Absolute Planck Values: Moving Beyond the Arbitrary Assignment of Unity

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ABSTRACT

Planck Values provide a valuable tool in our efforts to understand the basic fabric of nature; however, they fall short of having any truly intrinsic value. Planck Values come with the assumption that unity can be assigned to up to five of the fundamental universal constants. While constraining these values to unity may be convenient, it by no means ensures that intelligent life anywhere in the universe would make the same assumption. Further, the peculiar value of the inverse fine structure constant of 137 would suggest that it is naïve to assume that any of the physical constants are equal to unity or some other simplistic value. The IWPD Research Center has derived absolute values of the universal constants that suggest that all constants and measurements can be expressed with true universal significance. As such, any value and/or measurement can be expressed as a dimensionless number without the need for relative scales that are established through the use of units of measurement. This finding provides intrinsic meaning to all physical constants, it opens up a new avenue for the exploration of the universe and it provides new information in the search for the unification of General Relativity with Quantum Mechanics.

In 1899, Max Planck introduced the concept of natural units based upon universal constants as opposed to human based associations. Because Planck Units were based upon universal constants, it was argued that they would be agreeable to all, and that any intelligent extraterrestrial life in the universe would understand the significance of the Planck Units of measurement.

Initially, these Planck Units were more of a curiosity than anything else. However, with time, significance has been attached with each of the Planck Values and today they are an integral part of the discussion on General Relativity (GR), Quantum Mechanics (QM) and the evolution of the universe. The Planck Length serves as a fundamental quantum of distance at a scale of $10^{-35}\,m$ with the argument that all distances are multiples of the Planck Length. On the other hand, the Planck Mass at $2.18 \times 10^{-8}\,kg$ suffers from being a large number relative to the quantum scale. Its significance is not as a quantum "building block," but rather as defining the parameters of a Black Hole that would serve as the barrier or transition between GR and QM [1].

However, any statement that the Planck Units are truly fundamental is a misguided statement predicated on the assumption that all intelligent life would assign a value of unity to up to five of the same fundamental constants of the universe. We already know that the Planck Units are not universal, for we have not always even agreed upon them here on Earth. At times we equate Planck's Constant (*h*) to be unity, at other times it has been *h-bar*, requiring an adjustment of 2π. In yet other applications – mostly related to General Relativity – we require an adjustment of 8π. And, none of these adjustments bring us any closer to a true understanding of the peculiar intrinsic value of the inverse fine structure constant of 137. Yet, these adjustments have been accepted as mild inconveniences to the overall achievement of defining such entities as a quantum unit of length down to the minuscule scale of $10^{-35} m$.

But there are other fundamental constants such as electric charge that do not have a value of unity within the Planck Units of measurement. The unity value of charge in the Planck system is equal to $11.7e$ in order to accommodate the inverse fine structure constant of 137. Therefore some universal constants – those that provide the greatest flexibility through the process of dimensional analysis – are treated with privilege as being "more universal" than others, thus introducing an additional human factor to the Planck Units of measurement. We therefore have a dilemma, which constants are unity and which must be derived from those assumptions? What if other intelligent life assigns unity to different universal constants, or for that matter non-unity values to all of the constants? They would have a different system of measurement all based upon the very human, or corresponding extraterrestrial, process of arbitrarily assigning values to the universal constants.

Further, by assigning unity to several of the fundamental constants they have been normalized in a way where they must be equivalent to each other in order to glean out the meaningful units for mass, distance and time through the process of dimensional analysis. We have, in a manner of speaking, made apples equal to oranges. If such a relationship were truly to exist between mass, distance and time it must be defined by the true intrinsic value of the constants and not by an arbitrary human decision to assign them with a value of unity. Therefore, if the Planck Mass is not a universally agreed upon "fundamental" mass – that is, it is not a value that any intelligent life would automatically derive without the need for any arbitrary assignment of value – it logically follows that the conversation regarding the transition from GR to QM may be misguided. A legitimate and completely logical question follows as to what really is the significance of a Planck Mass derived from the assumption that both the Gravitational Constant and Planck's Constant have a value of unity? The immediate answer to this question is that if a universally agreeable value of Planck Mass exists, it would most definitely shed new light on our efforts to unify GR and QM.

If a truly universal system of measurement exists, it must be based upon some true intrinsic value for each of the universal constants that would be observed the same way to all intelligent life anywhere in the universe. Truly universal Planck Values must be void of all arbitrary assumptions if they are to have any inherent physical meaning within the framework of the universe.

