The Mystery of Mass as Understood from Atomism

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June 7, 2018

Abstract

Over the past few years I have presented a theory of modern atomism supported by mathematics [1, 2]. In each area of analysis undertaken in this work, the theory leads to the same mathematical end results as Einstein's special relativity theory when using Einstein-Poincaré synchronized clocks. In addition, atomism is grounded in a form of quantization that leads to upper boundary limits on a long series of results in physics, where the upper boundary limits traditionally have led to infinity challenges.

In 2014, I introduced a new concept that I coined "time-speed" and showed that this was a way to distinguish mass from energy. Mass can be seen as time-speed and energy as speed. Mass can also be expressed in the normal way in form of kg (or pounds) and in this paper we will show how kg is linked to time-speed. Actually, there are a number of ways to describe mass, and when they are used consistently, they each give the same result. However, modern physics still does not seem to understand what mass truly is.

This paper is mainly aimed at readers who have already spent some time studying my mathematical atomism theory. Atomism seems to offer a key to understanding mass and energy at a deeper level than modern physics has attained to date. Modern physics is mostly a top-down theory, while atomism is a bottom-up theory. Atomism starts with the depth of reality and surprisingly this leads to predictions that fit what we can observe.

Key words: Mass, energy, time-speed, collision-time, from time-speed to kg, the Haug gravitational constant.

1 The Mystery of Mass

In modern physics, mass is rather mysterious. There is no doubt that modern physics has good insights, both mathematically and experimentally, regarding the relationship between energy and mass. However, for all of the years of analysis and theorizing, physicists still cannot really explain what energy and mass are. As once stated by Richard Feynman

> *It is important to realize that in physics today, we have no knowledge what energy is.*

Much of modern physics is top-down, in that is one has observed a certain phenomenon and then tries to explain it by digging deeper and deeper. Atomism has an advantage here, as it is bottom-up. In a bottom-up theory, one starts with an idea concerning what the world is at the very deepest level, then derives what that idea will predict and compares it with actual observations and with other theories. Naturally a bottom-up theory must be consistent with experiment; if not, then there is clearly something wrong with the fundamentals. Further, attempting to start at the bottom does not guarantee success. However, atomism seems to have remarkable success: in our experience, nothing that atomism has predicted so far goes against the findings of traditional experiments. However, it seems to lead to a more logical and more straightforward theory.

For example, we have shown that atomism leads to all of the same mathematical end results as special relativity when using Einstein-Poincaré synchronized clocks; see [1]. In addition, atomism predicts an exact maximum velocity of matter that is just below the speed of light; this seems to remove a series of infinity challenges in special relativity theory. The prediction from atomism on the maximum velocity of anything with rest-mass is also the same limit we have found recently by combining Heisenberg's uncertainty principle with some of Max Planck's key concepts.

The mass of subatomic particles can be written as

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

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where $\hbar$ is the Planck constant, $\bar{\lambda}$ is the reduced Compton wavelength of the particle in question, and c is the well-known speed of light. One never sees modern physics papers discuss what the speed of light represents inside a mass formula. It is well- known that the speed of light (squared) is needed to go from mass to energy and from energy to mass, but that just shows there is potentially an enormous amount of energy in a small amount of mass. However, why also consider the speed of light inside a mass? Modern physics does not have an explanation for this. The field in general probably just look at this as something purely mathematical that one can derive from other concepts. However, we will soon see and understand why the speed of light is so essential in a mass, and what it represents.

2 Time-Speed, Continuous Time, and Collision Time

The purest form of mass under atomism comes into being at the very collision point (counter-strike) between indivisible particles. A collision between two indivisible particles lasts for one Planck second. The number of internal collisions in an electron per second, for example, is simply the speed of light divided by the reduced Compton wavelength of the electron. That is to say, we have the following number of internal collisions in an electron per second

$$\frac{c}{\bar{\lambda}_e} \approx 7.7634 \times 10^{20} \text{ collisions per second} \tag{2}$$

This is what we can call the "internal frequency" of an elementary particle. Each elementary particle has an internal collision frequency. This is very similar to Schrödinger's [3] hypothesis in 1930 of a Zitterbewegung ("trembling motion" in German) in the electron that he indicated was approximately

$$\frac{2m_e c^2}{\hbar} = \frac{2c}{\bar{\lambda}_e} \approx 1.55269 \times 10^{21} \text{ trembling motions per second} \tag{3}$$

This is actually exactly twice our number, but we think our number is more relevant in this respect. Schrödinger also did not seem to have an explanation of exactly what was behind this "trembling motion." Here we are hypothesizing that it is the number of internal counter strikes inside an electron that will also make the electron stand and vibrate. Further, each collision lasts for one Planck second; see [4, 5]. This means that, in total, the collisions in an electron last for

$$\frac{c}{\bar{\lambda}_e}\frac{l_p}{c} = \frac{l_p}{\bar{\lambda}_e} \approx 4.18532 \times 10^{-23} \text{ continuous seconds per second} \tag{4}$$

This is actually a dimensionless number, but as we will explain, it can be seen as the number of continuous seconds per second. That is, we consider each collision as a period with continuous time and then add all the collision times together and call this continuous time, even if it consists of many discrete collisions. So one could always argue about the use of words here. We could also have looked at the amount of continuous seconds for the time it takes for light to travel one meter in a vacuum. This would be

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

This is the amount of continuous time per meter of light travel. Alternatively, we can say that it is the amount of continuous time per approximately 3.3 nano-seconds, as light travels one meter in this time. This is directly related to the time-speed concept introduced by Haug in 2014. We consider the collisions as continuous time, or seen another way, it could be called collision time. How much time are the indivisible particles in an elementary particle spending on collisions per time unit? Bear in mind that under atomism, an elementary particle like an electron consists of (minimum) two indivisible particles moving back and forth counter-striking. The indivisible particles always move at the speed of light, with the exception of that point of collision, when they stand still for one Planck second.

Instead of calling this continuous time, we could simply call this collision time per time unit. The idea behind continuous time is that it represents the time where particles collide relative to the time the indivisible particles making up the elementary particle are not colliding. Time-speed is a ratio of collision time relative to non-collision time. In other words, it is the time in rest (collision) relative to time in internal motion of the indivisible particles. Hypothetically, in a Planck mass particle there is no distance between the indivisible particles and they are colliding as frequently as possible. The time-speed of a Planck mass is

$$\hat{m} = \frac{l_p}{l_p}\frac{1}{c} = \frac{1}{c} \approx 3.33564 \times 10^{-9} \text{ second per meter} \tag{6}$$

That is is 3.3 nano-seconds per meter, which is the maximum possible time-speed. In other words, it is colliding for 3.3 nano-seconds, per 3.3 nano-seconds, or per meter the light travels. A Planck mass can also be written simply as

$$\hat{m} = \frac{l_p}{l_p} = 1 \text{ continuous second per second} \tag{7}$$

That is only a Planck mass is pure continuous time, and it only consist of collisions. All other elementary particles, $\bar{\lambda} > l_p$, must spend the following amount of continuous time per meter that light travels (that is per 3.03 nano-seconds)

$$\hat{m} = \frac{l_p}{\bar{\lambda}} \frac{1}{c} \text{ continuous seconds per meter} \tag{8}$$

For example, an electron is

$$\hat{m}_e = \frac{l_p}{\bar{\lambda}_e} \frac{1}{c} \approx 1.3961 \times 10^{-31} \text{ continuous seconds per meter} \tag{9}$$

That is, for every 3.03 nano-seconds an electron will have spent 1.3961×10^{-31} seconds on collisions.

