**Physics Journal**
Vol. 2, No. 1, 2016, pp. 54-60
http://www.aiscience.org/journal/pj

# Crenel Physics, a Model to Address Gravity

**Hans van Kessel***

Independent Scholar, Rijswijk, Netherlands

## Abstract

Nature surprises in the found symmetry of elementary particles. However, such symmetry is a strong indication that our models and units of measurement are overlapping, thereby blurring the fundamentals. One way to straighten that out is to fundamentally rework our systems of units of measurement, bottom up. Such effort is not new, and referred to as 'normalization'. The only strongholds one thereby has are the universal natural constants, and mathematical procedures and constants such as '$e$' and '$\pi$', which also are universal. This manuscript starts with describing such a 'normalization' procedure of units of measurement, and it was named *Crenel Physics* (to avoid confusion). It quickly and smoothly results in the Crenel Physics counterparts of some key Planck units of measurement, and thereby shows its consistency with 'main stream physics'. Subsequently it embeds Boltzmann's equation $S = k_B.\ln(w)$ into the model. Key thereby is that minimum detectable particles must have an entropy value of 2 bits or 3 bits. These elementary particles have been named 'entropy atoms'. Entropy atoms lie at the basis of a third 'content' dimension, on top of 'mass' and 'energy'. The implication thereof is overlap in currently recognized 'universal natural constants'. This is expressed in the following found relationship: $G = \frac{h}{k_B} \times \ln(4)$ Thereby, Boltzmann's constant $k_B$ is to be expressed in the Energy/Temperature unit of measurement. In the S.I. system of units of measurement that would be J/K. The thus found gravitational constant $G$ is 0.3% below its numerical value as found in literature. However, the here found value is only valid between 2-bit entropy atoms. At this point, the model still leaves open several options to find higher values of 'G' between more complex objects. Thereby the gravitational constant remains a universal natural constant, but the gravitational equation demands a correction term. The magnitude of that correction term still needs to be explored, albeit that the underlying conceptual mechanism has been identified. Because this manuscript is authentic, there are only few references. Most of these refer to earlier publications of the author.

## Keywords

Gravity, Elementary Particle, Orbiting, Entropy Atom, Boltzmann Gravity

Received: August 31, 2015 / Accepted: October 31, 2015 / Published online: January 11, 2016



## 1. Normalizing Units of Measurement (UoM)

Physics describes nature in terms of Units of Measurement (UoM). For the latter, the Metric S.I. system is generally used. This system defines the meter, second, kilogram and Joule as 'base'. These are however not 'base' because the S.I. system embeds overlap. This blurs the true fundamentals of physics: these are hard to find.

Consider Einstein's equation $E = m.c^2$, which can be rewritten as: $c^2 = {}^{E}/_{m}$. Per this equation the UoM for $c^2$ equals ${}^{J}/_{kg}$, and therefore the UoM for light velocity $c$ equals $\sqrt{{}^{J}/_{kg}}$. Or: the light velocity equals $1\left[\sqrt{{}^{J}/_{kg}}\right]$. However, in practice velocity is not expressed in $\sqrt{{}^{J}/_{kg}}$. It is expressed in ${}^{m}/_{s}$. Thereby, one $\sqrt{{}^{J}/_{kg}}$ is equal to

* Corresponding author
E-mail address: hans.vankessel@upbound.com

299792458 $m/_s$. This is just one example of the overlap, which is historically grown.

Efforts to straighten out the system of UoM are not new. Such process is referred to as 'normalization'. A –probably- first proposal was made in 1881 by George Johnstone Stoney (see reference 1). Today, 'Planck units' are commonly used, the initiation of which was proposed by Max Planck in 1899 (see reference 2).

Here, we will produce a new normalization procedure. To avoid confusion between Metric units and our new system of UoM we will refer to the latter as *'Crenel Physics'* as opposed to 'Metric Physics'.

