Quaternions and Relativity

(and relation to Euler's Conjecture)

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Minkowski Metric

$$\psi^2 = t^2 - x^2 + y^2 + z^2$$

Quaternions

$$i^2 = j^2 = k^2 = ijk = -1$$

$$(1, A, x, y, z) = A(1) + x\vec{i} + y\vec{j} + z\vec{k}$$
$$1 = \sqrt{\cos^2\theta + \sin^2\theta}$$
$$A = \sqrt[3]{x^3 + y^3 + z^3}$$

$$\varphi = a + x + y + z$$
$$\varphi^2 = (a + x + y + z)^2$$
$$\psi = a + i(x + y + x)$$
$$\psi\psi^* = [a + i(x + y + x)][a - i(x + y + x)] = a^2 + (x^2 + y^2 + z^2)$$

$$\mathrm{X} = a^2 + (x^2 + y^2 + z^2)$$
$$\mathrm{X}^2 = \left[a^2 + (x^2 + y^2 + z^2)\right]^2$$
$$\Phi = a^2 + i(x^2 + y^2 + z^2)$$
$$\Phi\Phi^* = \left[a^2 + i(x^2 + y^2 + z^2)\right]\left[a^2 - i(x^2 + y^2 + z^2)\right] = a^4 + (x^2 + y^2 + z^2)^2$$

Let $a = t$

The Minkowski Metric is then characterized by

$$\Theta^2 = t^2 - \left(x^2 + y^2 + z^2\right) = t^2 + i^2\left(x^2 + y^2 + z^2\right)$$

$$\Theta^2\left(\Theta^2\right)* = \left[t^2 + i^2\left(x^2 + y^2 + z^2\right)\right]\left[t^2 - i^2\left(x^2 + y^2 + z^2\right)\right]$$
$$= t^4 + \left(x^2 + y^2 + z^2\right)$$

Note that

$$\psi^2 = \tau^2 + x^2 + y^2 + z^2$$
$$\psi^2 = \tau^2 \Leftrightarrow (x^2 + y^2 + z^2) = r^2 = 0$$
$$c^2\tau^2 = 1^2\tau^2 \Leftrightarrow \left\{r^2 = 0 \wedge c^2 = 1^2\right\}$$
$$\left(\psi'\right)^2 = \left(\tau'\right)^2 + \left(x^2 + y^2 + z^2\right)$$
$$\left(\psi'\right)^2 = \left(\tau'\right)^2 \Leftrightarrow (x^2 + y^2 + z^2) = r^2 = 0$$
$$c^2\left(\tau'\right)^2 = \left(1\right)^2\left(\tau'\right)^2 \Leftrightarrow \left\{r^2 = 0 \wedge c^2 = \left(1\right)^2\right\}$$

Let $\Phi = 1^2 + i\left(x^2 + y^2 + z^2\right) = \left(c\tau\right)^2 + i\left(x^2 + y^2 + z^2\right)$

$$\left\{t, x, y, z\right\} > 0$$
$$\varphi = t + x + y + z$$
$$\varphi^2 = \left(t + x + y + z\right) = t^2 + x^2 + y^2 + z^2 + rem(t, x, y, z)$$
$$\varphi^2 = 0 \Leftrightarrow t = x = y = z = 0$$

Note: $\varphi = t + x\vec{i} + y\vec{j} + z\vec{k}$ represents a quaternion for $x = y = z = 1$

$$\varphi = \tau + x + y + z = \tau + r$$
$$\varphi^2 = \left(\tau + r\right)^2 = \tau^2 + r^2 + 2\tau r$$
$$\psi = \tau + ir$$
$$\psi\psi* = \left(\tau + ir\right)\left(\tau + ir\right) = \tau^2 + r^2$$

$$r = c\tau \Leftrightarrow \tau = \frac{r}{c}$$

$$c^2 = 1^2 \Leftrightarrow \tau^2 = r^2$$

$$\psi\psi* = 2$$

$\varphi^2 = 4$

Conjugation eliminates the interaction between "time" (τ) and "space" (r); i.e., space and time are "orthogonal" so any function of space and time is linear (the "area" of the relativistic unit circle is eliminated, where

$$A_O = \frac{\beta}{\gamma},\ 0 < v < c$$
$$A_O = \beta\gamma, \beta > 0, \tau' > \tau \Leftrightarrow \gamma > 1$$
$$A_O = n\gamma^2 = n \Leftrightarrow v = c \Leftrightarrow \gamma^2 = 1^2$$

$\beta\gamma > 0$ implies absorption process

$\frac{\beta}{\gamma} < 1$ implies radiation process

$A_O{}^2 + (iA_O)^2 = 0$ implies energy equals 0.

For equal and opposite momentum, implies momentum =0.