It is worth noting that when we work with mass as time-speed we do not need Planck's constant. Further, when we work with mass as time-speed, then the Planck mass is easily given and it only depends on the speed of light. For all other masses, we also need the Planck length and the reduced Compton wavelength. For a Planck mass, the reduced Compton wavelength is equal to the Planck length and they cancel out, so we are only dependent on the speed of light. That is the speed of the indivisible particle in a vacuum.

3 Mass as kg and How to Go from kg to Time-speed

It is interesting to see from the mass definitions in the previous section that we have never used the Planck constant or the reduced Planck constant. As Haug has written about previously, the Planck constant is a conversion factor that is actually a composite constant, which can be written as

$$\hbar = \frac{c^2}{8.52247 \times 10^{50}} \approx 1.05457 \times 10^{-34} \ m^2 \cdot kg/s \tag{10}$$

where 8.52247×10^{50} is the number of internal hits per second in one kg. The mass of any elementary particle is defined under standard physics and can also be defined under atomism

$$m = \frac{\hbar}{\bar{\lambda}} \frac{1}{c} \text{ kg} \tag{11}$$

For example, for an electron we have

$$m = \frac{\hbar}{\bar{\lambda}_e} \frac{1}{c} \approx 9.10938 \times 10^{-31} \text{ kg} \tag{12}$$

Now let's replace $\hbar$ with $\frac{c^2}{8.52247 \times 10^{50}}$ and we get

$$m = \frac{\frac{c^2}{8.52247 \times 10^{50}}}{\bar{\lambda}} \frac{1}{c} = \frac{\frac{c}{\bar{\lambda}}}{8.52247 \times 10^{50}} \tag{13}$$

Seen at a deeper level, a mass in kg is simply the internal hit frequency in the elementary particle divided by the hit frequency in one kg. One kg is a "random" practical amount of matter that someone decided to call one kg. It was not too heavy (so it could not be carried around), but also not so light that it was hard to measure. A kilogram is basically a dimensionless number in the sense that it is a hit frequency ratio. To go from kg to time-speed in continuous seconds per meter we need to divide the mass in kg with

$$\frac{\hbar}{l_p} \approx 6.525012 \ m \cdot kg \cdot s^{-1} \tag{14}$$

The reduced Planck constant divided by the Planck constant is a conversion factor needed to go from kg to time-speed, or from time-speed to kg. One kg is $\frac{1}{6.525012} \approx 0.15$ continuous seconds per meter, and 45945119 continuous seconds per second ($\frac{1}{6.525012} \times 299792458$) . We must have that 6.52 kg is one continuous second per meter and 299,792,458 continuous seconds per second. Also 299,792,458 Planck masses is 6.52 kg. Any mass with a time-speed of more than one continuous second per second cannot be an elementary particle, but must consist of a collection of elementary particles. And masses with time-speeds less than one continuous second per second can be collections of elementary particles, but they don't have to be. For example, a Planck mass is one continuous second per second.

There are actually a number of ways to describe a mass; they all are correct, and they can be converted from one to the other. Table 1 show several ways to express mass

Table 2 shows various ways to describe the mass of elementary particles. All of them are correct and we can go from one definition to another by using a conversion factor

	Time-speed per meter	**Time-speed per second**	**Frequency per second**	**Frequency ratio known as kg**
General formula:	$\frac{l_p}{\bar{\lambda}}\frac{1}{c}$	$\frac{l_p}{\bar{\lambda}}$	$\frac{c}{\bar{\lambda}}$	$\frac{\hbar}{\bar{\lambda}}\frac{1}{c}$
Mass-gap	5.39106×10^{-44}	5.39106×10^{-44}	1	$\frac{1}{8.52247\times 10^{50}} \approx 1.17 \times 10^{-51}$
Electron	1.396×10^{-31}	4.18532×10^{-23}	7.763×10^{20}	$\frac{7.76\times 10^{20}}{8.52247\times 10^{50}} \approx 9.11 \times 10^{-31}$
Proton	2.56×10^{-28}	7.68488×10^{-20}	1.425×10^{24}	$\frac{1.43\times 10^{24}}{8.52247\times 10^{50}} \approx 1.67 \times 10^{-27}$
Planck mass	3.34×10^{-09}	1	1.855×10^{43}	$\frac{1.855\times 10^{43}}{8.52247\times 10^{50}} \approx 2.18 \times 10^{-08}$
One kg	0.153	45945119	8.522×10^{50}	$\frac{8.52247\times 10^{50}}{8.52247\times 10^{50}} = 1$
6.52 kg	1	299792458	5.561×10^{51}	$\frac{5.56\times 10^{51}}{8.52247\times 10^{50}} \approx 6.52$

Table 1: The table shows mass as time-speed per meter, time-speed per second, and mass as kg.

	Time-speed per meter	**Time-speed Per second**	**Frequency**	**Frequency ratio kg**
Mass-gap	$\frac{l_p}{\bar{\lambda}_c}\frac{1}{c}$	$\frac{l_p}{\bar{\lambda}_c}$	1	$\frac{\hbar}{\bar{\lambda}_c}\frac{1}{c} =$ "$\frac{\hbar}{c^2}$"
Other masses	$\frac{l_p}{\bar{\lambda}}\frac{1}{c}$	$\frac{c}{\bar{\lambda}}\frac{l_p}{c} = \frac{l_p}{\bar{\lambda}}$	$\frac{c}{\bar{\lambda}}$	$\frac{\hbar}{\bar{\lambda}}\frac{1}{c}$
Planck mass	$\frac{l_p}{l_p}\frac{1}{c} = \frac{1}{c}$	$\frac{c}{l_p}\frac{l_p}{c} = 1$	$\frac{c}{l_p}$	$\frac{\hbar}{l_p}\frac{1}{c}$
One kg	"$\frac{l_p}{\frac{\hbar}{c}}\frac{1}{c} = \frac{l_p}{\hbar}$"	"$\frac{c}{\frac{\hbar}{c}}\frac{l_p}{c} = \frac{l_p}{\hbar}c$"	"$\frac{c}{\frac{\hbar}{c}} = \frac{c^2}{\hbar}$"	$\frac{\hbar}{\frac{\hbar}{c}}\frac{1}{c} = 1$
6.52 kg	1	299792458	$\frac{c^2}{l_p}$	$\frac{\hbar}{l_p}$

Table 2: The table shows ways of expressing mass; all of them are correct.

In some of the formulas above, we have, on purpose, mistakenly written as

$$\frac{\hbar}{\bar{\lambda}_c}\frac{1}{c} = \text{``}\frac{\hbar}{c^2}\text{''} \tag{15}$$

This is not true from a unit perspective; it is simply done because we have a reduced Compton wavelength $\bar{\lambda}_c$ that is equal to the length light travels in one second, so we have for convenience replaced it with c in the right-hand part (so it is easier to remember and to see "connections").

Both tables also mention the mass-gap. We will not go in much discussion about that here, but a deeper discussion around the mass-gap is given in [6]. The reduced Compton wavelength of the mass-gap is $\bar{\lambda}_c =$ 299792458 meter per second. The mass-gap in terms of frequency is always one, it is one collision, one collision will be observational time independent. However, the mass-gap as a relative ratio is the only mass that is always observational time dependent.

