocity must be

$$\begin{aligned}
E_k c - c^3\frac{\tilde{M}\tilde{m}}{r} &= 0 \\
\frac{1}{2}\tilde{m}v^2 - c\frac{\tilde{M}c\tilde{m}c}{r} &= 0 \\
v &= \sqrt{2c^3\frac{\tilde{M}}{r}} \\
v &= \sqrt{2c^3\frac{\frac{l_p}{\bar{\lambda}}\frac{l_p}{c}}{r}} \\
v &= c\sqrt{2\frac{l_p}{r}\frac{l_p}{\bar{\lambda}}}
\end{aligned} \tag{38}$$

Further, orbital velocity is given by $v_o = \sqrt{\frac{l_p}{r}\frac{l_p}{\bar{\lambda}}}$. This is actually exactly the same escape and orbital velocities we get from Newtonian theory, but then we are dependent on G and knowing the traditional mass measure.

More accurate calculations can be obtained by taking into account relativistic effects; the escape velocity is then

$$v = c\sqrt{2\frac{l_p^2}{\bar{\lambda}r} - \frac{l_p^4}{\bar{\lambda}^2 r^2}} \tag{39}$$

Our new escape velocity seems to predict zero time-dilation in quasars, see [23] for a discussion on this. It has been a surprise for modern physics that observations of even high Z quasars show no signs of time-dilation, see [27, 28].

4.2 Gravitational acceleration

The gravitational acceleration in a weak field is given by

$$\begin{aligned} ma &= c^3\frac{\tilde{M}\tilde{m}}{r^2} \\ a &= c^3\frac{\tilde{M}}{r^2} \\ a &= l_p\frac{c^2}{r^2}\frac{l_p}{\bar{\lambda}} \end{aligned} \tag{40}$$

Similarly, we can derive all standard gravity formulas. As we will see in a weak field, we get the same results as Newton.

5 Summary Gravity Formulas

Table 1 summarizes the gravity formulas in our theory and in standard Newtonian theory. The output is identical.

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

Table 1: The table shows the Newton gravitational force in addition to our new quantum gravity theory.

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. In other words, it is the collision length. The Schwarzschild radius is a 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 of G and the Planck constant. We will return to this idea later.

5.1 Relativistic gravity theory, weak and strong field

The strong field (relativistic version), when observing everything from the gravitational mass $\tilde{M}$, is

$$F = c^3 \frac{\tilde{M}\frac{\tilde{m}}{\sqrt{1-\frac{v_m^2}{c^2}}}}{r^2} \tag{41}$$

Or in terms of quantum entities

$$F = c^3 \frac{\frac{l_p}{c}\frac{l_p}{\bar{\lambda}_M\sqrt{1-\frac{v^2}{c^2}}}\frac{l_p}{c}\frac{l_p}{\bar{\lambda}_m\sqrt{1-\frac{v^2}{c^2}}}}{r^2} = c\frac{\frac{l_p^2}{\bar{\lambda}_M\sqrt{1-\frac{v^2}{c^2}}}\frac{l_p^2}{\bar{\lambda}_m\sqrt{1-\frac{v^2}{c^2}}}}{r^2} \tag{42}$$

In case we are observing two gravity objects from a third frame, we expect to have the equation below, since this seems to give the correct prediction of the perihelion of Mercury.

$$F = c^3 \frac{\frac{\tilde{M}}{\sqrt{1-\frac{v_M^2}{c^2}}}\frac{\tilde{m}}{\sqrt{1-\frac{v_m^2}{c^2}}}}{r^2\left(1-\frac{v_M^2}{c^2}\right)} = c^3 \frac{\frac{\tilde{M}}{\sqrt{1-\frac{v_M^2}{c^2}}}\frac{\tilde{m}}{\sqrt{1-\frac{v_m^2}{c^2}}}}{r^2\left(1-\frac{v_M^2}{c^2}\right)^{3/2}} \tag{43}$$

A similar Newton equivalent formula to equation 41 was suggested in 1981 and 1986 by Bagge [29] and Phillips [30]. This formula was soon forgotten, as it only predicted half of Mercury's precession, see also [31–36]. 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 suggest that one must use equation 43.

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

Table 2: The table shows the Newton gravitational force in addition to our new quantum gravity theory, here the solution holds for also a strong gravitational field.

6 Gravity Quantum Mechanics

Here we will introduce a new quantum wave equation that also is consistent with gravity and takes into account that one ultimately has a collision time.

The Klein–Gordon equation is given by:

$$\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\Psi - \nabla^2\Psi + \frac{m^2c^2}{\hbar^2}\Psi = 0 \tag{44}$$

The Klein–Gordon equation has strange properties, such as energy squared, which is one of several reasons that Schrödinger did not like it that much. We have argued previously that one should make a wave equation from the Compton wavelength rather than the de Broglie wavelength [37, 38]. 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 if we also know the Planck constant and the speed of light, see [39]. 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 (and actually the de Broglie wavelength is rooted in an old, non-optimal definition of momentum), that is

$$p = \frac{mv}{\sqrt{1-\frac{v^2}{c^2}}} \tag{45}$$

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

$$p_t = \tilde{E} = \frac{mc}{\sqrt{1-\frac{v^2}{c^2}}} \tag{46}$$

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

$$p_k = \tilde{E}_K = \frac{mc}{\sqrt{1-\frac{v^2}{c^2}}} - mc \tag{47}$$

This gives us a new and simpler relativistic energy momentum relation, that both generates the same correct output, but 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

$$E = \sqrt{p^2c^2 - m^2c^4} \tag{48}$$

while our new energy momentum relation is given by

$$\tilde{E} = \tilde{p}_k - \tilde{m}c \tag{49}$$

that also can be written as

$$\tilde{E} = \tilde{E}_k - \tilde{m}c = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} \tag{50}$$

The main difference is that standard physics 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 leads to many different interpretations in standard QM of the same equations. Our theory is much more straightforward and fully consistent with our gravity theory.