We start the *Crenel Physics* normalization with an evaluation of the bottom line of Einstein's equation $E = m.c^2$. It delivers a universal way to convert mass into energy, valid within any system of UoM. Of course energy and mass are two totally different appearances for which we need (and have) different sensors. But given the fact that nowadays we can physically convert back and forth between mass and energy, there is a good argument to consider both properties as separate and independent dimensions of something more fundamental underneath. That something is to be associated with 'content'. Obviously all observable physical objects have 'content', and that content can reveal itself as mass or as energy (and other ways). A photon is the ultimate example for recognizing the issue at hand: we can measure its 'content' either by absorbing/measuring its contained energy or by measuring its impulse force and thereby mass when it hits a target. Because of Einstein's equation, at bottom line we only need one single measure for 'content'. It will be named '*Package*' (symbol '*P*'). Thus in *Crenel Physics* both 'mass' as well as 'energy' will be expressed in *Packages* (just like we express both the X-coordinate as well as the Y-coordinate in an XY plane in a shared underlying UoM for distance: the meter).

Consequently, the conversion factor $c^2$ between mass and energy is normalized to a dimensionless 1. And thereby '*c*' is equal to the dimensionless 1:

$$c_{CP} \equiv 1 \tag{1.1}$$

The subscript '*CP*' in the above indicates that this is the *Crenel Physics* version of light velocity '*c*'.

This makes 'velocity' a dimensionless property: velocity is expressed as a fraction of light velocity '$c_{CP}$' and ranges from 0 to 1. In Metric Physics velocity is expressed in m/s, and therefore in *Crenel Physics*, to arrive to the dimensionless measure for velocity, the unit of measurement for distance must unavoidably be equal to the unit of measurement for time. As mass and energy were considered to be dimensions of something more fundamental underneath (named the *Package*) here we have the same issue at hand: there must be something more fundamental underneath distance and time, and we need a measure for it. That measure will be named '*Crenel*' (symbol '*C*'). Thus in *Crenel Physics* both 'distance' as well as 'time' will be expressed in *Crenel*. Where the *Package* is used to express the 'content' of a body, the *Crenel* is used to address its *whereabouts* in terms of space and time.

Note: the name Crenel is associated with crenels as found on top of castle walls. That shape has a pattern that can be associated with both 'distance' as well as 'frequency' (and thereby 'time').

In Metric Physics acceleration '$a$' is expressed in $m/s^2$. Therefore, in *Crenel Physics* acceleration is expressed in $C/C^2$ which can be simplified to $C^{-1}$. Based on Newton's law $F = m.a$, force F is measured in $kg.m/s^2$, which unit of measurement converts to $P.C/C^2 = P/C$. From the gravitational equation $F = G.\frac{M_1.M_2}{d^2}$ we can now derive the value of the gravitational constant *G* in *Crenel Physics*: $G = \frac{F.d^2}{M_1.M_2}$. In this equation we substitute the associated *Crenel Physics* units of measurement: $G = \frac{\frac{P}{C}.C^2}{P.P} = {}^{C}/_{P}$. Thus:

$$G_{CP} \equiv \frac{C}{P} \tag{1.2}$$

As in equation (1.1), the subscript '*CP*' in the above indicates that this is the *Crenel Physics* version of the gravitational constant '*G*'.

We can also blend Planck's equation $E = h.v$ into the model. In this equation energy *'E'* is to be expressed in *Packages*, and frequency $'v'$ is expressed in $Crenel^{-1}$ (the Crenel Physics counterpart of $seconds^{-1}$). This gives the *Crenel Physics* version of Planck's constant '*h*':

$$h_{CP} \equiv 1\ C.P \tag{1.3}$$

With three natural constants $c_{CP}$, $G_{CP}$ and $h_{CP}$ defined, we thereby have three equations that relate their respective values to their Metric counterparts:

$$1\ (\text{dimensionless}) = c\ (m.s^{-1}) \tag{1.4}$$

$$1\ P.C = h\ (N.m.s) \tag{1.5}$$

$$1\ C.P^{-1} = G\ (Nm^2kg^{-2}) \tag{1.6}$$

Thereby, the left sides of the equations express the natural constant in *Crenel Physics* UoM, whereas the right sides express these in Metric UoM. From these three equations one can extract *P* and *C*, and express these in Metric UoM as follows (note: for readability the following has been copied from reference 5):

