# The Intrinsic Structure of the Quantities

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## Real mathematics

At high school I wondered why differentiating acceleration gives velocity and why differentiating velocity gives distance and why differentiating the surface of a disc gives the circumference. There must be a deep relationship between all the quantities. And not until I studied biology I learned about complex numbers. I became convinced that complex numbers must be very natural just like the number 'zero' and negative numbers are. A few years ago I read about hypercomplex number systems like quaternions, octonions, Grassmann numbers en Clifford algebra. But which numbers systems are seen in nature and which ones are not? I became also convinced that nature and mathematics must be very close intertwined. The mathematics according to which physics is composed I will refere to as *real mathematics*. Ultimately physics will provide emperical input to confirm what the *real mathematics* is. Ofcourse we can use other kinds of math for different things, but real mathematics must be inherently true and in that sense be different from and limiting the other possible mathematical algebras. I believe that *proportional imaginairy quantities* are the key. They are the elements of the hypercomplex. **The physical equations have their origin in and are limited by this intrinsic structure.** How can we discover this intrinsic structure?

## Dimensionality

In a quantity table cells next to each other differ by length and cells below each other differ by time (or velocity). We can make for example a $kg^1 m^x s^y$-table with energy, momentum, mass, power, force and pressure. Physical quantities can be brought back into at least 7 of such quantity tables. All quantities with 'charge' like mass and electric charge, although different dimensions, have something in common. I named it '*dimensionality*', which slightly extends the concept of 'dimension' used in dimensional analyses. I put all quantities with the same dimensionality together. In this way all physical quantities are merged into one table, the *main quantity table*, defined by only two arbitrary dimensionalities.

From this merging, and this is very interesting, we get a column called the *main sequence* of the quantities. It's composed of respectively time, length, mass, momentum and energy. The quantities in this main sequence can be divided into two groups. A group with 'marble' quantities (time and length) and a group with 'wooden' quantities (energy, momentum and mass). Empty places in those groups argued for an extention of the number of quantities. The group with time and length is extended with respectively *gmflux*, *burst* and *valention*. The group with energy, momentum and mass is extended with respectively *string* and *instant*. Two quantities with the same dimensionality I will call *counterparts*. Time and instant are counterparts of each other. Other pairs are: length and string, gmflux and mass, burst and momentum, valention and energy.

## Scalar and vector quantities

Time, mass, energy, electric current, electric charge and pressure are *scalar quantities*. Length, velocity, acceleration, momentum and force are *vector quantities*. In the main quantity table it looks like that scalar and vector quantities alternate. So the table looks like a checkerboard. I suggest that this is not by accident. This argument will hold in most cases. At least it holds for the main sequence and the idea of a main sequence is important. Time, mass and energy are scalar quantities. Length and momentum are vector quantities. Therefore valention, gmflux and instant will also be scalar quantities. And burst and string will be vector quantities.

## The metrics of the gravitomagnetic system

The relativistic energy-momentum equation:

$$E^2c^{-4} - p_x^2c^{-2} - p_y^2c^{-2} - p_z^2c^{-2} = m^2$$

My first try was to write the Minkowski metric just like the relativistic energy momentum equation i.e. the invariant of spacetime is gmflux:

$$t^2c^4 - l_x^2c^2 - l_y^2c^2 - l_z^2c^2 = f^2$$

From:

$$F = m \cdot a \quad \text{and} \quad F = G \cdot \frac{(m \cdot m)}{r^2}.$$

We can derive the proportional equation of length $l$:

$$l = \frac{G}{c^2} \cdot m.$$

and because $\frac{l}{c} = gmflux$ we get: $gmflux = \frac{G}{c}\ mass.$

Using this last equation, we can combine then energy-momentum equation and the Minkowski metric into:

$$t^2c^4 - l^2c^2 = \left(\frac{G}{c}\right)^2 (E^2c^{-4} - p^2c^{-2})$$

In the meantime I discovered that because of symmetry the invariant of spacetime is identified as being composed of two quantities: gravitomagnetic flux f and burst b. Thus the *extended Minkowski metric* is composed of 8 dimensions of which only three spatial: $t^2 - l^2 = f^2 - b^2$. In the energy-momentum equation, I found that mass is also composed of two different quantities: rest-mass m and string s. This results in the *extended energy-momentum equation* composed of 8 dimensions: $E^2 - p^2 = m^2 - s^2$. After I discovered the extended Minkowski metric and the extended relativistic energy-momentum equation, I wrote:

$$t^2c^4 - l^2c^2 + b^2c^{-2} = \left(\frac{G}{c}\right)^2 (E^2c^{-4} - p^2c^{-2} + s^2c^2)$$