This in turn leads to a simpler relativistic energy momentum relation than the standard one and also leads to a new wave equation, see [40] for details. In fact, this gives the same wave equation that we have derived before, but now we show that the Heisenberg principle collapse at the Planck scale is directly linked to gravity.

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

$$\begin{aligned}
\tilde{E} &= \mathbf{p}_k + \tilde{m}c \\
\tilde{E} &= \left(\frac{\tilde{m}c}{\sqrt{1-\frac{\mathbf{v}^2}{c^2}}} - \tilde{m}c\right) + \tilde{m}c \\
\tilde{E} &= \frac{\tilde{m}c}{\sqrt{1-\frac{\mathbf{v}^2}{c^2}}} \\
\tilde{E} &= \frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{\mathbf{v}^2}{c^2}}}
\end{aligned} \tag{51}$$

Keep in mind that r_e is half of the relativistic Schwarzschild radius, so we must have $r_e = \frac{1}{2}r_s = \frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{\mathbf{v}^2}{c^2}}}$. This means that the relativistic energy momentum relation under our new and deeper understanding of mass can also be written as

$$\begin{aligned}
\tilde{E} &= \mathbf{p}_k + \tilde{m}c \\
r_e &= \tilde{m}\mathbf{c}
\end{aligned} \tag{52}$$

Based on this, we get the following relativistic wave equation

$$-l_p^2\frac{\partial\Psi}{\partial t} = -l_p^2\nabla\cdot(\Psi\mathbf{c}) \tag{53}$$

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

$$\nabla\cdot\mathbf{c} = 0 \tag{54}$$

that is[1] the light velocity field is a solenoidal, which means we can rewrite our wave equation as

$$\frac{\partial\Psi}{\partial t} - \mathbf{c}\cdot\nabla\Psi = 0 \tag{55}$$

So, in the expanded form, we have

$$\frac{\partial\Psi}{\partial t} - c_x\frac{\partial\Psi}{\partial x} - c_y\frac{\partial\Psi}{\partial y} - c_z\frac{\partial\Psi}{\partial z} = 0 \tag{56}$$

Our new relativistic quantum equation has quite a different plane wave solution than the Klein–Gordon and Schrödinger [41] equations, our plane wave equation is given by

$$\psi = e^{i(kt-\omega x)} \tag{57}$$

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

$$k = \frac{r_e}{l_p^2} = \frac{\frac{r_e}{\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2} = \frac{2\pi}{\lambda_c} \tag{58}$$

So, we can also write the plane wave function as

$$e^{i\left(\frac{\tilde{L}}{l_p^2}t - \frac{\tilde{T}}{l_p^2}x\right)} = e^{i\left(\frac{\tilde{E}}{l_p^2}t - \frac{\tilde{m}}{l_p^2}x\right)} = e^{i\left(\frac{r_e}{l_p^2}t - \frac{\tilde{m}}{l_p^2}x\right)} \tag{59}$$

where r_e is half the relativistic Schwarzschild radius as defined earlier. Our quantum wave function is rooted in the Compton wavelength instead of the de Broglie wavelength and it incorporates collision time that does not exist in modern physics, except, as we will see indirectly, through gravity. For formality's sake, we can look at the Schwarzschild radius operator and mass operators and see that they are correctly specified.

[1] 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 $\nabla\cdot(\Psi\mathbf{c}) = \mathbf{c}\cdot\nabla\Psi$

This means the Schwarzschild operator (space with respect to time) must be

$$\frac{\partial \psi}{\partial t} = \frac{i r_e}{l_p^2} e^{i\left(\frac{r_e}{l_p^2} t - \frac{\tilde{m}}{l_p^2} x\right)} \tag{60}$$

and this gives us a time operator of

$$r_e = -i l_p^2 \frac{\partial}{\partial t} \tag{61}$$

And for mass we have

$$\frac{\partial \psi}{\partial x} = \frac{-i \tilde{m}}{l_p^2} e^{i\left(\frac{r_e}{l_p^2} t - \frac{\tilde{m}}{l_p^2} x\right)} \tag{62}$$

and this gives us a mass operator of

$$\tilde{m} = -i l_p^2 \nabla \tag{63}$$

The only difference between the non-relativistic and relativistic wave equations is that in a non-relativistic equation we can use

$$k = \frac{r_e}{l_p^2} = \frac{r_e}{l_p^2} = \frac{2\pi}{\lambda_c} \tag{64}$$

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

7 Deeper Insight on the Collision Space-Time Form Only

Since energy is collision length (space) $\tilde{E} = \tilde{L}$ and mass is collision time $\tilde{m} = \tilde{T}$, we can write the relativistic energy relation as

$$\tilde{L} = \tilde{T}\mathbf{c} \tag{65}$$

Now we can substitute $\tilde{L}$ and $\tilde{T}$ with corresponding collision-space and collision-time operators and get a new relativistic quantum mechanical wave equation

$$-l_p^2 \frac{\partial \Psi}{\partial t} = -l_p^2 \nabla \cdot (\Psi \mathbf{c}) \tag{66}$$