In equation (1.5) the symbol 's' in the UoM can be replaced by 'c m' because in Metric Physics 1 second corresponds to 'c' meters. Equation (1.5) can then be written as:

$$1.P.C = h.c \ (N.m^2) \qquad (1.7)$$

Based on Einstein's $E=m.c^2$, 1 kg corresponds to $c^2$ Joules or $c^2$ (N.m). In equation (1.6) the $kg^{-2}$ in the UoM can therefore be replaced by $c^{-4}$ ($N^{-2}.m^{-2}$):

$$1 \ C.P^{-1} = G.c^{-4} \ (N.m^2.N^{-2}m^{-2}) = G.c^{-4} \ (N^{-1}) \qquad (1.8)$$

Dividing equation (1.7) by equation (1.8) gives:

$$P^2 = \frac{h.c^5}{G} \ (N^2.m^2) = \frac{h.c^5}{G} \ (Joule^2)$$

Or:

$$1 \ Package = \sqrt{\frac{h.c^5}{G}} \ Joule = 4.90333830\text{E+09 Joule} \qquad (1.9)$$

Because 1 Joule equals $c^{-2}$ kg:

$$1 \ Package = \sqrt{\frac{h.c}{G}} \ kg = 5.45569963\text{E-08 kg} \qquad (1.10)$$

Based on $E = h.\upsilon$, equation (1.9) can be converted to frequency (in $seconds^{-1}$):

$$1 \ Package = \sqrt{\frac{h.c^5}{G}} \times \frac{1}{h} \ (s^{-1}) = \sqrt{\frac{c^5}{h.G}} \ (s^{-1})$$

or:

$$1 \ Package = \sqrt{\frac{c^5}{h.G}} \ Hertz = 7.40007065\text{E+42 Hz} \qquad (1.11)$$

Multiplying equation (1.7) with equation (1.8) gives:

$$C^2 = \frac{h.G}{c^3} \ (meter^2)$$

Or:

$$1 \ Crenel = \sqrt{\frac{h.G}{c^3}} \ meter = 4.05121075\text{E-35 m} \qquad (1.12)$$

And, because one meter corresponds to $c^{-1}$ seconds:

$$1 \ Crenel = \sqrt{\frac{h.G}{c^5}} \ seconds = 1.35133845\text{E-43 s} \qquad (1.13)$$

Equations (1.9) through (1.13) show resemblance with the well-known Planck's natural UoM's. Albeit that the above equations hold Planck's constant '$h$', whereas Planck's UoM's –as found in literature- hold the 'reduced Planck constant 'h/2.π' (for which symbol '$\hbar$' is used). The above conversion results demonstrate that in setting up a leaner system of units of measurement –based on *Crenel* and *Package* only- we nevertheless delivered an unambiguous (that is: non-relativistic) set of measures for the mass, energy, frequency, time and distance dimensions.

Above results thereby salute the well-known Planck UoM's. The difference is explained by *Crenel Physics* being frequency based, whereas Planck's UoM's are based on an *angular* frequency. Crenel Physics thereby applies Planck's equation also to a binary system that flip-flops at some frequency (this will be addressed later).