4 Relativistic Mass

The masses in Tables 1 and 2 are for rest-masses. Table 3 looks at relativistic masses. Einstein's relativistic mass formula [7, 8] for an elementary particle can be written as

$$m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\frac{\hbar}{\bar{\lambda}}\frac{1}{c}}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{c} = \frac{c}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{8.52247\times 10^{50}} \text{ kg} \tag{16}$$

We see that relativistic mass has to do with contraction of the reduced Compton wavelength, that is the average void distance between the indivisible particles are contracted as measured with Einstein-Poincaré synchronized clocks. The indivisible particle itself cannot contract. Further, atomism (see [1, 9, 10, 11]) gives us an exact limit on the maximum velocity any elementary particle can take; this is given by

$$v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} \tag{17}$$

This means that no elementary particle can attain a relativistic mass higher than the Planck mass particle. Further, the shortest reduced Compton wavelength after maximum length contraction is the Planck length. We also find that Lorentz symmetry is broken at the Planck scale, as proven by Haug in his recent Heisenberg paper. Special relativity theory is actually not consistent with a minimum length equal to the Planck length. The SR theory needs to be modified in the way predicted by atomism in order to become consistent with Heisenberg, when combined with key concepts from Max Planck.

Table 3 shows relativistic mass formulas for elementary particles, the Planck mass particle is not affected by velocity because its maximum velocity is zero. It is using all its time in collision mode.

	Time-speed per meter	**Time-speed Per second**	**Frequency**	**Frequency ratio kg**
Mass-gap per second	$\frac{l_p}{\bar{\lambda}_c}\frac{1}{c}=$ "$\frac{l_p}{c^2}$"	$\frac{l_p}{c}$	1	$\frac{\hbar}{\bar{\lambda}_c}\frac{1}{c}=$ "$\frac{\hbar}{c^2}$"
Other masses	$\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{c}$	$\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$	$\frac{c}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}$	$\frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}}\frac{1}{c}$
Planck mass	$\frac{l_p}{l_p}\frac{1}{c}=\frac{1}{c}$	$\frac{c}{l_p}\frac{l_p}{c}=1$	$\frac{c}{l_p}$	$\frac{\hbar}{l_p}\frac{1}{c}$

Table 3: The table shows formulas for relativistic mass.

5 The Simplicity of $E = mc^2$ When Looking at Mass as Time-speed

The Planck mass particle is the purest mass and has a time-speed of $\hat{m} = \frac{1}{c}$. It is interesting to see that the famous Einstein formula $E = mc^2$ then simplifies to

$$\begin{aligned} \hat{E} &= \hat{m}c^2 \\ c &= \frac{1}{c}c^2 \end{aligned} \tag{18}$$

and naturally we have

$$\begin{aligned} \hat{m} &= \frac{E}{c^2} \\ \hat{m} &= \frac{c}{c^2} = \frac{1}{c} \end{aligned} \tag{19}$$

In other words, c^2 in the $E = mc^2$ formula is at a deeper level nothing other than a conversion factor to go from time-speed (indivisibles moving back and forth in a "stable" pattern counter-striking, or colliding) to speed. Naturally, for continuous time masses that are not in the purest form, the equations are slightly more complicated

$$\begin{aligned} \hat{E} &= \hat{m}c^2 \\ \frac{l_p}{\bar{\lambda}}c &= \frac{l_p}{\bar{\lambda}}\frac{1}{c}c^2 \end{aligned} \tag{20}$$

This explains why the Planck mass particle is the only mass that is the same as observed across all reference frames. It is only the reduced Compton wavelength that can contract for a moving mass. However, it can never be shorter than the Planck length, because this is the diameter of the Planck length.

See also Figure 1, which explains quite well the intuition behind time-speed and the relationship between energy and mass. This method is more intuitive than using kg as mass, but both kg and time-speed can be used to describe mass.

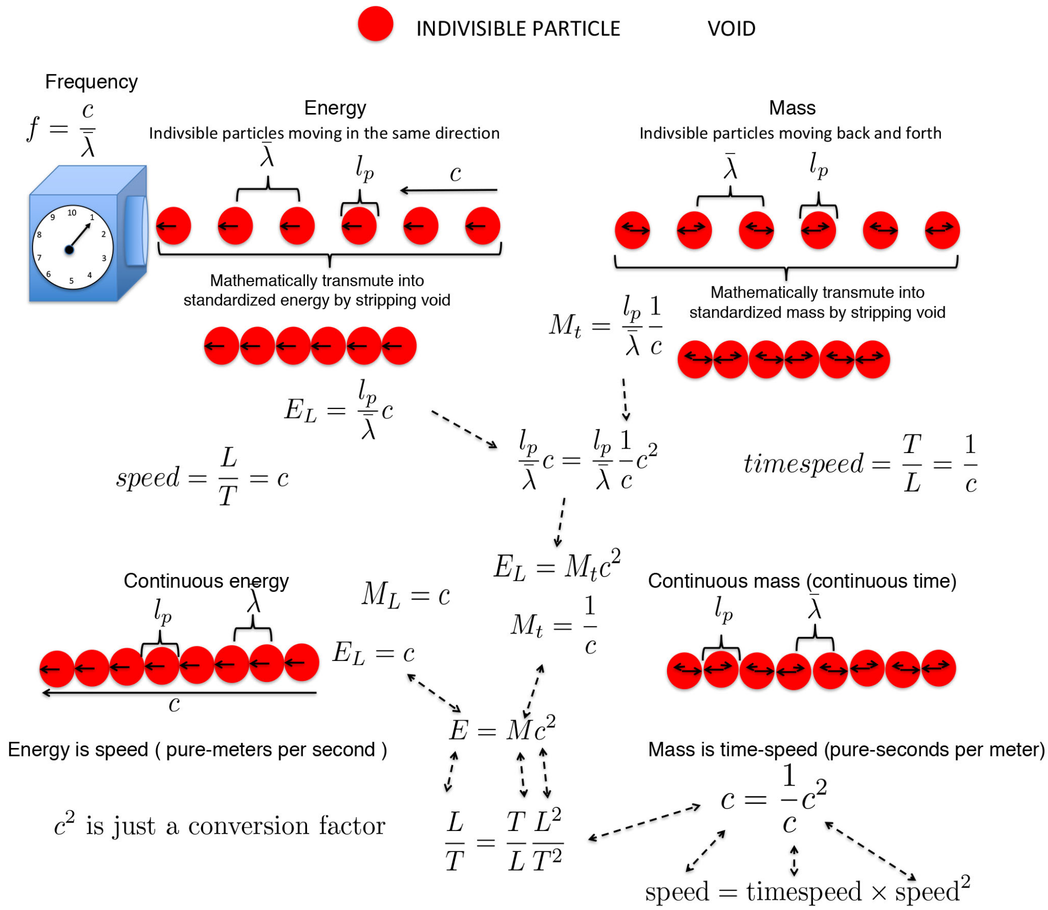

Figure 1: This figure illustrates the relationship between energy and mass, when mass is viewed as time-speed (collision time).

6 Probabilistic Atomist Theory

From atomism, we also get a simple probabilistic quantum theory. Figure 2 illustrates an elementary particle.

Assume we have an elementary particle such as an electron with a reduced Compton wavelength of $\bar{\lambda}$. What is the probability inside one Planck second that the particle is in a mass state? Remember, under atomism there is only one true mass, the Planck mass that lasts for one Planck second, which occurs at the collision point of two indivisible particles. The probability that the elementary particle is in a mass state in an observational time window of one Planck second must be

$$P = \frac{l_p}{\bar{\lambda}}. \tag{21}$$

This is the quantum probability that the indivisible particle in the elementary particle is at rest (colliding), that is to say, it is in a mass state, as we have defined collision as what mass actually is. We see that the reduced Compton wavelength, $\bar{\lambda}$, is in the quantum probability. The Planck mass particle has the shortest possible reduced Compton wavelength, l_p, which means it is in a mass state if observed. The Planck mass particle is the collision point between two indivisible particles, as explained earlier in this text. The probability of it being in a mass state during the Planck second during which we observe the Planck mass particle is

$$P = \frac{l_p}{\bar{\lambda}} = \frac{l_p}{\bar{l}_p} = 1 \tag{22}$$

That is conditional on the premise that if we observe a Planck mass particle in a Planck second observational time window, it must be in a mass state. All other elementary particles (when at rest) always have a probability lower than one of being in a mass state.