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 l_p^2, we can rewrite this as

$$-\frac{\partial \Psi}{\partial t} = -\nabla \cdot (\Psi \mathbf{c}) \tag{67}$$

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

$$\nabla \cdot \mathbf{c} = 0 \tag{68}$$

that is the light velocity field is a solenoidal, which means we can rewrite our wave equation as

$$\frac{\partial \Psi}{\partial t} - \mathbf{c} \cdot \nabla \Psi = 0 \tag{69}$$

So, in the expanded form, we have

$$\frac{\partial \Psi}{\partial t} - c_x \frac{\partial \Psi}{\partial x} - c_y \frac{\partial \Psi}{\partial y} - c_z \frac{\partial \Psi}{\partial z} = 0 \tag{70}$$

Our new relativistic quantum equation has quite a different plane wave solution than the Klein–Gordon and Schrödinger equations

$$\psi = e^{i(kt - \omega x)} \tag{71}$$

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

$$k = \frac{\tilde{L}}{l_p^2} = \frac{\frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2} = \frac{2\pi}{\lambda_{c,R}} \tag{72}$$

So, we can also write the plane wave solution as

$$e^{i\left(\frac{\tilde{L}}{l_p^2}t - \frac{\tilde{T}}{l_p^2}x\right)} \tag{73}$$

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 collision-space (energy) and collision time (mass) operators and see that they are correctly specified

$$\frac{\partial\psi}{\partial x} = \frac{i\tilde{T}}{l_p^2}e^{i\left(\frac{\tilde{L}}{l_p^2}t - \frac{\tilde{T}}{l_p^2}x\right)} \tag{74}$$

This means the collision-time space operator (mass) must be

$$\tilde{T} = -il_p^2\nabla \tag{75}$$

and for collision space (energy) we have

$$\frac{\partial\psi}{\partial t} = \frac{-i\tilde{L}}{l_p^2}e^{i\left(\frac{\tilde{L}}{l_p^2}t - \frac{\tilde{T}}{l_p^2}x\right)} \tag{76}$$

and this gives us a collision-space-time operator of

$$\hat{L} = -il_p^2\frac{\partial}{\partial t} \tag{77}$$

The only difference between the non-relativistic and relativistic wave equation is that in a non-relativistic equation we can use

$$k = \frac{p_t}{l_p^2} = \frac{\tilde{L}}{l_p^2} = \frac{2\pi}{\lambda_c} \tag{78}$$

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

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

This is the most important missing part of modern wave mechanic – 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

$$\Psi = e^{i\left(\frac{\tilde{E}}{l_p^2}t - \frac{\tilde{m}}{l_p^2}x\right)} = e^{i\left(\frac{r_e}{l_p^2}t - \frac{\tilde{m}}{l_p^2}x\right)} \tag{79}$$

Keep in mind that energy is collision length (space) and mass is collision time, so if we call collision time for $\tilde{T}$ and collision space for $\tilde{L}$, then we can write the wave equation as

$$\Psi = e^{i\left(\frac{\tilde{L}}{l_p^2}t - \frac{\tilde{T}}{l_p^2}x\right)} \tag{80}$$

However, since we are particular interested in gravity, we can also remember that the collision length actually is equal to half of the relativistic Schwarzschild radius

$$r_e = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{l_p^2}{\bar{\lambda}}\frac{1}{c}c}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{l_p^2}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{81}$$

Based on this, we can rewrite the wave function as

$$\Psi = e^{i\left(\frac{\frac{l_p^2}{\lambda\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2}t - \frac{\frac{l_p^2}{c\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}}{l_p^2}x\right)} = e^{i\left(\frac{1}{\lambda\sqrt{1-\frac{v^2}{c^2}}}t - \frac{1}{c\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}x\right)} \tag{82}$$

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

$$\Psi = e^{i\left(\frac{1}{l_p}\frac{l_p}{c} - \frac{1}{cl_p}l_p\right)} = e^{i\times 0} = 1 \tag{83}$$

That is, the Ψ is always equal to one in the special case of the Planck mass particle, see also [42]. 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 only one Planck second. Keep in mind that all elementary particles can be seen as Planck mass particles coming in and out of existence at their Compton periodicity.

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

$$\begin{aligned} \frac{\partial\Psi}{\partial t} &= c\frac{\partial\Psi}{\partial x} + c\frac{\partial\Psi}{\partial y} + c\frac{\partial\Psi}{\partial z} \\ \frac{\partial 1}{\partial t} &= c\frac{\partial 1}{\partial x} + c\frac{\partial 1}{\partial y} + c\frac{\partial 1}{\partial z} \end{aligned} \tag{84}$$

that 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. This also means the Schwarzschild radius is dominated by probability for masses smaller than a Planck mass and is dominated by determinism for masses larger than a Planck mass.