This equation is not symmetrical, it would be more symmetrical in the following form:

$$t^2c^4 - l^2c^2 + b^2c^{-2} - f^2 = \left(\frac{G}{c}\right)^2 (E^2c^{-4} - p^2c^{-2} + s^2c^2 - m^2)$$

Or written as the *general metric* composed of 16 quantities (8 positive, 8 negative). :

$$f^2 + l_x^2c^2 + l_y^2c^2 + l_z^2c^2 + E^2\frac{G^2}{c^6} + s_x^2G^2 + s_y^2G^2 + s_z^2G^2 \ =$$
$$t^2c^4 + \frac{b_x^2}{c^2} + \frac{b_y^2}{c^2} + \frac{b_z^2}{c^2} + m^2\frac{G^2}{c^2} + p_x^2\frac{G^2}{c^4} + p_y^2\frac{G^2}{c^4} + p_z^2\frac{G^2}{c^4}$$

The general metric is a 16-dimensional background-independent relativistic metric. The predictions made by the *general metric* will be different from the predictions made by the *general theory of relativity*.

For each table of the gravito-magnetic system there is a general metric. For example the table with $mass^2$, the table with mass, the table with velocity and force, the table with acceleration and the table with energy density.

## Quantities versus proportional quantities

Minkowski used the hyperbolic quaternion to describe space-time. Because of the *special theory of relativity* and especialy the work of Minkowski we can describe quantities as *proportional imaginairy quantities* [2]. Proportional quantities all have the same dimension. Here I will choose gmflux as the *positive* quantity. All other quantities of the mainsequence will have the same dimension as gmflux, that's why they are called 'proportional'. A main sequence with proportional quantities is equivalent to a main sequence with one quantity that can either be real or imaginair. So we can describe proportional quantities as complex and hypercomplex elements. In my schema *proportional velocity* is for example the dimensionless imaginary unit $-\mathbf{i}\ \frac{v}{c}$.

Both 8-dimensional metrics can be decomposed in two different ways: as the result of two opposite quaternions $(i^2 = -1)$. Second as the result of two opposite hyperbolic quaternions $(i^2 = 1)$. And the 16 dimensional general metric can also be decomposed in two differend ways: as the result of two opposite octonions and as the result of two opposite hyperbolic octonions. The vector quantities wil receive the imaginairy units: **i**, **j** and **k**. The imaginairy unit **L** is reserved for wooden quantities. In the 'non-hyperbolic' case we get the following two opposite octonions:

$$O_F = f + \mathbf{i}\ cl_x + \mathbf{j}\ cl_y + \mathbf{k}\ cl_z + \mathbf{L}\frac{G}{c^3}\ E + \mathbf{iL}Gs_x + \mathbf{jL}Gs_y + \mathbf{kL}Gs_z$$

$$O_t = -c^2t - \mathbf{i}\ \frac{b_x}{c} - \mathbf{j}\ \frac{b_y}{c} - \mathbf{k}\ \frac{b_z}{c} - \mathbf{L}\frac{G}{c}\ m - \mathbf{iL}\frac{G}{c^2}\ p_x - \mathbf{jL}\frac{G}{c^2}\ p_y - \mathbf{kL}\frac{G}{c^2}\ p_z$$

## Periodicity

We can make a table with all the proportional quantities of the mainsequence. In such a table we see that there is periodicity. The marble quantities *proportional valention* and *proportional time* have the same representation: respectively $valention/c^2$ and $time\ c^2$ are both 'negative gmflux' $-y$. Therefore I suggest that the quantity *proportional valention* in fact is the same as *proportional time*. In the same way *proportional instant* is the same as *proportional energy*. So in a sense *proportional time* and *proportional energy* are counterparts of each other.