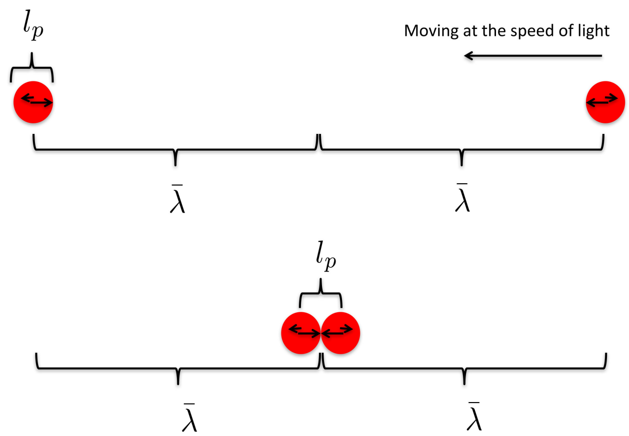

Figure 2: This figure illustrates two indivisible particles traveling back and forth at the speed of light and standing still for one Planck second at each collision.

6.1 Relativistic Quantum Probabilities

When the particle is moving at speed v relative to the laboratory frame, the reduced Compton wavelength will contract as observed from the laboratory frame. Derivation of length contraction under atomism is the same as that of special relativity theory when using Einstein Poincaré synchronized clocks; this is shown by Haug [1]. This means our relativistic quantum probabilities must be

$$P = \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \tag{23}$$

At first this may seem unrealistic, as the probability can go above unity when v approaches c. However, remember that the indivisible particles cannot contract; they are indivisible. That is, the maximum length contraction in the reduced Compton wavelength must be limited by the Planck length. The concept that the maximum length contraction is limited to the diameter of the indivisible particles leads to a maximum velocity for matter as described by Haug in a series of papers is given by

$$v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}} \tag{24}$$

This maximum velocity gives a maximum relativistic probability of one:

$$\begin{aligned} \frac{l_p}{\bar{\lambda}} \leq \quad P \quad &\leq \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}} \\ \frac{l_p}{\bar{\lambda}} \leq \quad P \quad &\leq 1 \end{aligned} \tag{25}$$

Thus, under atomism the probabilities are always inside what are considered valid probabilities. The interpretation of this should be that if we are observing a known elementary particle – an electron, for example, then this is the probability that the particle is in a mass state in a observational time window of one Planck second. With the term "known particle" I simply mean that we know its reduced Compton wavelength.

Probabilities in our theory are more than mere abstractions; they always have to do with distances and velocities. And since velocity is distance divided by a time interval, we can say that our quantum probabilities are always related to space and time at the quantum level.

6.2 Heisenberg-type uncertainty principle and the link to atomism

There seems to be a very interesting relationship between Heisenberg's [12] uncertainty principle and atomism. The Heisenberg uncertainty principle is given by

$$\Delta p \Delta x \geq \hbar \tag{26}$$

where Δp is the uncertainty in momentum and Δx is the uncertainty in position. Now, the uncertainty in the length of the reduced Compton wavlength of an indivisible particle in the atomist model inside a given elementary particle is

$$\Delta x = \bar{\lambda}\sqrt{1-\frac{v^2}{c^2}} \tag{27}$$

so under atomism we have

$$\begin{aligned}
\Delta pc\frac{\Delta x}{c} &\geq \hbar \\
\Delta E \Delta t &\geq \hbar \\
\Delta E\frac{\bar{\lambda}\sqrt{1-\frac{\Delta v^2}{c^2}}}{c} &\geq \hbar \\
\Delta E &\geq \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{\Delta v^2}{c^2}}}c
\end{aligned} \tag{28}$$

Our interpretation is simply that the uncertainty in energy is a function of the uncertainty in velocity. Under atomism the minimum velocity for a particle we assume is $v = 0$ and the maximum velocity is $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. This means we must have

$$\begin{aligned}
\frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}}c \geq \quad \Delta E \quad &\geq \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{v_{min}^2}{c^2}}}c \\
\frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}}c \geq \quad \Delta E \quad &\geq \frac{\hbar}{\bar{\lambda}\sqrt{1-\frac{0^2}{c^2}}}c \\
\frac{\hbar}{\bar{\lambda}\sqrt{1-1-\frac{l_p^2}{\bar{\lambda}^2}}}c \geq \quad \Delta E \quad &\geq \frac{\hbar}{\bar{\lambda}}c \\
\frac{\hbar}{l_p}c \geq \quad \Delta E \quad &\geq \frac{\hbar}{\bar{\lambda}}c \\
m_p c^2 \geq \quad \Delta E \quad &\geq mc^2
\end{aligned} \tag{29}$$

Thus, our uncertainty principle gives a range for the total energy in a particle. Modern physics has nothing like it, as there is then no limit on v, except for $v < c$, and in this case, one can always move v closer to c, something that basically leads to a situation where we can get as close to infinite energy as we want. Under atomism, the maximum energy is the Planck mass energy, and the minimum is the rest-mass energy. So, if I know the particle is an electron, then I know its energy must be between $m_e c^2$ and $m_p c^2$. The Planck mass energy is reached when it is accelerated to its maximum velocity.

In terms of time-speed we get

$$\begin{aligned}
\frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{max}^2}{c^2}}}c \geq \quad \Delta E \quad &\geq \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v_{min}^2}{c^2}}}c \\
\frac{l_p}{l_p}c \geq \quad \Delta E \quad &\geq \frac{l_p}{\bar{\lambda}}c \\
c \geq \quad \Delta E \quad &\geq \frac{l_p}{\bar{\lambda}}c \\
m_p c^2 \geq \quad \Delta E \quad &\geq mc^2
\end{aligned} \tag{30}$$

We predict that there also is another type of maximum uncertainty in the position of the indivisible particle (particles) making up an elementary particle related to the maximum length transformation (not the length contraction) of the reduced Compton wavelength of the elementary particle in question at its maximum velocity. This is given by

$$
\begin{aligned}
\Delta x_{max} &= \frac{\bar{\lambda}}{\sqrt{1-\frac{v_{max}^2}{c^2}}} \\
\Delta x_{max} &= .\frac{\bar{\lambda}}{\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}} \\
\Delta x_{max} &= \frac{\bar{\lambda}}{l_p \bar{\lambda}} \\
\Delta x_{max} &= \frac{\bar{\lambda}^2}{l_p}
\end{aligned} \tag{31}
$$

we use here $\Delta barx$ rather than Δx as there in our view is two types of uncertainty in the position of the indivisible particle, one is related to length contraction of the reduced Compton wavelength, the other perspective is from a length transformation.

For an electron this gives a maximum uncertainty in its position of

$$\Delta x_{max} = \frac{\bar{\lambda}_e^2}{l_p} = 9,226,523,482 \text{ m}$$

.