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

$$\frac{\partial\Psi}{\partial x} = 0 \tag{85}$$

Thus, the Schwarzschild operator (space operator) must be zero for the Planck mass particle. Therefore, we must have

$$\begin{aligned} [\hat{r}_e, \hat{x}]\Psi &= [\hat{r}_e\hat{x} - \hat{x}\hat{r}_e]\Psi \\ &= \left(-0\times\frac{\partial}{\partial x}\right)(x)\Psi - (x)\left(-0\times\frac{\partial}{\partial x}\right)\Psi \\ &= 0 \end{aligned} \tag{86}$$

That is, $\hat{r}_e$ and $\hat{x}$ commute for the Planck particle (which simply means the Planck mass particle is the collision point between two photons, it is gravity).

We also have

$$\begin{aligned} [\hat{\hat{T}}, \hat{x}]\Psi &= [\hat{\hat{T}}\hat{x} - \hat{x}\hat{\hat{T}}]\Psi \\ &= \left(-0\times\frac{\partial}{\partial x}\right)(x)\Psi - (x)\left(-0\times\frac{\partial}{\partial x}\right)\Psi \\ &= 0 \end{aligned} \tag{87}$$

For formality's sake, the uncertainty in the special case of the Planck particle must be

$$\begin{aligned}\sigma_p\sigma_x &\geq \frac{1}{2}|\int \Psi^*[\hat{r},\hat{x}]\Psi dx| \\ &\geq \frac{1}{2}|\int \Psi^*(0)\Psi dx| \\ &\geq \frac{1}{2}|-0\times\int \Psi^*\Psi dx| = 0 \end{aligned} \tag{88}$$

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. The momentum is equal to the half the Schwarzschild radius; remember we have a probabilistic Schwarzschild radius. 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 we automatically also knows its Schwarzschild radius (and therefore also its momentum is certain in that moment), since the particle (according to our maximum velocity formula) must stand still, so it only has rest-mass momentum which is the Schwarzschild radius. In other words, for this and only this particle, we know the position and Schwarzschild radius (re-defined 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. There is the standard gravity theory on one hand, and quantum theory on the other hand, and the idea is that the break down at the Planck scale is something special happening outside this system. For 100 years, many have tried to unify QM with gravity, but with basically no success. In our theory, we see that gravity is the break down at the Planck scale. We have derived this theory from the Planck scale, and naturally combined the analysis with key concepts from Newton, Einstein, Compton, and others. Possibly, for the first time in history, we have developed a unified theory that can address the challenges involved.

9 Why the Planck Scale Has Not Been Found Experimentally Before

A series of quantum gravity theories predicts break down of Lorentz symmetry at the Planck scale. However, the Planck scale is normally considered only to be related to enormous high energy levels, that for example are much higher than anything one even can approach at the Large Hadron Collider. One has hoped to observe effects at lower energy levels than the Planck energy, but so far one has concluded no signs of Lorentz symmetry break down have been found, a recent review article [43] has noted:

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

However, modern physics have not been incorporated collision-time and space directly into their mass and energy definitions. They have only unknowingly got collision-time into the model through the Newton gravitational constant. It is clear from our theory that gravity itself is Lorentz symmetry break down at the Planck scale. However, one has always assumed the Planck scale is an enormous high energy, this is only true when observed at a time window close to the shortest possible time window, something we not are doing. At the time windows we are observing one should expect Lorentz symmetry break down to be detected only at incredible weak "energies", which is exactly what gravity is observed to be at the time scales we are operating. Another reason is naturally that modern physics have been looking for Planck scale effects more or less in the blind since they not have been able to come up with a decent unified quantum gravity theory. This we claim is now solved. We have a robust and simple model that explains both gravity and electromagnetism.

From our discovery (theoretically) that the Heisenberg principle and Lorentz symmetry must be broken at the Planck scale, it took another year to understand that these are directly linked to gravity itself. Gravity is Lorentz symmetry and Heisenberg uncertainty break down. This means we have been observed this all along. But instead of being able to obtain it from one and the same theory, we had developed a separate theory for gravity. It is first when one sees that mass consist of collisions and also understanding that the duration of these collisions is important that one is able to get a unified theory. This is shockingly simple, but it also shows that the existing main formulas in physics will stand, even if many of them now can be rewritten in a simpler form, as we have done in this paper.

10 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 surprise that the Planck length is seen where the Planck constant normally is observed. Further, we can see how everything is related to space and time alone. For example, rest-mass momentum is the same as collision length, and therefore the same as one of our energy definitions, namely collision length. That is, the space taken up in forms of collision in form of a length.

	Revisited Uncertainty Principle	**Standard Uncertainty Principle**
Momentum position uncertainty	$\Delta\tilde{E}_t\Delta x \geq l_p^2$	$\Delta p\Delta x \geq \hbar$
Momentum position uncertainty	$\Delta r_s\Delta x \geq 2l_p^2$	$\Delta p\Delta x \geq \hbar$
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 as collision length	$\Delta\tilde{E}\Delta t \geq \frac{l_p^2}{c}$ Pauli Objection solved	$\Delta E\Delta t \geq \hbar$ Pauli Objection not solved
Energy time uncertainty	$\Delta r_s\Delta t \geq 2\frac{l_p^2}{c}$ Pauli Objection solved	$\Delta E\Delta t \geq \hbar$ Pauli Objection not solved
Energy as collision length	$l_p \geq \tilde{E} \geq l_p\frac{l_p}{\bar{\lambda}}$	$0 \leq E \leq \infty$
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	$\left(l_p - \frac{l_p^2}{\bar{\lambda}}\right) \geq \tilde{E}_k \geq 0$	Undefined ? $\Delta E \geq \frac{\hbar}{\Delta t}$ Pauli Objection not solved
Mass as collision time	$\frac{l_p}{c} \geq \tilde{m} \geq \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}$ Length of collision time	Missing
Velocity mass	$0 \leq v \leq c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$	$v < c$
Quantum probability	$1 \geq P \geq \frac{l_p}{\bar{\lambda}}$	Undefined ?
Trans-Planckian crisis	No	Yes

Table 3: The table shows the Revisited Uncertainty Principle and the Standard Uncertainty Principle.