By using equations (1.9) through (1.13), within the Crenel Physics model, the dimensions energy, mass, frequency, distance and time can likewise be spanned, but the equations can then be simplified because here c=1. This gives the following conversion factors, which can be considered to be 'Crenel Physics Planck UoM's' that only apply to the *Crenel Physics* model:

$$1 \ Package = \sqrt{\frac{h}{G}} \ Crenel \ Physics \ Energy \ Units \qquad (CP1.14)$$

$$1 \ Package = \sqrt{\frac{h}{G}} \ Crenel \ Physics \ Mass \ Units \qquad (CP1.15)$$

$$1 \ Package = \sqrt{\frac{1}{h.G}} \ Crenel \ Physics \ Frequency \ Units \qquad (CP1.16)$$

$$1 \ Crenel = \sqrt{h.G} \ Crenel \ Physics \ Distance \ Units \qquad (CP1.17)$$

$$1 \ Crenel = \sqrt{h.G} \ Crenel \ Physics \ Time \ Units \qquad (CP1.18)$$

Note that the equation numbers are preceded by 'CP', to indicate that these equations are only valid in the *Crenel Physics* system of UoM (or for that matter: also in any other system in which light velocity 'c' has been normalized to a dimensionless 1).

In particular equation (CP1.16) is of interest: it allows *Packages* to be expressed in the frequency UoM. That same UoM (for frequency) is also equal to the *Crenel*$^{-1}$. Thus, by inverting this UoM (a mathematical and thus universal procedure) we get the *Crenel*. To see the implication thereof, we review the procedure to convert 'content' (in Packages, for 'mass' and 'energy' alike per equations CP1.14 and CP1.15) to 'whereabouts' (in Crenel, for 'distance' and 'time' alike per equations CP1.17 and CP1.18).

That conversion procedure consists of two steps:

1. INVERT (the conversion factor)…. this gives $\sqrt{\frac{G}{h}}$
2. MULTIPLY the result with Planck's constant 'h'…. this gives $\sqrt{h.G}$, which matches (CP1.17) and (CP1.18).

The remarkable and typical point is, that the exact same conversion procedure can be used to re-convert 'whereabouts' (expressed in *Crenel*) into 'content' (expressed in *Packages*):

1. INVERT (the conversion factor)…. this gives $\sqrt{\frac{1}{hG}}$
2. MULTIPLY the result with Planck's constant 'h'…. this gives $\sqrt{\frac{h}{G}}$, which matches (CP1.14) and (CP1.15).

Mathematically, the fail-safe approach to re-convert to the original would be to undo each conversion step in reverse order. Here that would be: first divide by Planck's constant (to undo step 2), and then invert the result (to undo step 1, note that the invert of the invert produces the original). But in this special case –as said- the above given conversion procedure works *both* ways. Or: by applying the conversion procedure twice, the original result is obtained. This is regardless whether one starts with the *Package* or with the *Crenel*. Consequently, applying the conversion procedure twice has the same impact as a multiplication by a dimensionless 1. Mathematically, a single conversion procedure can therefore be compared with multiplying it's source (Package or Crenel) with complex number 'i' = $\sqrt{-1}$: thereby, $i^2$ =1.

The fact that the UoM for 'content' and 'whereabouts' can be converted back and forth into each other by multiplying with complex number 'i' (=$\sqrt{-1}$) leads to the conclusion that the *Package* UoM and the *Crenel* UoM themselves construct their own arena. Here, they shape two dimensions of something more fundamental underneath. It is Planck's equation $E = h.\upsilon$ that lies at the root of this shaping: the left term in this equation ('E') is a dimension in the 'content' arena, whereas the frequency ('$\upsilon$') in the right term of the equation represents (via the mathematical procedure of inversion) the 'whereabouts' arena. That 'something more fundamental underneath' is the bottom line of *Crenel Physics*, and therefore must be set equal to unity: the dimensionless 1. And in Crenel Physics this dimensionless 1 represents the universal natural constant 'c'. *Package* ('contents') and *Crenel* ('whereabouts') thus represent the Yin and Yang of physics. However, they are not opposite to each other, but reciprocal to each other, with Planck's constant as intermediate.