This is a very large distance, but still makes more sense than infinity, which is given by modern physics. This is also the distance light travels in approximately 30.78 seconds. So, what does this mean? The maximum uncertainty in position simply means we are dealing with an electron traveling at its maximum velocity $v_{max} = c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}$. Then, from the lab frame to measure the point where the two indivisible particles in the electron collide, one has to wait up to 30.78 seconds, and in this time the electron will have traveled 9,226,523,482 m. In other words, there is nothing mysterious about it. The uncertainty principle is actually closely linked to relativity theory, but can only be fully understood when one understands the atomist idea of elementary particles. Another way to see this is that the time between each counter-strike in the electron is, as measured from its rest frame, simply the reduced Compton time, that is $\frac{\bar{\lambda}_e}{c} \approx 1.29 \times 10^{-21}$ s. However, at its maximum velocity as observed from the laboratory frame (the frame the electron moves relative to at this speed) we have a time interval of

$$t_2 = \frac{t_1}{\sqrt{1-\frac{v_{max}^2}{c^2}}} = \frac{\frac{\bar{\lambda}}{c}}{\sqrt{1-\frac{\left(c\sqrt{1-\frac{l_p^2}{\bar{\lambda}^2}}\right)^2}{c^2}}} = \frac{\bar{\lambda}^2}{c l_p} \approx 30.78 \text{ s} \tag{32}$$

Again, this means approximately 30.78 seconds between each counter-strikes in the electron just before the electron reaches its maximum velocity, as observed from the laboratory frame. Since the maximum velocity is very close to the speed of light, this means that the electron has traveled approximately $c \times 30.78 \approx 9,227,611,857$m, between two counter-strikes.

Table 4 summarizes the "uncertainty" limits in elementary particles from the perspectives of atomism and modern physics. The modern physics perspective is naturally more complex than illustrated here. In modern physics many questions remain on the existence and nature of the mass gap, for example, and further, the natural units of Max Planck, including the Planck length and Planck time is also not understood well from modern physics, but have clear relations and explanations under atomism.

	Max Uncertainty atomism	**Max Uncertainty standard physics**
Momentum	$\frac{\hbar}{\bar{\lambda}} \leq p \leq \hbar\sqrt{\frac{1}{l_p^2} - \frac{1}{\bar{\lambda}^2}}$	$0 \leq p \leq \infty$
Position uncertainty	$l_p \leq x \leq \frac{\bar{\lambda}^2}{l_p}$	$0 \leq x \leq \infty$
Mass	$\frac{\hbar}{\bar{\lambda}}\frac{1}{c} \leq m \leq \frac{\hbar}{l_p}\frac{1}{c}$	$0 \leq m \leq \infty$
Mass gap	$\frac{\hbar}{\bar{\lambda}}\frac{1}{c} \leq m \leq \frac{\hbar}{l_p}\frac{1}{c}$	Unknown
Reduced Compton wavelength	$l_p \leq L \leq \bar{\lambda}$	$0 \leq L \leq \infty$

Table 4: The table shows formulas for relativistic mass.

Assume for a moment that a proton was an elementary particle, then the maximum uncertainty in its position would be

$$\Delta x_{max} = \frac{\bar{\lambda}_P^2}{l_p} \approx 2736.6 \text{ m}$$

.

This in strong contrast to modern physics dictum that says to know the momentum of a proton exactly means there will be infinite uncertainty in the position of the proton.

6.3 All elementary particles are a probabilistic function of the one and only pure mass

Under atomism the only really pure mass, and in reality the only mass, is the Planck mass particle. All other elementary particles can be seen as a probabilistic function of the Planck mass particle. The expected relativistic mass of any particle is simply

$$E[m] = m_p P = m_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} \leq m_p \tag{33}$$

This is the expected mass over a long time period. A “long time period” is a time period that is long relative to the reduced Compton time.

Interestingly, this also means that we can rewrite the quantum probability as

$$\begin{aligned} m_p \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} - mc^2 &= \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}} - mc^2 \\ \frac{l_p}{\bar{\lambda}\sqrt{1-\frac{v^2}{c^2}}} &= \frac{E_k + mc^2}{m_p} \\ P &= \frac{E_k + mc^2}{m_p} \end{aligned} \tag{34}$$

The quantum probability is equal to the kinetic energy plus the particle rest-mass energy divided by the Planck mass. Again remember that the maximum velocity of the Planck mass particle is zero. This means that Planck mass particles cannot have kinetic energy and all their energy is rest-mass energy, so we must have

$$P_p = \frac{0 + m_p c^2}{m_p} = 1 \tag{35}$$

Again, we see the Planck mass particle quantum probability always must be one. Turning to the maximum relativistic quantum probability for other particles, we get, at their maximum velocity

$$\begin{aligned} P_{max} &= \frac{E_k + mc^2}{m_p} \\ P_{max} &= \frac{E_k + mc^2}{m_p} \\ P_{max} &= \frac{\frac{mc^2}{\sqrt{1-\frac{v_{max}^2}{c^2}}} - mc^2 + mc^2}{m_p} \\ P_{max} &= 1 \end{aligned} \tag{36}$$

When $v < v_{max}$, we must have a quantum probability of less than one. The Planck mass particle, however, is unique as $v = v_{max}$; because the the maximum velocity for the Planck mass particle is zero. In our view, this simply means the Planck mass particle only exists for one Planck second before it bursts into pure energy (light).

7 Reduced Compton Time

A very useful concept to understand and develop theories for subatomic particles involves the time interval that the speed of light uses to travel a distance equal to the reduced Compton wavelength of the particle we are considering. We assume the speed of light as measured with Einstein-Poincareé synchronized clocks. For example, the reduced Compton time of an electron will then be

$$\bar{t}_e = \frac{\bar{\lambda}_e}{c} \approx 1.28809 \times 10^{-21} \text{ seconds} \tag{37}$$

When observing subatomic particles at time intervals close to the reduced Compton time, “strange” quantum effects will appear, but they will be fully understandable, even at a logical level, through atomism. We will look at this in the next section.

8 Elementary Particles Become Time Dependent at Observational Time Windows Close to Their Reduced Compton Time

Again, an electron has the following number of internal collisions per second

$$\frac{c}{\bar{\lambda}_e} \approx 7.7634 \times 10^{20} \text{ collisions per second} \tag{38}$$

and we have defined one kg as approximately 8.52247×10^{50} collisions per second. The mass of the electron in kg is simply its internal collision frequency divided by the kg frequency. This gives us

$$\frac{7.7634 \times 10^{20}}{8.52247 \times 10^{50}} \approx 9.10938 \times 10^{-31} \text{ kg} \tag{39}$$

For most time intervals, the mass of an elementary particle, such as an electron, is observational time independent. For example, if we observed the particle for half a second we would get

$$\frac{1}{2}\frac{c}{\bar{\lambda}_e} \approx 3.8817 \times 10^{20} \text{ collisions per second} \tag{40}$$

And one kg has the following number of internal collisions per half second $\frac{8.52247\times 10^{50}}{2}$, so the ratio of collisions in the electron decided by the collisions in the mass we have defined as one kg is still the same. Again, under atomism the kg definition is a collision frequency relative to an amount of matter that we called a kg. That the collisions and therefore the building blocks of an elementary particle comes in quantum first becomes "visible" when we work with (observe) a particle at time intervals close to the reduced Compton time. Assume we are observing an electron over a time interval of only 1.5 its reduced Compton time, that is a time interval of

$$t = 1.5\bar{t}_e = 1.5\frac{\bar{\lambda}}{c}$$

The mass for elementary particles under atomism is directly linked to the number of counter strike between indivisible particles making up the elementary particle and these collisions only happen every reduced Planck time. This means that in this case we not will have 1.5 collisions, but only one collision. The number of collisions in the one kg over this time interval is

$$n = 8.52247 \times 10^{50} \times 1.5\frac{\bar{\lambda}}{c} \approx 1.64665 \times 10^{30} \tag{41}$$

The mass of the electron is the collision ratio frequency in that time interval and it now is

$$m_e = \frac{1}{1.64665 \times 10^{30}} \approx 6.0729 \times 10^{-31} \text{ kg} \tag{42}$$

This we see is considerably lower than the known electron mass. This mass is actually approximately 33% lower than the known mass of the electron. Again, this is because we are working with such short time intervals that quantum effects are starting to play a role. If we measure it exactly over one reduced Compton time interval, then the mass of the electron would be its "known" mass. The mass simply gets unstable when observing the mass at close to the reduced Compton time interval.