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. Modern physics has only captured the collision frequency at the quantum level, but 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

$$\frac{l_p}{c} \geq \tilde{m}_t \geq \frac{l_p}{\bar{\lambda}}\frac{l_p}{c} \tag{89}$$

This 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 for one Planck second, so that is the maximum collision time in a Planck second. Or, 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 $\frac{l_p}{\bar{\lambda}}\frac{l_p}{c}$. 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.

It is also clear one can never get a unified theory based on the existing Heisenberg uncertainty fundamentals, which 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 that is clear if one has looked into several extensions of the uncertainty principle in the hope of incorporating gravity, see, for example, [44, 45]. Still, the missing piece seems to entail incorporating collision time in the mass, which will automatically change the uncertainty principle. This keeps the uncertainty principle unchanged inside a large range, but gives upper and lower bounds.

11 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, Bell's [46] theorem and the evidence running contrary to the idea that local hidden variable theories [47] cannot exist are based on the assumption that Heisenberg's uncertainty principle always holds, see [48, 49]. 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 used in 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,

$$\begin{aligned}
P &= \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}} \\
P &= \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}} \\
P &= \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{c^2\left(1-\frac{l_p^2}{\bar{\lambda}^2}\right)}{c^2}}} \\
P &= \frac{l_p}{l_p} = 1
\end{aligned} \tag{90}$$

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 mass, 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 built 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.

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

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

Table 4: 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 $m_{\mathbf{P}}$.

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.

12 Our new relativistic energy momentum relation also gives the Schrödinger equation when $v << c$

Our new energy momentum relation is

$$\tilde{E} = \tilde{E}_k - \tilde{m}c = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} \tag{91}$$

This can be rewritten as

$$\tilde{E} = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} \tag{92}$$

and when $v << c$, then using the first two terms of a Taylor series approximation we get $\tilde{p} = \frac{\tilde{m}c}{\sqrt{1-\frac{v^2}{c^2}}} \approx \tilde{m}c + \frac{1}{2}\tilde{m}\frac{v^2}{c}$. Based on this, we can rewrite equation 91 as

$$\begin{aligned} \tilde{E} &\approx \frac{1}{2c}\tilde{m}v^2 + \tilde{m}c \\ \tilde{E} &\approx \frac{\tilde{p}^2}{2\tilde{m}c} + \tilde{m}c \end{aligned} \tag{93}$$

where $\tilde{p} = \tilde{m}v$, and now replacing $\tilde{E}$ with the energy operator $\hat{E} = il_p^2\frac{\partial}{\partial t}$ and $\tilde{p}$ with the momentum operator $\hat{p} = il_p^2\frac{\partial}{\partial x}$ we get

$$il_p^2\frac{\partial\Psi}{\partial t} \approx \left(\frac{i^2l_p^4}{2\tilde{m}c}\nabla^2+\tilde{m}c\right)\Psi \quad (94)$$

$$i\frac{\partial\Psi}{\partial t} \approx \left(\frac{-l_p^2}{2\tilde{m}c}\nabla^2+\frac{\tilde{m}c}{l_p^2}\right)\Psi \quad (95)$$

$$i\frac{\partial\Psi}{\partial t} \approx \left(\frac{-\bar{\lambda}}{2}\nabla^2+\frac{1}{\bar{\lambda}}\right)\Psi \quad (96)$$

$$(97)$$

This is a close parallel to the Schrödinger equation. The clear connection to the Schrödinger equation is first seen when we use the standard (incomplete) mass measure $m=\frac{\hbar}{\bar{\lambda}}\frac{1}{c}$, then we have

$$E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} \quad (98)$$

$$E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}-mc^2+mc^2 \quad (99)$$

$$E \approx \frac{1}{2}mv^2+mc^2 \quad (100)$$

$$E \approx \frac{p^2}{2m}+mc^2 \quad (101)$$

$$(102)$$

Replacing E with the energy operator $i\hbar$ and p with the momentum operator $i\hbar$ we get

$$i\hbar\frac{\partial\Psi}{\partial t} \approx \left(\frac{i^2\hbar^2}{2m}\nabla^2+mc^2\right)\Psi \quad (103)$$

$$i\hbar\frac{\partial\Psi}{\partial t} \approx \left(\frac{-\hbar^2}{2m}\nabla^2+mc^2\right)\Psi \quad (104)$$

$$i\frac{\partial\Psi}{\partial t} \approx \left(\frac{-\hbar}{2m}\nabla^2+\frac{mc^2}{\hbar}\right)\Psi \quad (105)$$

$$i\frac{\partial\Psi}{\partial t} \approx \left(\frac{-\bar{\lambda}c}{2}\nabla^2+\frac{c}{\bar{\lambda}}\right)\Psi \quad (106)$$

$$(107)$$

The difference is simply a c due to the standard energy definition is our energy definition multiplied by c, otherwise the equations are identical. This simply means that the Schrödinger equation is consistent with our new framework.