Positive definite momentum can always be made equal and opposite by selecting the origin as the center of all positive definite lines in a single dimension, so that $1^2 + i^2 = 0$ where the interaction product is eliminated by conjugation:

$$\varphi = 1 + i$$
$$\varphi^2 = (1+i)^2 = 1^2 + i^2 + 2(1)(i) = 2(1)(i)$$
$$\psi = 1 + i$$
$$\psi\psi^* = (1+i)(1-i) = 2$$

Quaternions remove interaction terms in a volume governed by the “trinomial” theorem.

$$\varphi = a + ix + iy + iz$$

The identities $i^2 = j^2 = k^2 = ijk = -1$, where i, j, and k are basis elements of H, determine all the possible products of i, j, and k, but NOT all possible products of quaternions where $\varphi = 1 + x\vec{i} + y\vec{j} + z\vec{k}$.

$$r = x + y + z$$
$$\eta = x^3 + y^3 + z^3$$
$$\varepsilon = 3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz$$
$$\eta + \varepsilon = (x + y + z)^3$$

$$\varphi = \psi = \eta + \varepsilon = r^3 = (x + y + z)^3$$
$$\psi = (\eta + i\varepsilon)$$
$$\psi\psi^* = (\eta + i\varepsilon)(\eta - i\varepsilon) = \eta^2 + \varepsilon^2$$
$$\varphi^2 = (\eta + \varepsilon)^2 = \eta^2 + \varepsilon^2 + 2\eta\varepsilon = \psi\psi^* + 2\eta\varepsilon$$

$$\varphi^3 = (x + y + z)^3 = (x^3 + y^3 + z^3) + (3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz)$$
$$\varphi^3 = r^3 = \eta + \varepsilon$$
$$(r')^3 = (ix + iy + iz)^3 = -(x^3 + y^3 + z^3) - i(3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz)$$
$$= -(x^3 + y^3 + z^3) - i(3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz)$$
$$= -\left[(x^3 + y^3 + z^3) + i(3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz)\right]$$
$$= -\left\{[\psi] + i(3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz)\right\}$$
$$(r')^3 = -[\psi] = -|r|^3 \Leftrightarrow (3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz) = 0$$

That is, for $r > 0$, the complex (“imaginary”) terms must vanish, so that $x = y = z = 0$

Then $r = 0$, so the only remaining term in $\varphi = a + ix + iy + iz$ is $\varphi = a$

For STR, $a = m_0 = c_0\tau_0$ where the coordinate terms have vanished.

$$x = y = z = 1$$
$$\chi_{(1^3)}{}^3 = (x+y+z)^3 = x^3 + y^3 + z^3 + 3x^2y + 3x^2z + 3y^2x + 3y^2z + 3z^2x + 3z^2y + 6xyz$$
$$= 1_x{}^3 + 1_y{}^3 + 1_z{}^3 + 3\left(1_{x^2y}\right)^3 + 3\left(1_{x^2z}\right)^3 + 3\left(1_{y^2x}\right)^3 + 3\left(1_{y^2z}\right)^3 + 3\left(1_{z^2x}\right)^3 + 3\left(1_{z^2y}\right)^3 + 6\left(1_{xyz}\right)^3$$
$$= 25(1^3) = 3^2 + 4^2 = (3+i4)(3-i4)$$
$$a = 2(3*4) = 2(12) = 24$$
$$49 = 7^2 = a + \varphi_{(1^3)}{}^3$$

$49 = 7^2 = a + \varphi_{(1^3)}{}^3$ implies that the Pythagorean triple $(3,4,5)$ is not valid for the positive real numbers where $25 = 9+16$ is a result of counting only (no "scaling" or interaction/scalar multiplication of different variables), since it requires the complex relation $25 = 3^2 + 4^2 = (3+i4)(3-i4)$ which eliminates the interaction $2(3*4)$. For positive real numbers, the only valid equation is that of the Binomial expansion: $\Omega^2 = 7^2 = (25) + 2(12) = \left(3^2 + 4^2\right) + 2(3*4)$

This result can then be extended to higher powers of n, where n corresponds to the distinct widget count as well as self- interactions (powers) and scalar multiplication (products), where powers are simply scalar products of identical numbers.

This constitutes a proof of Euler's conjecture as well and extended to Theory of Relativity where $x_0 = m_0 = a = c_0\tau_0$ and $x'_i = v_i\tau'_i$ are parameterized, since Euler's conjecture $\varphi_{(1^n)}{}^n$ cannot be an integer for x_i positive real numbers for $n > 2$, where

$\varphi_{(1^n)}{}^n = (a_0 + a_1 + a_2 + \ldots a_n)^n = \left(\sum_{i=0}^{n} a_i\right)^n$, $a_1 = a_2 = .. = a_n$ since there will always be interactive products that cannot be eliminated by conjugation. For Relativity,

$\varphi_{(1^n)}{}^n = (\gamma_0 + \gamma_1 + \gamma_2 + \ldots \gamma_n)^n = \left(\sum_{i=0}^{n} \gamma_i\right)^n$, $\gamma_1 = \gamma_2 = .. = \gamma_n$, where $\begin{array}{l} \gamma_0 = 1_0 = \left|1_0{}^2\right| \\ \gamma_i = 1_i = \dfrac{\tau_i}{\tau_i} = \dfrac{\tau_i'}{\tau_i'} \Leftrightarrow v_i = 0 \end{array}$

$\beta^2 > 1^2$ implies absorption, $\beta^2 < 1^2$ implies radiation, and $\beta = 0$ implies no change (i.e., sea level, no photon interaction "Ow" :).