Figure 2 shows the electron's deterministic mass as a function of the observational time window. We are using time steps of 0.1 reduced Compton time, that is $0.1\frac{\bar{\lambda}_e}{c}$. As we can see the mass quite rapidly gets very stable around the "known" electron mass.

The fact that the mass is time dependent at very short time intervals has serious implications. It means that if we are operating on short observational time intervals and there is an uncertainty in what exactly time window is, due to measurement errors, for example, then we will get very interesting probability distributions in the mass.

What would the expected mass be if we included z Compton intervals (which also gives collisions per observational time window in the particle one is observing, where z is an integer) + a random time interval between $\frac{l_p}{c}$ and $\frac{\bar{\lambda}}{c} - \frac{l_p}{c}$. Here we are basically working with a known time interval of $z \times \frac{\bar{\lambda}}{c}$ + a random time interval between $\frac{l_p}{c}$ and $\frac{\bar{\lambda}}{c} - \frac{l_p}{c}$ (uniformly distributed). The expected mass is then

$$E[m] = \frac{1}{n}\int_a^b f(x)dx = \frac{1}{n}\int_a^b \frac{z}{\left(z\frac{\bar{\lambda}}{c} + \frac{xl_p}{c}\right)\frac{c^2}{\hbar}}dt = \frac{1}{n}\frac{\hbar z(\ln(bl_p + \bar{\lambda}z) - \ln(al_p + \bar{\lambda}z))}{cl_p} \tag{43}$$

In the special case where $a = 1$ and $z = b = \frac{\bar{\lambda}_e}{l_p}$ we get

$$E[m] = \frac{1}{\frac{\bar{\lambda}_e}{l_p}}\frac{\hbar\frac{\bar{\lambda}_e}{l_p}\left(\ln\left(\frac{\bar{\lambda}_e}{l_p}l_p + \bar{\lambda}_e\frac{\bar{\lambda}_e}{l_p}\right) - \ln\left(l_p + \bar{\lambda}_e\frac{\bar{\lambda}_e}{l_p}\right)\right)}{cl_p} = \frac{\hbar\left(\ln\left(\bar{\lambda}_e + \frac{\bar{\lambda}_e^2}{l_p}\right) - \ln\left(l_p + \frac{\bar{\lambda}_e^2}{l_p}\right)\right)}{cl_p} = \frac{\hbar}{\bar{\lambda}_e}\frac{1}{c} = m_e \tag{44}$$

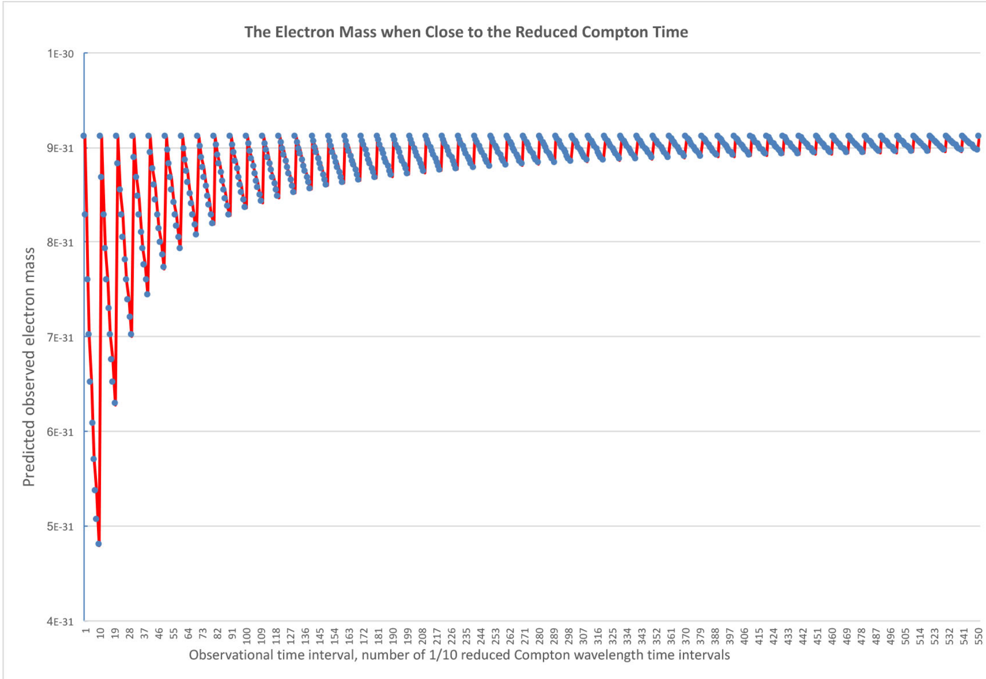

Figure 3: This figure illustrates the observation that the mass of an electron becomes time dependent at time intervals close to the reduced Compton time of the electron. The blue points are time points we have calculated for. The time intervals used are 0.1 reduced Compton time intervals.

Number of Compton times	Observational time window electron	Expected electron Mass kg	Observational time window proton	Expected proton mass kg
1	2.57618E-21	6.31414E-31	1.40303E-24	1.15937E-27
2	3.86427E-21	7.38707E-31	2.10455E-24	1.35638E-27
3	5.15235E-21	7.86182E-31	2.80606E-24	1.44355E-27
4	6.44044E-21	8.13080E-31	3.50758E-24	1.49294E-27
5	7.72853E-21	8.30418E-31	4.20909E-24	1.52478E-27
10	1.4169E-20	8.68217E-31	7.71667E-24	1.59418E-27
100	1.30097E-19	9.06414E-31	7.0853E-23	1.66431E-27
1000	1.28938E-18	9.10483E-31	7.02217E-22	1.67179E-27
100000	1.2881E-16	9.10934E-31	7.01522E-20	1.67261E-27
1000000	1.28809E-15	9.10938E-31	7.01516E-19	1.67262E-27

Table 5: The table shows the expected mass of an electron and a proton. we have a uniformly-distributed random time interval between $\frac{l_p}{c}$ and $\frac{\bar{\lambda}}{c} - \frac{l_p}{c}$, in addition to a known part of the observational time window of $z\frac{\bar{\lambda}}{c}$.

Table 4 shows the observational time window dependent mass of an electron and a proton. Here we have chosen the time interval so that the mass is underestimated to the maximum extent, so this is basically the approach described above. Even then the expected mass is quickly converging to its "known" mass, as the observational time window increases.

9 Gravity When Mass is Time-Speed

Haug has suggested that Newton's gravitational constant[1] is a composite constant of the form; see [9**?** , 15]

$$G = \frac{l_p^2 c^3}{\hbar} \approx 6.67384 \times 10^{-11}\ m^3 \cdot kg^{-1} \cdot s^{-2} \tag{45}$$

McCulloch 2014 [16] has derived a similar formula for big G based on Heisenberg's uncertainty principle; see also [17]. Haug [9] has derived this formula from dimensional analysis, as well as from Heisenberg's uncertainty principle, using his newly-introduced maximum velocity formula for matter [18].

[1]See [13] and [14].