13 Minkowski Space-Time Is Unnecessarily Complex at the Quantum Level

Our 4-dimensional wave equation is invariant. It should be consistent with relativity theory, since it is a relativistic wave equation. As pointed out by Unruh [50], 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 [51]. 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

$$dt^2c^2-dx^2-dy^2-dz^2=ds^2 \quad (108)$$

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

$$dt^2c^2-dx^2=ds^2 \quad (109)$$

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

$$t'^2c^2 - x'^2 = \left(\frac{t - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - tv}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 = s^2 \tag{110}$$

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

$$t'^2c^2 - x'^2 = \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \tag{111}$$

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

$$\begin{aligned} t'^2c^2 - x'^2 \quad &= \quad \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 c^2 - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\ &\quad \left(\frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 - \left(\frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}}\right)^2 \\ &\quad \frac{L^2 - 2L^2\frac{v}{v_2} + L^2\frac{v^2}{v_2^2}}{1-\frac{v^2}{c^2}} - \frac{L^2\frac{c^2}{v_2^2} - 2L^2\frac{v}{v_2} + L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\ &\quad \frac{L^2 + L^2\frac{v^2}{v_2^2} - L^2\frac{c^2}{v_2^2} - L^2\frac{v^2}{c^2}}{1-\frac{v^2}{c^2}} \\ &\quad \frac{L^2\left(1 - \frac{v^2}{c^2} + \frac{v^2}{v_2^2} - \frac{c^2}{v_2^2}\right)}{1-\frac{v^2}{c^2}} \\ &\quad \frac{L^2\left(1 - \frac{v^2}{c^2}\right)\left(1 - \frac{c^2}{v_2^2}\right)}{1-\frac{v^2}{c^2}} \\ &\quad L^2\left(1 - \frac{c^2}{v_2^2}\right) \end{aligned} \tag{112}$$

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

$$\begin{aligned} t'c - x' \quad &= \quad \left(\frac{\frac{L}{v_2} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right) c - \left(\frac{L - \frac{L}{v_2}v}{\sqrt{1-\frac{v^2}{c^2}}}\right) \\ &= \quad \frac{L\frac{c}{v_2} - L\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{L - L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}} \\ &= \quad \frac{L\frac{c}{v_2} - L\frac{v}{c} - L + L\frac{v}{v_2}}{\sqrt{1-\frac{v^2}{c^2}}} \end{aligned} \tag{113}$$

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

$$\begin{aligned}
t'c - x' &= \frac{\frac{L}{c} - \frac{L}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{L - \frac{L}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} = 0
\end{aligned} \tag{114}$$

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

$$\begin{aligned}
t'c - x' &= \frac{\frac{\bar{\lambda}}{c} - \frac{\bar{\lambda}}{c^2}v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} \\
&= \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} - \frac{\bar{\lambda} - \frac{\bar{\lambda}}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} = 0
\end{aligned} \tag{115}$$

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

$$dtc - dx - dy - dz = 0 \tag{116}$$

The Minkowski space-time is unnecessarily complex for the quantum world. Collision space-time in the quantum world gives a strongly 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 simply that an indivisible particle moves its own diameter during the period two other indivisible particles spend in collision. This means length (space) and time are directly liked or actually gives us the speed of light.

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

$$\begin{aligned}
t'c - x' &= 0 \\
\frac{\frac{\bar{l_p}}{c} - \frac{l_p}{c^2} \times v}{\sqrt{1-\frac{v^2}{c^2}}}c - \frac{l_p - \frac{l_p}{c}v}{\sqrt{1-\frac{v^2}{c^2}}} &= 0 \\
\frac{l_p - \frac{l_p}{c} \times 0}{\sqrt{1-\frac{0^2}{c^2}}} - \frac{l_p - \frac{l_p}{c} \times 0}{\sqrt{1-\frac{0^2}{c^2}}} &= 0 \\
t_p c - l_p &= 0
\end{aligned} \tag{117}$$

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.

14 All gravity phenomena can be easily predicted with no knowledge of G, the Planck constant, or even any knowledge of the traditional mass size

Recently it has been show by Haug [52, 53] that all gravity phenomena can be easily predicted with no knowledge of Newton's gravity constant, nor any knowledge of the standard mass size of the object. This can be done by finding the Schwarzschild radius of any astronomical object simply by using the following formula

$$\frac{1}{2}r_s = g\frac{r^2}{c^2} \tag{118}$$

The gravitational acceleration field can be measured quite easily without any knowledge of gravity theory, at the surface of Earth it is about 9.8 m/s^2. This we can simply measure by dropping an object through two time gates. The speed of light we can measure without any knowledge of gravity and the same with the radius of the Earth. Now that we know the Schwarzschild radius of the Earth, we can predict all other gravity phenomena from this as shown in Table 4.

Since mass is assumed to be the cause of gravity, how can it be that we can predict all gravity phenomena without knowing either the traditional mass of the Earth or the Newton gravitational constant? The reason is simple. Standard physics uses an incomplete mass measure. Half of the Schwarzschild radius is the collision space of the mass in question; it is the (gravitational) energy of the mass. So, using this approach we are naturally predicting how gravity affect such things as light. However, since the mass is the collision length is Schwarzschild radius, we do not first need to convert an incomplete mass measure (kg) into collision time by first finding the gravitational constant and then multiplying the mass with this for then to find the Schwarzschild radius. We already have incorporated this into our mass definition, and that is why our theory is so much simpler, and helps us understand why we can do all gravitational predictions without knowledge of G or the Planck constant, or the traditional mass size.