A universal agreement on the fundamental constants would negate the need for units of measurement altogether. All measurements could be described as dimensionless numbers representing the absolute value for the entity being described. In addition, all physical constants would be expressible as absolute numbers of universally accepted significance. These numbers would represent a true intrinsic value, as opposed to an arbitrary value derived through the very human process of normalization. The question should not be whether these values exist, but rather are they attainable to us. Can we humans derive these universally significant values, or have they somehow been permanently hidden from us by nature herself? Those who have studied this will agree it is a slippery path with each new effort ending with the cancellation of units in such a way as to hide any efforts to establish a truly universal scaling of all measurements.

Currently, the Planck Length is determined by the product of either G and h or G *and* h-*bar* depending upon the interpretation. In either case, the product of these constants is arbitrarily set to 1. Assuming that the speed of light is unity will provide the following relationship:

$$\left(7.41\times10^{-28}\,m/kg\right)\left(2.21\times10^{-42}\,kg\cdot m\right)=1$$

$$\sqrt{1.64\times10^{-69}\,m^2}=1$$

$$4.05\times10^{-35}\,m=Planck_{Length}$$

Or,

$1.61\times10^{-35}\,m$ when h-bar is used

Planck Mass is determined from the ratio of $h\text{-}bar/G$. The Planck Mass can be determined as:

$$\frac{\left(2.21\times10^{-42}\,kg\cdot m\right)}{(2\pi)\left(7.41\times10^{-28}\,m/kg\right)}=1$$

$$\sqrt{4.75\times10^{-16}\,kg^2}=1$$

$$2.18\times10^{-8}\,kg=Planck_{Mass}$$

However, these Planck Values have no universal standing as being significant in anyway without an understanding of the true intrinsic value of the fundamental constants. Is it possible to derive such fundamental values? And, if so, would they truly represent the fundamental building blocks of the universe?

In exploring this question, a logical argument can be made that G and h are inversely proportional to each other. This would ensure a small value for the Planck Length regardless of the intrinsic value for either G or h. That is, the product of $G\cdot h$ would always be unity (within a factor of 2π or so) and therefore the value of the Planck Length would be invariant to the intrinsic values of both G and h. This assumption can be quantitatively tested by exploring the relative strength of the electrostatic force to the gravitational force through the ratio of k/G, where $k = 8.99 \times 10^9\ kg \cdot m^3 / C^2 \cdot s^2$. The electrostatic force exerted between two electrons is known to be 4.2×10^{42} times stronger than the corresponding gravitational force between the same electrons. Therefore, for the relative force between electrons, it follows that:

$$k = 4.2 \times 10^{42} G$$

We also know that:

$$\frac{hc}{2\pi k (e)^2} = 137$$

Therefore, by substitution we know that:

$$\frac{hc}{(2\pi)(4.2x10^{42} G)(e)^2} = 137$$

However, if G and h are inversely proportional it should be true that:

$$\frac{h^2 c}{2\pi (4.2 \times 10^{42})(e)^2} = 137$$

This is indeed correct (within a factor of 2π) verifying that h and G are inversely proportional to each other. Therefore the traditional value of Planck Length should represent a length that is truly on the scale of a fundamental quantum “building block”. At a value of $10^{-35} m$ most all would agree that this is a viable statement. In a manner of speaking, we have essentially lucked our way into a nearly correct value of the fundamental unit of length.

What does this mean for the Planck Mass? In dimensional analysis, the Planck Mass is derived through a ratio of $h\text{-}bar/G$. Therefore, if $h\text{-}bar$ and G have inversely proportional – non-unity – values, the Planck Mass – as currently defined – is not a fundamental quantum mass. It also suggests that a fundamental quantum mass must exist. If not, the gravitational force would either be infinite or non-existent. Neither of these cases exist, therefore there must be some mass associated with the small force of gravity.

At this point you typically get stuck. Without any additional information you can select any mass you want as the "Planck Mass". That is, all inversely proportional values of h and G satisfy the dimensional analysis as long as $G \times h = 1$ (within a factor of 2π or so). Therefore, some additional information is necessary if a universally accepted Fundamental Mass is to be derived.

The IWPD Research Center has found that when:

$$F = G\frac{M_1 M_2}{d^2}$$

is expressed in terms of velocity squared:

$$v^2 = \frac{2GM}{d} \qquad \text{EQUATION 1}$$

it is equivalent to the expression:

$$v^2 = 1 - \frac{1}{\left[1 + \left(\frac{1}{2\pi\lambda}\right)\left(\frac{M}{d}\right)\right]^2} \qquad \text{EQUATION 2}$$

Where λ is the wavelength of the fundamental mass.