Other than e.g. 'mass' and 'energy' being two totally independent dimensions of the *Package*, which thus can be modelled as two orthogonal unit vectors, 'content' and 'whereabouts' are not completely independent to each other. Per Einstein's theory, space is 'curved' (perhaps 'compressed' is a better word) to some extend when mass is around. In the *Crenel Physics* model this must be reflected in that the *Package* and *Crenel* UoM vectors are not exactly orthogonal. Thus, the 'whereabouts' have a 'content' component, and vice versa. One can envision this by assuming a spatial transition zone between 'content' and 'whereabouts', whereby 'content' is inversed 'whereabouts'. This issue will be re-addressed later, but will be ignored for now.

## 2. Boltzmann and the Entropy Atom

Boltzmann's equation…

$$S = k_B.\ln(w) \quad (2.1)$$

…specifies the entropy '*S*' of a body. Entropy is a measure for a body's complexity. Parameter 'w' equals the number of states in which a body can reside.

In Metric Physics entropy is expressed in various UoM, from macroscopic (such as J/K and Hz/K) to microscopic (such as 'bit' and 'nat'). Per UoM there is an associated value for Boltzmann's constant $k_B$. The –to Crenel Physics-most relevant values (as generally known, and can be found in e.g. Wikipedia) are:

$k_B$=1.3806488 x $10^{-23}$J/K

$k_B$=2.0836618 x $10^{10}$Hz/K

$k_B$=1.442695bit

$k_B$=1nat

In all cases the same underlying physical fact is addressed. Consequently there is an unambiguous relationship between all versions of $k_B$. Let's explore this.

When we apply Boltzmann's equation to a row of 'n' coins, recognizing that each coin has two states, we end up with the equation S= $k_B$.ln($2^n$)=$k_B$.n.ln(2). The factor 'ln(2)' in the equation is in recognition of 'w' being equal to 2 when it comes to coins. We thereby used the 'nat' as the unit of measurement for entropy, and therefore in this equation: $k_B$ = 1 'nat' (the 'nat' stands for the natural logarithm). Alternatively, we can express the entropy in 'bit'. In that case the equation simplifies to S= $k_B$.n, whereby $k_B$ is to be expressed in 'bit'. This explains why $k_B$ in 'nat' can be converted to $k_B$ in 'bit' by applying the conversion factor 1/ln(2). This conversion factor indeed –as expected- delivers the above listed value for $k_B$ in bit: $k_B$ = 1.442695041 bit.

The 'nat' and the 'bit' are mathematical properties. Therefore they are universally shared between Metric Physics, *Crenel Physics* and any other system of units of measurement.

To explore the relationship between the above microscopic scales ('nat' and 'bit') at the one side, and the macroscopic scales ('J/K' and 'Hz/K') at the other, we first need to introduce a UoM for temperature in *Crenel Physics* ($T_{CP}$). The common approach to define one degree of temperature is as follows:

$$1^0\, T = \frac{Unit\ of\ measurement\ for\ Energy}{k_B} \quad (2.2)$$

In the above equation (and from here onwards) it should be recognized that for $k_B$ the *energy* version of Boltzmann's constant is to be used (in SI the J/K version). In *Crenel Physics*, the *Package* is the UoM for energy. Thus, in *Crenel Physics* equation (2.2) translates to:

$$1^0\, T_{CP} = \frac{Package}{k_B} \tag{2.3}$$

By substituting equation (1.9) –the conversion from *Package* towards the 'energy' UoM - into equation (2.3) we find the conversion factor from $T_{CP}$ towards Kelvin:

$$1^0\, T_{CP} = \sqrt{\frac{h.c^5}{G.(k_B)^2}}\ \text{Kelvin} = 3.55147399\text{E+32 K} \tag{2.4}$$

Note: the above conversion factor (as all the earlier found conversion factors) is equal to the 'Planck temperature', apart from Plank's constant *'h'* being used instead of the reduced Planck constant '$\hbar$'.