What to measure/predict	Formula	How
Half Schwarzschild radius	$r_e = \frac{gR^2}{c^2}$	From g (9.8 m/s^2 Earth)
Gravitational acceleration field	$g = \frac{r_e}{R^2}c^2$	Find r_e first
Orbital velocity	$v_o = c\sqrt{\frac{r_e}{R}}$	Find r_e first
Escape velocity	$v_e = c\sqrt{2\frac{r_e}{R}}$	Find r_e first
Time dilation	$t_2 = t_1\sqrt{1 - 2\frac{r_e}{R}}$	Find r_e first
GR bending of light	$\delta = 4\frac{r_e}{R}$	Find r_e first
Gravitational red-shift	$\lim_{R\to+\infty} z(R) = \frac{r_e}{R}$	Find r_e first

Table 5: The table shows that the most common gravitational measurements and predictions can be done without any knowledge of Newton's gravitational constant or knowledge of the traditional mass size. The reason is that the Schwarzschild radius actually represent the collision space, which is the mass in terms of collision-time multiplied by the speed of light.

15 A closer look at the Newton gravity constant and why it is needed only in standard incomplete physics

Actually Newton [54] himself never introduced a gravity constant. His gravity formula was simply $F = \frac{Mm}{r^2}$. 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 [26]. 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 [55] using the Newton constant, namely

$$F = f\frac{Mm}{R^2} \tag{119}$$

In the 1890s, the gravity constant was first called G, but many physicists still called it f in the early 1900s, see, for example, [56]. 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 exists in nature that is $m^3 \cdot kg^{-1} \cdot s^{-2}$?

In several papers, [16, 57, 58] we have suggested that the Newton gravity constant is a composite constant of the form

$$G = \frac{l_p^2 c^3}{\hbar} \tag{120}$$

This can be found simply by solving the Planck [59, 60] 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 [19, 61, 62]. In gravity we can do without 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 collision 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.

16 Is collision-time three dimensional and the same three dimensions as collision space?

Since collision-time and collision-space are so closely connected one should consider that collision time is three dimensional and actually the same three dimensions as the collision-space dimensions. This does not mean one would have six dimensions (three in time and three in space), but only three dimensions in total. The mass-gap in our model consist of two colliding indivisible particles. In terms of quantum mechanics one could suggest that the relativistic wave equation should be

$$\nabla_t \Psi - \mathbf{c} \cdot \nabla_x \Psi = 0 \tag{121}$$

or in its full form

$$\begin{aligned} \frac{\partial \Psi}{\partial t_x} + \frac{\partial \Psi}{\partial t_y} + \frac{\partial \Psi}{\partial t_z} &= c\frac{\partial \Psi}{\partial x} + c\frac{\partial \Psi}{\partial y} + c\frac{\partial \Psi}{\partial z} \\ \frac{\partial \Psi}{\partial t_x} + \frac{\partial \Psi}{\partial t_y} + \frac{\partial \Psi}{\partial t_z} - c\frac{\partial \Psi}{\partial x} - c\frac{\partial \Psi}{\partial y} - c\frac{\partial \Psi}{\partial z} &= 0 \end{aligned} \tag{122}$$

(123)

This is naturally no surprise as the collision time (at collision) must take up one Planck length (center to center between the two colliding indivisible particles). The constant c is only needed because we tend to use different unit systems for length and time. If we use the same units, that is the speed of light per Planck second rather than per second then $c = 1$ and we then have

$$\frac{\partial \Psi}{\partial t_x} + \frac{\partial \Psi}{\partial t_y} + \frac{\partial \Psi}{\partial t_z} - \frac{\partial \Psi}{\partial x} - \frac{\partial \Psi}{\partial y} - \frac{\partial \Psi}{\partial z} = 0 \tag{124}$$

This simply means we can have no extension in collision-time without an extension in space, this because time is colliding indivisible particles. This seems to indicate that collision-time is three dimensional. However, this does not mean that one can go back in time. This simply means the collision-time takes up space and if it is negative then it means it happens to the left of us or below us, rather than to the right of us or above us. This is simply where the collision takes place in space.

For example, the t_x axis would be the same as the x axis, but as long as we do not set $c = 1$, this means we are using different unit systems for length and time, and a conversion factor like c on each axis is needed to go from space coordinates to time coordinates. Naturally by setting $c = 1$, that is one dimensional diameter per time unit, then they are one and the same, collision-space is collision-time. This does not change the concept that the speed of light is isotropic and the same in every direction. However, it is more correct to say the speed of light always is one. This simply means one get one collision time unit for every collision space unit. This also means a free moving indivisible particle can travel its own diameter in space at the same time two other indivisible particles spend in collision. This simply mean we cannot have observable time without taking up space with collisions, and we cannot have collisions taking up space without spending time in collisions.