Surprisingly, we can perform all of our Newton gravitational calculations based on the perspective of mass as time-speed and a new gravitational constant. The Haug gravitational constant is based on time-speed (rather than kg) and is given by

$$G_H = l_p c^3 \approx 4.35469 \times 10^{-10}\ m^4 \cdot s^{-3} \tag{46}$$

The gravity force, when operating with mass as time-speed per meter, is given by

$$F = G_H \frac{\hat{m}\hat{m}}{r^2} \tag{47}$$

This we can decompose

$$\begin{aligned} F &= \bar{G}_H \frac{\hat{m}\hat{m}}{r^2} \\ F &= \bar{G}_H \frac{n_1 \hat{m}_p n_2 \hat{m}_p}{r^2} \\ F &= l_p c^3 \frac{\frac{1}{c}\frac{1}{c}}{r^2} = \frac{c l_p}{r^2} \end{aligned} \tag{48}$$

where n_1 and n_2 simply are the number of Planck masses in the two masses. The orbital velocity for a Planck mass is given by

$$v_o = \sqrt{\frac{G_H \hat{m}_p}{r}} = \sqrt{\frac{l_p c^3 \frac{1}{c}}{r}} = c\sqrt{\frac{l_p}{r}} \tag{49}$$

The orbital velocity for any mass larger than a Planck mass is given by

$$v_o = \sqrt{\frac{G_H \hat{m}}{r}} = \sqrt{\frac{G_H N \hat{m}_p}{r}} = \sqrt{N \frac{l_p c^3 \frac{1}{c}}{r}} = c\sqrt{N \frac{l_p}{r}} \tag{50}$$

These are all the same formulas as given by standard Newtonian gravity, when decomposed into a deeper level. This is not so strange, as kg is simply a frequency ratio, and mass can also be expressed in other forms.

We will return to the subject of gravity later on. We will claim there are a few common misunderstandings around the interpretation of Newtonian gravity that push scientists to think big G is essential, when in fact, the Planck length is most likely the key to understanding gravity from a fresh perspective.

Table 5 shows the decomposed gravitational formulas, that is the gravitational formulas from a deeper perspective, both when we start with Newton's gravitational constant and mass as kg, and when we start with Haug's gravitational constant and mass as time-speed. We see that all of the formulas are exactly the same for things related to gravity that we actually can observe. And we see that only for the gravitational force itself is there a difference in the formulas, and that force cannot be observed directly. However, both are correct from a theoretical point of view: one is linked to kg and the other to time-speed, and to go from time-speed to kg we can simply multiply by $\frac{\hbar}{l_p}$.

What we can observe:	**From mass as kg**	**From mass as time-speed:**
Orbital velocity	$v_o = c\sqrt{n\frac{l_p}{r}}$	$v_o = c\sqrt{n\frac{l_p}{r}}$
Gravitational acceleration field	$g = n\frac{l_p}{r^2}c^2$	$g = n\frac{l_p}{r^2}c^2$
Gravitational red-shift	$\lim_{r\to+\infty} z(r) = n2\frac{l_p}{r}.$	$\lim_{r\to+\infty} z(r) = n2\frac{l_p}{r}.$
Gravitational deflection	$\delta = n4\frac{l_p}{r}$	$\delta = n4\frac{l_p}{r}.$
Gravitational time dilation	$t_0 = t_f\sqrt{1 - n\frac{2l_p}{r}}$	$t_0 = t_f\sqrt{1 - n\frac{2l_p}{r}}$
What we cannot observe:	**From mass as kg**	**From mass as time-speed:**
Gravitational force	$F = n_1 n_2 \frac{\hbar c}{r^2}$	$F = n_1 n_2 \frac{l_p c}{r^2}$

Table 6: The table of a series of measurements that actually can be observed/measured in relation to gravity, and also the gravitational force that we cannot observe and measure.

10 Fundamental Electricity as Time-speed

The well-known fundamental electrical units such as the Planck charge and Planck voltage can be rewritten in the time-speed form. This can be done simply by multiplying the traditional expressions of these units with $\sqrt{\frac{l_p}{\hbar}}$. For example, the Planck charge is given by

$$q_p = \sqrt{\frac{\hbar}{c}}\sqrt{10^7} \tag{51}$$

in the time-speed form this is

$$q_p = \sqrt{\frac{l_p}{c}}\sqrt{10^7} \tag{52}$$

That is to say, the charge is the square root of the Planck time multiplied by $\sqrt{10^7}$. This leads to an invariant Planck charge across any reference frame. This because under atomism when we are all the way down to the Planck length, there can be no length contraction. The light particles only have a charge at collision; this charge is half of the Planck charge

$$q_i = \frac{1}{2}\sqrt{\frac{l_p}{c}}\sqrt{10^7} \tag{53}$$

The electron charge is based on time-speed

$$e = q_p\sqrt{\alpha} = \sqrt{\frac{l_p}{c}\alpha}\sqrt{10^7} \tag{54}$$

Also, the electron charge must be invariant and the same as observed from any reference frame, if the fine structure constant is not affected by velocity.

When it comes to electron voltage, we have

$$V_e = \frac{c\alpha}{\bar{\lambda}_e}\sqrt{c\hbar\alpha}\sqrt{10^{-7}} \tag{55}$$

Converted to time-speed form this gives

$$V_e = \frac{c\alpha}{\bar{\lambda}_e}\sqrt{cl_p\alpha}\sqrt{10^{-7}} \tag{56}$$

In other words, the electron voltage is affected by velocity, as the reduced Compton wavelength of the electron will contract at high velocity. And we know that the electrical energy is given by

$$E = V_e e = \frac{c\alpha}{\bar{\lambda}_e}\sqrt{cl_p\alpha}\sqrt{10^{-7}}\sqrt{\frac{l_p}{c}\alpha}\sqrt{10^7} = \frac{l_p}{\bar{\lambda}_e}\alpha^2 c = \frac{l_p}{\bar{\lambda}_e}\alpha^2 c \tag{57}$$

Since the velocity is very low (αc), we actually have to work with "kinetic" electrical energy here, and actually we should have a $\frac{1}{2}$ in front of this equation. However, our point is simply that we can just as well operate with time-speed system rather than the traditional units.

We can also rewrite the standard charge formula simply by decomposing the Planck constant into what it is in atomism. The Planck charge is then

$$\sqrt{\frac{\hbar}{c}}\sqrt{10^7} = \sqrt{\frac{\frac{c^2}{8.52247\times10^{50}}}{c}}\sqrt{10^7} = \sqrt{\frac{c}{8.52247\times10^{50}}}\sqrt{10^7} \tag{58}$$

The units of the number 8.52247×10^{50} is collisions per second. So $\frac{c}{8.52247\times10^{50}} \approx 3.51767 \times 10^{-43}$ is meters per collision, so the charge is now the square root of meters per collision, in contrast to the charge in the time-speed form that is the square root of the time between each collision in a Planck mass. 3.51767×10^{-43} is less than the Planck length, so at first sight this sounds absurd if the shortest length is one Planck length. However, it is derived from the Planck constant and it is related to kg. As explained under section 3, there are approximately 45,945,119 Planck masses in one kg, so 3.51767×10^{-43} is simply the Planck length divided by number of Planck masses in one kg.

11 The Planck Units

All of the Planck units can be written in their normal form or their time-speed form. From Table 4 we see the difference is only in Planck units, where the standard form has the Planck constant. There is no Planck constant in the time-speed form. The standard form using the gravitational constant is the most confusing one, with such things as c^7, c^8, and even c^9. It is very hard to get any intuition out from the speed of light powered to anything above 2. The fact that modern physics has not understood that big G is very likely a composite constant leads to a lot of confusing formulas that are much easier to understand once one understands that the gravitational constant is a composite constant.