Thus the 4 basal quantities in a main sequence convert into each other because they differ from each other by $\mathbf{i}c$.

The dimension of the speed of light c is $\frac{length}{time}$ and the dimension of $\frac{G}{c}$ is $\frac{gmflux}{mass}$. It's likely that $\frac{G}{c}$ has the same properties as the speed of light. It will express relativistic effects and in the complex schema it will show periodicity. We can also make horizontal main sequences when we formulate some new quantities, for example: nuennonne, jangil, gmflux, mass and chono. **L** is an imaginary unit. $chono\frac{G}{\mathbf{L}c} = mass$, $mass\frac{G}{\mathbf{L}c} = gmflux$, $gmflux\frac{G}{\mathbf{L}c} = jangil$ and $jangil\frac{G}{\mathbf{L}c} = nuenonne$. Then *proportional nuenonne* is the same as *proportional chono*. And if we take a further look, we will see that *proportional chono* is the same as *proportional time*. Because proportional quantities show periodicity, there is no need to extend the number of quantities to infinity. We only need 16 dimensions to cover the gravitomagnetic system.

## Extended Lorenz factor

The extended Lorentz factor will be:

$$\frac{1}{\sqrt{1 - \frac{v^2}{c^2} - \frac{\left(\frac{f}{t}\right)^2}{c^4} + \frac{\left(\frac{b}{t}\right)^2}{c^6}}}$$

## Phase versus relativistic quantities

The ratio of the quantities gmflux and burst determines the speed of light. The ratio of the quantities burst and mass determines the gravitational constant. The product of $\frac{\text{gmflux}}{\phi}$ and mass determines the planck constant. To normalize the speed of light to one we must adjust the unit of burst to the unit of gmflux. To normalize the gravitational constant we must adjust the unit of mass to the unit of burst. But we are still free to choose one unit arbitrary. But if we want to normalize the planck constant to one then we have to choose an absolute unit. So this absolute unit is tied up in nature. But this is only the case when we take *phase* into account. Phase is inherently connected with the planck constant.

The product gmflux $\cdot$ mass doesn't give the planck constant, only $\frac{\text{gmflux}}{\phi} \cdot$ mass gives the planck constant. It's like a sphere. We can wrap as many area as we want around the sphere, but only when we take into account the phase, we determine the surface of the sphere. There is no smallest area but there exists a smallest sphere. It is just like the measurement paradox in quantummechanics. A measurement is like taking away the phase out from the physical system at a particular event (wavefunction collapse). The confusion arises when we make no difference between length ('position') and wavelength. Phase is the only *non-local* quantity and is responsible for quantum entanglement. The other quantities are *local* quantities because they are connected to each other by relativity.

### The Planck equations extended

Because of symmetry, besides the two well known planck equations there are three more equations:

$$\begin{aligned}
h &= E \cdot t/\phi \\
h &= p \cdot l/\phi \\
h &= m \cdot gmflux/\phi \\
h &= string \cdot burst/\phi \\
h &= instant \cdot valention/\phi
\end{aligned}$$

The above equations are $marble \cdot wood$, but there are also equations of $marble^2$ and $wood^2$. All those equations come with their own Heisenberg uncertainty relations like

$$\frac{1}{2}\hbar\phi = \Delta m \cdot \Delta gmflux.$$

We must realise that $h\frac{c}{G}$ has an other dimension then $h$. In total there are 16 different kinds of proportional planck constants.

Equation $m^2 = \frac{\phi hc}{G}$ is interesting in regard to the mentioning by Penrose of Regge trajectories. For a certain group of hadrons when the square of the mass is plotted against the value of the spin the lines are very straigth lines [10].