17 Possible reasons why a unified quantum gravity theory has not been formulated before now)

The two main reasons one has not been able to produce a unified theory before now is that one not has incorporated collision time in the mass, one has only done this indirectly as gravity. That is gravity has been almost a magical force that is related to mass, but not have been embedded in the mass. Modern physics has been incorporating the Planck scale in all gravity indirectly through the Newton gravity constant. The Newton gravity constant should, as we have discussed earlier, be seen as a composite constant. It is first when one understands this and sees that it is actually used to get rid of the Planck constant and to introduce the Planck length and the speed of light into all gravity phenomena that one is closing in on how things are connected. This is naturally not known in standard physics. The Newton gravity constant is there just a constant to be calibrated to a gravity phenomenon to get the gravity formulas to predict other gravity phenomena. The Newton gravitational constant is indeed a universal and important constant; it is just that it is a composite constant. When one understands this and further understands why this is the case, one can see that it is no longer needed. One can instead reformulate the mass to what it truly is, namely collisions between indivisible particles that happen at the Compton frequency, and further that each collision lasts for one Planck second. One does not need the gravitational constant or the Planck constant to observational wise find the Planck length. The Planck length is embedded in any gravity phenomena, as it is directly linked to the very essence of mass. This is also why the Schwarzschild radius is so important.

Second, one has developed a quantum mechanics rooted in the de Broglie wavelength rather than the Compton wavelength. The de Broglie wavelength is, in our view, simply a mathematical derivative of the true physical matter wave, which is the Compton wave. This leads to several absurd predictions, such as the idea that a particle at rest will have an infinite de Broglie wavelength. This also means that the standard momentum is a derivative of the more fundamental momentum. Modern physics has thereby mostly reached the right predictions, but with the use of unnecessarily complex equations.

18 Conclusion

We have unified quantum mechanics with gravity and have formulated a simple but powerful unified quantum gravity theory. The key is to take into account collision time in mass, something that has been missing in standard mass measures. Standard mass measures such as kg have only embedded the number of collisions in a collision ratio. Gravity is surprisingly Lorentz symmetry as well as a form of Heisenberg uncertainty break down at the Planck scale. Mass is directly linked to Compton frequency, and elementary particles have strong parallels to clocks in the sense that they tick at the Compton frequency. Each tick is a Planck mass that lasts for one Planck second. The Planck length, which is the diameter of an indivisible particle, can be found without any knowledge of the Newton gravitational constant and there is even no need for the Planck constant. The Planck length and Planck time are essential as the smallest (even theoretically) observable collision-length (energy) and collision-time (mass).

Our theory also gives us a model consistent with a simplified version of Minkowski space-time. The beauty of our theory is that it keeps most major predictions and formulas in modern physics intact. However, with our new mass definition many equations get significantly simplified. Also, many of the interpretations in quantum mechanics are simplified and less mystical. Wave-particle duality breaks down at the Planck scale (inside a Planck second) and this is linked to Lorentz symmetry break down that again can be observed, as it is gravity.

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19 Appendix

Entity	**Standard physics**	**Unified Quantum Gravity**
Rest mass	$m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c}$	$\tilde{T} = \tilde{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}}$ Collision time
Rest mass energy	$E = \frac{\hbar}{\bar{\lambda}}c$	$\tilde{L} = \tilde{E} = l_p\frac{l_p}{\bar{\lambda}}$ Collision length (space)
Relativistic mass	$m = \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{c}$	$\tilde{T} = \tilde{m} = \frac{l_p}{c}\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$ Collision time
Relativistic energy	$m = \frac{\hbar c}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$	$\tilde{L} = \tilde{E} = l_p\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$ Collision length
Know how to find l_p independent of G and $\hbar$	No	Yes
Matter wave	Mistakenly using de Broglie wave de Broglie wave is a derivative the physical Compton wave	Compton wave
Energy momentum relation	$E = \sqrt{p^2c^2 - m^2c^4}$	$\tilde{E} = \tilde{p}_t$ $\tilde{L} = \tilde{T}c$
Plane wave	$\Psi = e^{i\left(\frac{\tilde{p}}{\hbar}x - \frac{E}{\hbar}t\right)}$	$\Psi = e^{i\left(\frac{\tilde{L}}{l_p^2}t - \frac{\tilde{T}}{l_p^2}x\right)}$
Plane wave		or $\Psi = e^{i\left(\frac{\frac{1}{2}r_s}{l_p^2}t - \frac{\tilde{m}}{l_p^2}x\right)}$
Plane wave		or $\Psi = e^{i\left(\frac{\tilde{E}}{l_p^2}t - \frac{\tilde{m}}{l_p^2}x\right)}$
Relativistic wave equation	$\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\Psi - \nabla^2\Psi + \frac{m^2c^2}{\hbar^2}\Psi = 0$	$\frac{\partial\Psi}{\partial t} - \mathbf{c}\cdot\nabla\Psi = 0$
Space-time geometry	Minkowski $dt^2c^2 - dx^2 - dy^2 - dz^2 = ds^2$ Not agreement if consistent with QM	' $dtc - dx - dy - dz = 0$ Consistent with QM and gravity
Gravity weak field	$F = G\frac{Mm}{r^2}$	$F = c^3\frac{\tilde{M}\tilde{m}}{r^2}$
QM full of "mystical" interpretations	Yes	No
Relativity theory consistent with minimum length	No	Yes
Found the Planck scale	No	Yes
Unified quantum gravity?	Not even close	Yes

Table 6: Modern/standard physics versus unified quantum gravity theory.