Units:	"Normal" form:	Deeper form:	Time-speed form:
Gravitational constant	$G \approx 6.67408 \times 10^{-11}$	$G = \frac{l_p^2 c^3}{\hbar}$	$G_H = l_p c^3$
Max velocity Planck mass particle	0	0	0
Planck length	$l_p = \sqrt{\frac{\hbar G}{c^3}}$	$l_p = l_p$	$l_p = l_p$
Planck time	$t_p = \sqrt{\frac{\hbar G}{c^5}}$	$t_p = \frac{l_p}{c}$	$t_p = \frac{l_p}{c}$
Planck mass	$m_p = \sqrt{\frac{\hbar c}{G}}$	$m_p = \frac{\hbar}{l_p}\frac{1}{c}$	$m_p = \frac{1}{c}$
Planck energy	$E_p = \sqrt{\frac{\hbar c^5}{G}}$	$E_p = \frac{\hbar}{l_p} c$	$E_p = \frac{l_p}{l_p} c$
Relationship mass and energy	$E_p = m_p c^2$	$\frac{\hbar}{l_p} c = \frac{\hbar}{l_p}\frac{1}{c} c^2$	$c = \frac{1}{c} c^2$
Reduced Compton wavelength	$\bar{\lambda}_p = \frac{\hbar}{m_p c}$	$\bar{\lambda}_p = l_p$	$\bar{\lambda}_p = l_p$
Planck area	$l_p^2 = \frac{\hbar G}{c^3}$	$l_p^2 = l_p^2$	$l_p^2 = l_p^2$
Planck volume	$l_p^3 = \sqrt{\frac{\hbar^3 G^3}{c^9}}$	$l_p^3 = l_p^3$	$l_p^3 = l_p^3$
Planck force	$F_p = \frac{c^4}{G}$	$F_p = \frac{\hbar}{l_p}\frac{c}{l_p}$	$F_p = \frac{c}{l_p}$
Planck power	$P_p = \frac{c^5}{G}$	$P_p = \frac{\hbar}{l_p}\frac{c^2}{l_p}$	$\mathrm{P}_p = \frac{c^2}{l_p}$
Planck mass density	$\rho_p = \frac{c^5}{\hbar G^2}$	$\rho_p = \frac{\hbar}{l_p}\frac{1}{c l_p^3}$	$\rho_p = \frac{1}{c l_p^3}$
Planck energy density	$\rho_p^E = \frac{c^7}{\hbar G^2}$	$\rho_p^E = \frac{\hbar}{l_p}\frac{c}{l_p^3}$	$\rho_p^E = \frac{c}{l_p^3}$
Planck intensity	$I_p = \frac{c^8}{\hbar G^2}$	$I_p = \frac{\hbar}{l_p}\frac{c^2}{l_p^3}$	$I_p = \frac{c^2}{l_p^3}$
Planck frequency	$\omega_p = \sqrt{\frac{c^5}{\hbar G}}$	$\omega_p = \frac{c}{l_p}$	$\omega_p = \frac{c}{l_p}$
Planck pressure	$p_p = \frac{c^7}{\hbar G^2}$	$p_p = \frac{\hbar}{l_p}\frac{c}{l_p^3}$	$p_p = \frac{c}{l_p^3}$
Planck charge	$q_p = \sqrt{4\pi\epsilon_0 \hbar c} = \frac{e}{\sqrt{\alpha}}$	$q_p = \sqrt{\frac{\hbar}{c}}\sqrt{10^7}$	$q_p = \sqrt{\frac{l_p}{c}}\sqrt{10^7}$
Planck current	$I_p = \sqrt{\frac{4\pi\epsilon_0 c^6}{G}}$	$I_p = \frac{c}{l_p}\sqrt{\frac{\hbar}{c}}\sqrt{10^7}$	$I_p = \frac{c}{l_p}\sqrt{\frac{l_p}{c}}\sqrt{10^7}$
Planck voltage	$V_p = \sqrt{\frac{c^4}{4\pi\epsilon_0 G}}$	$V_p = \frac{c}{l_p}\sqrt{c\hbar}\sqrt{10^{-7}}$	$V_p = \frac{c}{l_p}\sqrt{c l_p}\sqrt{10^{-7}}$
Planck impedance	$Z_p = \frac{1}{4\pi\epsilon_0 c}$	$Z_p = \frac{V_p}{I_p} = c \times 10^{-7}$	$Z_p = \frac{V_p}{I_p} = c \times 10^{-7}$
Electric energy	$E_p = q_p V_p = \sqrt{\frac{\hbar c^5}{G}}$	$E_p = q_p V_p = \frac{\hbar}{l_p} c$	$\mathrm{E}_p = q_p V_p = c$
Planck acceleration	$a_p = \frac{F_p}{m_p}$	$a_p = \frac{F_p}{m_p} = \frac{c^2}{l_p}$	$a_p = \frac{F_p}{m_p} = \frac{c^2}{l_p}$
Planck gravitational acceleration field	$g_p = \frac{G m_p}{l_p^2}$	$g_p = \frac{G_p m_p}{l_p^2} = \frac{c^2}{l_p}$	$g_p = \frac{G_H m_p}{l_p^2} = \frac{c^2}{l_p}$

Table 7: The table shows the standard Planck units and the units rewritten in a simpler and more intuitive form.

12 Summary of Key Numbers and Conversion Factors

Here we will summarize some key numbers and conversion factors

- To go from time-speed (continuous seconds per meter) to kg, multiply by $\frac{\hbar}{l_p} \approx 6.525$. This is also the momentum of a Planck mass particle.
- To go from kg to time-speed (continuous seconds per meter) to kg, divide by $\frac{\hbar}{l_p} \approx 6.525$.
- To go from time-speed (continuous seconds per second) to kg, multiply by $\frac{\hbar}{l_p}\frac{1}{c} \approx 2.17651 \times 10^{-8}$. This conversion factor is also the mass of a Planck mass in kg. And naturally we also have the understanding that the Planck mass is one continuous second per second.
- One kg is $\frac{1}{6.525012} \approx 0.15$ continuous seconds per meter, and 45,945,119 continuous seconds per second. The number 45,945,119 is also the number of Planck masses in one kg.
- Any mass that is more than one continuous second per second must contain more than one elementary particle.

- Approximately 6.52 kg is 1 continuous seconds per meter, and 299,792,458 continuous seconds per second. 299,792,458 is also the number of Planck masses in 6.52 kg.
- When it comes to mass as time-speed, we know only the Planck mass without knowing the Planck length. For mass in terms of kg, we only need to know the Planck length to know the Planck mass; we do not need to know the Planck length for other masses.
- The standard mass is easier work with and measure; the time-speed mass seems to give deeper insight, but it is much more difficult to observe and requires, for example, that we have already found the Planck length from gravitational experiments.
- The mass of elementary particles in form of kg is actually observational time dependent, but the observational time-dependence rapidly gets so small that it hardly is observable as soon as the observational time window is considerably larger than the reduced Compton time of the particle we want to study. Under atomism this would mean we need to use probabilistic models at the quantum scale, and it also explains why this quantum randomness rapidly gets negligible as we approach the macroscopic world. .

13 Conclusion

We have shown how we can describe mass as both time-speed (collision time) and as kg, and how to go from kg to time-speed or from time-speed to kg. We have also shown that we can do gravity calculations just as well from the perspective that mass is time-speed (time spent on collisions). We then need to use a different gravity constant. This supports the view that Newton's gravitational constant is "arbitrary" in the sense that it is a composite constant needed to turn a certain perspective on mass into the correct and deeper formulas for gravity. Both the time-speed way of looking at gravity and the normal way lead to exactly the same formulas at a deeper level.

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