**The quantized general metric**

$$\left(\frac{\hbar\delta}{\delta m}\right)^2-\left(\frac{\hbar\delta}{\delta p_x}\right)^2-\left(\frac{\hbar\delta}{\delta p_y}\right)^2-\left(\frac{\hbar\delta}{\delta p_z}\right)^2-\left(\frac{\hbar\delta}{\delta t}\right)^2-\left(\frac{\hbar\delta}{\delta b_x}\right)^2-\left(\frac{\hbar\delta}{\delta b_y}\right)^2-\left(\frac{\hbar\delta}{\delta b_z}\right)^2=$$
$$\left(\frac{\hbar\delta}{\delta E}\right)^2-\left(\frac{\hbar\delta}{\delta s_x}\right)^2-\left(\frac{\hbar\delta}{\delta s_y}\right)^2-\left(\frac{\hbar\delta}{\delta s_z}\right)^2-\left(\frac{\hbar\delta}{\delta f}\right)^2-\left(\frac{\hbar\delta}{\delta l_x}\right)^2-\left(\frac{\hbar\delta}{\delta l_y}\right)^2-\left(\frac{\hbar\delta}{\delta l_z}\right)^2$$

Parts of the equation:

$$\Xi^2=-\left(\frac{\hbar\delta}{\delta t}\right)^2-\left(\frac{\hbar\delta}{\delta b_x}\right)^2-\left(\frac{\hbar\delta}{\delta b_y}\right)^2-\left(\frac{\hbar\delta}{\delta b_z}\right)^2$$

$$\Theta^2=-\left(\frac{\hbar\delta}{\delta f}\right)^2-\left(\frac{\hbar\delta}{\delta l_x}\right)^2-\left(\frac{\hbar\delta}{\delta l_y}\right)^2-\left(\frac{\hbar\delta}{\delta l_z}\right)^2$$

Penrose [11] uses Clifford algebra elements for the 4-dimensional (Lorentzian) Laplacian. But by using the new found quantities and after we re-arrangend the metrics, we don't need Clifford algebra elements but we can use the imaginairy elements of the octonion:

$$\Xi^2=\left(L\frac{\hbar\delta}{\delta t}+iL\frac{\hbar\delta}{\delta b_x}+jL\frac{\hbar\delta}{\delta b_y}+kL\frac{\hbar\delta}{\delta b_z}\right)^2$$

$$\Theta^2=\left(-L\frac{\hbar\delta}{\delta f}-iL\frac{\hbar\delta}{\delta l_x}-jL\frac{\hbar\delta}{\delta l_y}-kL\frac{\hbar\delta}{\delta l_z}\right)^2$$

For the other (marble)part it is more difficult. Maybe the octonions must be complexified. But I hope theoretical prove or experiments can show wether the octonion picture is right or wrong.

## Black holes and the cosmological constant

Now I will speculate about the general metric. I think it will solve the problem of the singularities in for example black holes. The event horizon is a barier just like the speed of light is. If we multiplicate the proportional imaginairy quantities with the proportional speed of light $-\mathbf{i}\,\frac{c}{c}$ then metric $f^2+l_x^2+l_y^2+l_z^2=$

$t^2+b_x^2+b_y^2+b_z^2$ turns into $b_x^2+f^2+b_z^2+l_y^2=l_x^2+t^2+l_z^2+b_y^2$. Possibly this metric describes the inside of a black hole. And ofcourse we have to multiplicate the whole general metric. And this new metric can be decomposed into two other opposite octonions.

The Einstein field equation is a first grade equation and the general metric is a second grade equation. One step before I received the general metric I had:

$$(t^2c^4-x^2c^2)+b^2c^{-2}=\left(\frac{G}{c}\right)^2(E^2c^{-4}-p^2c^{-2})+\left(\frac{G}{c}\right)^2 s^2c^2$$

In this form it has some superficial resemblance with the Einstein equation (including the vacuum energy density):

$$R_{\mu\upsilon}-\frac{1}{2}Rg_{\mu\upsilon}=\left(\frac{8\pi G}{c^4}\right)(T_{\mu\upsilon}+\rho_{vac}g_{\mu\upsilon})$$

So maybe the Ricci and the cosmological constant (or the so called 'dark energy') could be present in the general metric. But maybe also the Weyl tensor because the general metric seems to encompas all of space.

The observed speeds of pioneer 10 and 11 have not the values they should have [13]. It is possible that the general metric will make predictions about their velocities. In that case the general metric will be a testible theory.