The full derivation of EQ 2 was published in 2005 [2]. Simply speaking, the relationship between EQ 1 and EQ 2 is based on the Pythagorean Theorem:

$$b^2 = c^2 - a^2$$

and considers that when c is constrained to 1 and as a approaches 1 it is true for b that:

$$b^2 = 2x = 1 - \frac{1}{(1+x)^2}$$

Where for this specific application:

$$x = \frac{GM}{d} = \left(\frac{1}{2\pi\lambda}\right)\left(\frac{M}{d}\right)$$

As the value of x increases, EQ 1 and EQ 2 begin to diverge with EQ 2 correctly taking into account the influence of relativistic effects on velocity.

The significance of EQ 2 is that it establishes a wavelength for the fundamental mass. The fundamental mass may be set at any value and therefore EQ 2 does not – in and of itself – provide any insight into a true intrinsic fundamental mass.

However, of key significance, it can also be shown that for any chosen Planck Mass, the value of $1/2\pi\lambda$ is equivalent to the gravitational constant G. Also, for a truly intrinsic fundamental mass of unity (m_f), it is known that:

$$m_f c = \frac{h}{\lambda_f}$$

and since both m_f and c are equal to unity, it follows that:

$$\lambda_f = h$$

Thus defining the wavelength of a truly intrinsic fundamental mass as being equivalent to Planck's Constant.

Therefore we have an exactly defined inverse relationship between the values of G and h that also clearly defines the "fuzzy" aspect regarding the application of 2π. The relationship is:

$$G = \frac{1}{2\pi h}$$

This relationship is achievable for all and should be agreeable to intelligent life anywhere in the universe. That is, there is no arbitrary assignment of unity, but rather a universal relationship between the intrinsic values for both G and h. As such the truly intrinsic fundamental length has a value of:

$$(2\pi)(7.41\times10^{-28}\,m/kg)(2.21\times10^{-42}\,kg\cdot m) = 1$$

$$1.01\times10^{-34}\,m = Length_{Fundamental}$$

Which differs from the current Planck Length by a factor of either 2π or $(2\pi)^2$.

It is also of key significance to note that Equation 2 completely describes electrostatic force by increasing the value of the constant $1/2\pi\lambda$ by a factor of 4.2×10^{42}. This is effectively achieved by decreasing the associated wavelength by the same factor of 4.2×10^{42} and suggests that the mass associated with the wavelength must be 4.2×10^{42} times larger than the intrinsic fundamental mass.

Furthermore, when the value of $1/2\pi\lambda$ is adjusted for electrostatic force it becomes equal to *k*. Therefore, a relationship exists between the relative values of the constants (*G and k*) and the value of the wavelengths associated with those constants. Just as *k* is 4.2×10^{42} times larger than G in a comparison between electrons, the mass associated with the wavelength for the constant *k* must be 4.2×10^{42} times larger than the intrinsic fundamental mass. Therefore, the intrinsic value of the electric charge carried by an electron must be 4.2×10^{42} times larger than the intrinsic value of the fundamental mass, which by definition is unity.

This requires that:

$$\frac{h^2}{\left(4.2\times10^{42}\right)^3}=137$$

and provides a truly intrinsic value for Planck's Constant – agreeable throughout the universe – of:

$$h=1.0\times10^{65}$$

From

$$h=\frac{1}{2\pi G}$$

It follows that the truly intrinsic value for the Gravitational Constant is:

$$G=1.6\times10^{-66}$$

And thus, the truly intrinsic fundamental mass is:

$$\frac{h\text{-}bar}{G}=\frac{\left(2.21\times10^{-42}\,kg\cdot m\right)}{(2\pi)\left(7.41\times10^{-28}\,m/kg\right)}=1\times10^{130}$$

$$\sqrt{4.75x10^{-146}\,kg^2}=1$$

$$2.18\times10^{-73}\,kg=Mass_{Fundamental}$$

This intrinsic Fundamental Mass represents a truly fundamental quantum of mass and suggests that all mass is comprised of multiples of this mass, just as Planck Length can be viewed as the quantum "building block" for all distances. What then is the meaning of the "traditional" Planck Mass? We believe that the traditional Planck Mass can be shown to be the largest possible mass of a single photon. Conversely, the intrinsic Fundamental Mass represents the smallest possible mass of a single photon.

Further, it can be argued that all energy is quantized not only within its natural wavelength, but also between allowable wavelengths. That is, energies – and their corresponding wavelengths – exist as multiples of the intrinsic Fundamental Mass, which has been dubbed by the IWPD Research Center as the "energime" [3].

While this may be considered a speculative notion, it must be noted that the derivation of these fundamental units are based solely on a progression of logical arguments. Barring a flaw in the logic, the results are far from speculative and suggest that a new era of fundamental units and measurement may be upon us.

REFERENCES

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3. *Ibid.,p. 1-2*