Again, for the Crenel Physics model, the equation can be simplified by substituting a dimensionless 1 for parameter 'c':

$$1^0\, T_{CP} = \sqrt{\frac{h}{G.(k_B)^2}} \tag{CP2.5}$$

(Again, note the equation number is preceded by 'CP' to indicate this equation is only valid in the Crenel Physics model).

To convert $k_B$ from 'nat' into 'Hz/K' one needs to divide the *Crenel Physics* conversion factor from *Package* towards Hz per equation (1.11) (= 7.40007065 x $10^{42}$ Hz) by the conversion factor from $T_{CP}$ towards Kelvin per equation (2.4) (= 3.55147399 x $10^{32}$ Kelvin). This division gives a value 2.0836618 x $10^{10}$, which (as to be expected) indeed and exactly matches the above listed macroscopic value for $k_B$ in Hz/K.

Finally, $k_B$ in J/K can be found by multiplying the Hz/K value by 'h', which conversion is based on Planck's equation: $E = h.\upsilon$.

The above demonstrates the unambiguous connection between microscopic entropy and macroscopic entropy. Key thereby is that in general per equation (2.3) the temperature scale is based on the 'nat' ($k_B$= 1 nat), which is a mathematical property, thus can be universally shared between all systems of UoM, just like the mathematical constants '$\pi$' and 'e'. Furthermore, the above demonstrates that the followed approach connects the temperature scale to Planck's energy UoM.

Equation (2.3) embeds a third dimension in the arena of 'content' (besides 'mass' and 'energy'). For this, the equation can be rewritten as:

$$Package = k_B \times T_{CP} \tag{CP2.6}$$

If we substitute (CP2.5) into (CP2.6) the result is:

$$Package = k_B \times T_{CP} = k_B\sqrt{\frac{h}{G.(k_B)^2}} = \sqrt{\frac{h}{G}} \tag{CP2.7}$$

This yardstick is equal to the yardsticks for 'mass' and 'energy' per equations (CP1.14) and (CP1.15). The Boltzmann equation (2.1) delivers via equation (CP2.6) a third –entropy based- dimension in the 'content' arena, and the yardstick of this third dimension per equation (CP2.7) is consistent and doesn't demand a correction factor. For dimensional verification the Crenel Physics versions of '$h$' (= C.P) and '$G$' (=C/P) can be substituted (see equations (1.2) and (1.3)) in the above equation.

However, via the 'temperature' route Boltzmann gives a second way to determine the 'content' of an elementary particle: 'content' is found by multiplying a particles temperature with its entropy. Note that this temperature is not to be confused with the macroscopic temperature of an ensemble of elementary particles: in our *Crenel Physics* model the temperature of e.g. a photon is at hand. A photon doesn't equalize its temperature when it is crossing a gas filled room: 'temperature' is an embedded property of a photon. This second way says that an elementary particle with a temperature of $1^0$ $T_{CP}$ (the *Crenel Physics* version of one unit of Planck temperature) multiplied with one 'base entropy' UoM delivers an object with a content of 1 *Package*. Therefore, the prime question at hand is: what is the value of one 'base entropy'? Or: what does an elementary –observable- particle look like?

To answer that question, the key consideration is that when we consider 'content' we thereby implicitly refer to *observable* 'content'. This demands that the object at hand must be able to exchange *information* with some sort of sensor, even when it is placed in an otherwise empty space. This demand for observability requires some minimum complexity (= entropy). Let's explore this bottom up. An object with an entropy value of 1 bit would not be detectable. That bit couldn't change its status because the conservation law prohibits it from doing that: per conservation principle any change of a parameter (here the single bit changing its status from e.g. 0 to 1) must be compensated, and there is nothing in it or around it to do that. Therefore, single bit objects might exist, but these cannot be part of the detectable 'content' world. This is different for an object with an entropy value of 2 bits. In such object, when one bit flips the other can flop to compensate. The frequency thereof is to be associated with Planck's law: $E = h.\upsilon$. Note: such binary flip-flopping (rather than some harmonic oscillation) is the prime reason why *Crenel Physics* has been frequency based, rather than *angular* frequency based. Thus, 2-bit objects (bi-bits) are the smallest possible observable objects, and their scale of magnitude is *entropy* based. Such bi-bit objects are '*entropy atoms*', whereby the word 'atom' is used in its originally intended way: it cannot be reduced further without disappearing from the detectable world.