## Superspace, CPT and anti-particles

Bosons have integer spin and fermions have half-integer spin. A full rotation of a boson turns the boson into itself again. It has the same amplitude as before the rotation. A full rotation of a fermion results in an opposite amplitude. A fermion needs two full rotations to turn into itself [3]. Bosons and fermions can't be transformed into each other because their phase paths have different topology. Only if there are other dimensions a fermion can be untwisted into a boson [4]. In supersymmetric equations we can interchange a fermion with a boson [7]. Rotations in space or in spacetime are connected with symmetry. But there are symmetries that are connected with rotations in other directions than the directions in space and time. So there must be more dimensions then only space and time [5]. Lorenz symmetry is the symmetry of spacetime. Supersymmetry is the symmetry of a space with more then the four dimensions of spacetime [6]. To imagine superspace think of normal spacetime coordinates that are associated with other coordinates that have special properties [9]. The largest symmetrygroup for supersymmetry is O(8). [8]. In the heterotic string theory there are two kinds of fibrations, one fibrating in the 26-dimensional spacetime, the other in the 10-dimensional space time. 26 - 10 = 16. The symmetrygroup of this 16 dimensional space is the group E(8) x E(8) [8]. Charge conjugation C, is the interchange of particles with their antiparticles. P is the spatial (mirror-)reflection of a particle and T is time reversal of a particle. Operation C is equivalent to the combined operation PT. A theorem from relativistic QFT says that the physical interactions are invariant under the combined operation of C,P and T. An anti-particle can be seen as the particle travelling backwards in time [12].

I want to speculate about this information. It could be that superspace is defined by the 8 dimensional extended Minkowski metric. PT-symmetry as the symmetry within spacetime. Charge conjugation C as the reflexion from spacetime into 'burstflux'. An electron in burstflux we experience as a positron with reversed spin in spacetime. A boson like a photon remains in 'burstfluxspacetime'. And maybe the (supersymmetric) transition from a fermion into a boson maybe can be seen as a transition from spacetime or 'fluxspace' into 'burstfluxspacetime'.

It could be that the 16 dimensional 'space' in heterotic string theory is composed of the 16 dimensions of the general metric. So what about the other 10 dimensions? 2 dimensions of them can be attributed to the spinor [14]. That leaves 8. In Kaluza-Klein theory, the fifth dimensions is a spatial dimension. If the electric charge is introduced in the equation, then there is a problem. According to general relativity, this fifth dimension must act like the other spatial dimensions. But the electric charge demands that this dimension must be a fixed dimension. My solution for this problem is that we can take a quantity with the same dimensionality as normal length. We can take em-length (one cell above electromagnetic-flux). So it doesn't have to curve under gravity and it complies with electric charge. Or maybe it's even better to take em-flux, because em-flux is a scalar quantity. The other three remaining dimensions are possibly related with vector quantities, maybe with the color charges. But this is all non-mathematical speculation. There are other ways in which electric charge and color charges are linked to (hyper)complex numbers [1].

# Bibliography


[1] John Baez. This week's finds in mathematical physics - week 104. `http://math.ucr.edu/home/baez/week104.html`, 06 1997.

[2] Albert Einstein. *Relativiteit*, pages 41–42. Het Spectrum BV, Utrecht, 1988.

[3] Vincent Icke. *The Force of Symmetry*, page 141. Cambridge university press, Cambridge, 1995.

[4] Vincent Icke. *The Force of Symmetry*, page 144. Cambridge university press, Cambridge, 1995.

[5] Vincent Icke. *The Force of Symmetry*, page 179. Cambridge university press, Cambridge, 1995.

[6] Vincent Icke. *The Force of Symmetry*, page 279. Cambridge university press, Cambridge, 1995.

[7] Michio Kaku. *Hyperspace*, page 145. Oxford university press, Oxford, 1995.

[8] Michio Kaku. *Hyperspace*, page 345. Oxford university press, Oxford, 1995.

[9] Gordon Kane. *Supersymmetry*, page 191. Perseus publishing, Cambridge, 2001.

[10] Roger Penrose. *The Road to Reality*, page 886. Vintage, London, 2005.

[11] Roger Penrose. *The Road to Reality*, page 618. Vintage, London, 2005.

[12] Roger Penrose. *The Road to Reality*, page 639. Vintage, London, 2005.

[13] Lee Smolin. *The Trouble with Physics*, pages 213–214. Mariner books, London, 2007.

[14] Ian Stewart. The missing link... *New Scientist*, 176(2368):30, 11 2002.