Next step up would be a tri-bit. Where a bi-bit can only flip-flop between two bits A and B, in case of a tri-bit a logical 1 (or 0) circulates around bits A, B and C. This circulation can be in the sequence ABC-ABC-ABC (or: 100-010-001-100-etcetera, the '1' moves to the right), or alternatively in the sequence ACB-ACB-ACB (or: 001-010-100-001-etcetera, the '1' moves to the left). This can be associated with a *spin*, for which there are the two shown options: left or right. 'Spin' thus is an additional elementary particle property that is frequency modulated on top of a base frequency within a tri-bit. Thus, tri-bits have a spin, whereas bi-bits do not have a spin. A 4-bit or higher object is not elementary in the model, as it is composed of a combination of bi-bits and/or tri-bits, and thus is dividable.

In conclusion: there are two types of *entropy atoms*: bi-bits (no spin) and tri-bits (2 spin options).

Per *Crenel Physics* model any observable object must be composed of these smallest observable objects, that is: of *entropy atoms*.

Photons are bi-bit entropy atoms, see reference 3. In this publication photons are modeled as a circle section with one bit at each end (perhaps compatible to a 'string'). The chord length of that circle section has been found constant for all photon energy's and equals one Planck length (or: 1/2π Crenel). The more the circle section is curled up, the higher the photons 'content'. The model thereby predicts a maximum content of 229 GeV/$c^2$.

Because the *entropy atom* is defined in terms of bits (a universal mathematical property), it is a universal and non-relativistic entity. Its 'content' however is relativistic.

Based on the above, the *entropy atom* represents the searched for 'base entropy'. We will now define the earlier searched 'base entropy' to equal two bits, thereby temporarily ignoring the 3-bit version of the *entropy atom*. The searched for base entropy is then equal to $\ln(2^2)=\ln(4)$ 'nat' (the 'nat' is the universal base unit for Boltzmann's constant). Thus, alternatively to equation (CP2.7), the UoM for the content of the smallest observable object (the bi-bit), expressed as 1 *Package*, can alternatively to equation (CP2.7) also be found by multiplying the base entropy ln(4) with the temperature UoM:

$$Package = \sqrt{\frac{h}{G.(k_B)^2}} \times \ln(4) \qquad \text{(CP2.8)}$$

We didn't give a name to this Boltzmann based third dimension of the *Package* (besides the already defined dimensions mass and energy). A proper name would be '*Information Temperature*'. What we are looking at here, is a frequency (or: bit stream of information) that represents the underlying 'content'. Both equation (CP2.7) and (CP2.8) represent the length of a unit vector along the '*Information Temperature*' dimension, which (as CP2.7 shows) is of equal length to the unit vectors along the mass and/or energy dimension per (CP1.14) and (CP1.15).

The bottom line of our reasoning is that along this third dimension, per equation (CP2.7), in order to restrict ourselves to observable particles only, we shouldn't use Boltzmann's constant $k_B$, but instead $k_B/ln(4)$, which then delivers equation (CP2.8).

We can now span a two dimensional *Package* space with any pair of these three unit vectors per equations (CP1.14) (CP1.15) and (CP2.8). Such two dimensional space has the dimension $Package^2$, and –presuming orthogonal vectors- the surface of such 2-dimensional area would be 1 $Package^2$.

Compare the yardstick *Package* to the yardstick 'meter'. We can span a Cartesian three dimensional space XYZ, using this underlying 'meter' as unit vector length. Multiplying e.g. the 'X' and 'Z' unit vectors then defines a $meter^2$.

Such multiplication of unit vectors (CP1.14) and (CP2.8) delivers:

$$\sqrt{\frac{h}{G}} \times \sqrt{\frac{h}{G.(k_B)^2}} \times \ln(4) = 1\,(Package^2) \qquad \text{(CP2.9)}$$

This can be rewritten as:

$$1\,(Package^2) = \frac{h}{k_{B.}G} \times \ln(4) \qquad \text{(CP2.10)}$$

This result comes forth from the *Crenel Physics* model, and involves a relationship between the 3 universal natural constants that shape this equation. Such relationship is of fundamental importance to physics. Although it comes forth from the *Crenel Physics* model and system of UoM, it must be valid in any system of UoM including the Metric SI system. Thereby, as said, the *energy* version of Boltzmann's constant is to be applied because the temperature scale in *Crenel Physics* is based on that version (as it is in Metric Physics).

## 3. Verification and Discussion

Substituting the literature values for $h$ (=6.62607E-34) and $k_B$ (=1.38065E-23), and ln(4) =1.38629 in equation (CP2.10) gives a calculated value for $G$:

$$G = \frac{6.62607\text{E}-34}{1.38065\text{E}-23} \times 1.38629 = 6.6531\text{E}-11 \qquad (3.1)$$

The literature value of $G$ is 6.67-E11. Thus, equation (CP2.10) undershoots the literature value by about 0.3%. There is however ongoing debate about the accuracy of this value for *G*. For the Crenel Physics model it thereby is of key relevance that in practice *G* was measured e.g. by using a torsion balance, or in general: all measurements of G involve interaction between ensembles of *entropy atoms* rather than between elementary particles, as is the case in the *Crenel Physics* model. For ensembles, the Crenel Physics model includes a temperature dependent (extra) component, see reference 4. However, this component could not yet be quantified.

Following presumptions have been made in the *Crenel Physics* model:

1. *Package* and *Crenel* were presumed to be *orthogonal* dimensions of 'unity' (= light velocity). Because 'space' is curved when 'content' is around, this independency cannot be exactly true. The relevance is that the third *Package* dimension '*Information Temperature*' is related to the *Crenel* (= time scale).
2. For equation (2.11) the universe has been presumed to be constructed of bi-bits only, where tri-bits are also a valid option. Bi-bits have an entropy of ln(4) = 1.386, tri-bits have an entropy of $\ln(2^3)=\ln(8)$ = 2.079. By simply applying Boltzmann's theory, equation (3.1) would lead to a higher value of G, should a certain percentage of tri-bits be present. However, one must consider that both bi-bits as well as tri-bits relay nothing but a bit-stream with a bandwidth of 1 bit only, at some base frequency. In case of a bi-bit that bit stream would appear as a symmetrical periodic 101010101… etc. signal, whereas a tri-bit bit stream contains a frequency modulated element for which there are two 'spin' options.

Apart from presumption 1, equation (CP2.10) should universally hold for gravitational interaction between entropy atoms such as photons, and it should hold in any system of UoM.

# References


[1] Stoney G. On The Physical Units of Nature, Phil. Mag. 11, 381–391, 1881

[2] Planck, Max. "Über irreversible Strahlungsvorgänge", (1899)

[3] Van Kessel, Hans. The heaviest possible elementary particle, (July 2015), http://vixra.org/abs/1507.0182. Note: this publication has not been peer-reviewed.

[4] Van Kessel, Hans. Boltzmann Gravity, (February 2014), http://vixra.org/abs/1307.0053. Note: this publication has not been peer-reviewed.

[5] Van Kessel, Hans. Crenel Physics (August 2014), http://vixra.org/abs/1408.0142. Note: this publication has not been peer-reviewed.