Continued analysis

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1 Introduction to orthogonality

Rest energy is the real component and momentum belongs to a direction vector in 3D space or i, j, k.

$$E^2 = m^2c^4 + p^2c^2 - >$$
$$E^\dagger E = m^2c^4 + c(ip_x + jp_y + kp_z)^\dagger c(ip_x + jp_y + kp_z)$$

In the standard approach to the energy momentum relation, $E = pc$ and $E = mc^2$ where one side of the triangle corresponds to a photons energy (momentum gained) and the other side the rest mass respectively. This could only both be true if they were orthogonal to each other (4D), hence the Pythagoras theorem being used represents the connection between the variables in the four dimensional space.

In this paper we attempt to decompose the rest mass of a particle in terms of overlapping light-matter waves from each of the 3 dimensions. This allows one to represent both massive and massless particles from the four dimensional space in a 3 dimensional basis. This can be seen as setting the energy to zero, representing a conservation equation for the energy-momentum relation.

$$E^2 = 0 = m^2c^4 + p^2c^2 - >$$
$$m^2c^4 = -p^2c^2 - >$$
$$mc = \sqrt{-p^2} = (ip_{mx} + jp_{my} + kp_{mz}) = p_m$$

The main drawback is having to use conjugation to separate out the mass. The quaternion based decomposition represents the colours of the strong force as the basis elements of the quaternion group.

Not expanding into quaternion basis elements, presents a matrix with anti-commutation relations between the momentum and rest energy, potentially explaining the parity inversion of the weak force.

The complex decomposition creates a two dimensional subgroup, which when modeled in a 3 dimensional space, gives rise to spinors. This appears to be the cause of the half-integer spin of subatomic particles, such as fermions and leptons.

Interference patterns observed can be explained by an orthogonal Hilbert space of equal dimension. Overlapping light-matter waves perpendicular to the measurement and time dimensions. Since we can only measure along a single axis, we can't detect the orthogonal light-matter waves, only their effects. This potentially explains why only hermitian operators are observable.

2 Energy momentum relation

Proof of the four to three dimensional mapping. Let the mass be a vector quaternion:

$$E = (ip_x + jp_y + kp_z)c + (ip_{mx} + jp_{my} + kp_{mz})c$$

$$E^\dagger E = c^2(i(p_x+p_{mx})+j(p_y+p_{my})+k(p_z+p_{mz}))^\dagger(i(p_x+p_{mx})+j(p_y+p_{my})+k(p_z+p_{mz}))$$

$$E^\dagger E = c^2((p_x + p_{mx})^2 + (p_y + p_{my})^2 + (p_z + p_{mz})^2)$$
$$= c^2(p^2 + p_m^2 + pp_m + p_m p) = 0$$

Only when p and p_m are anti-commutative and equal opposite magnitude.

$$= c^2(p^2 - p_m^2 + pp_m - pp_m) = 0$$

This means the only way to go from the four dimensional space into the Euclidean 3D space is to make the space contain complex (or vector quaternion) valued mass. If momentum is allowed to take any value, then the corresponding mass must be opposite in value to conserve total energy-momentum. If this were not the case, computing the energy squared results in a negative value for energy, which is nonphysical.

$$E^2 = -E^\dagger E = -c^2((p_x + p_{mx})^2 + (p_y + p_{my})^2 + (p_z + p_{mz})^2)$$

$E^2 = E^\dagger E$ only when $E^2 = E^\dagger E = 0$. This requires $pp_m = -p_m p$ and $p^2 + p_m^2 = p^2 - p_m^2$.

Note, we repeat this logic multiple times during this paper.

3 SU(3) algebra and the strong nuclear force

Let $m^2c^4 = 0$. This implies $E^2 \neq 0$, but this is not the case. All energy must therefore be taken from the vacuum/orthogonal components, which requires overlap of orthogonal light-matter waves, potentially explaining why the strong force only happens in an extremely small volume. This borrowing of energy potentially explains the paired nature of gluons when mediating the strong force.

$$E = c[0, p_x, p_y, p_z]$$

Convoluting this equation with itself (matrix multiplication) effectively produces a Jacobian matrix.

$$E^\dagger E = c^2 \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & p_x^2 & p_x p_y & p_x p_z \\ 0 & p_y px & p_y^2 & p_y p_z \\ 0 & p_z p_x & p_z p_y & p_z^2 \end{bmatrix}$$

The only way this matrix can still be zero, is if it can be decomposed into orthogonal components. Assuming each element of the matrix can be separated into the basis elements of the quaternion algebra, this produces 8 distinct, linearly independent bosons. The sum of all linearly independent types is zero.

$$E^\dagger E = qE^\dagger E - qE^\dagger E = 0$$

Where q denotes the unit quaternion $a + i + j + k$, $|q| = 1$. Dividing any independent matrix by the magnitude of it's independent energy-momentum four vector produces a unitary matrix, having a determinant of 1. Effectively a normalized probability function of the orthogonal variables, though it originated from the energy-momentum four vector.

3.1 Quarks

Let $p^2c^2 = 0$, as earlier this implies $E \neq 0$, but again this is not the case. The matrix can be decomposed into quaternion components.

$$E = [0, p_{mx}, p_{my}, p_{mz}]$$

$$E^\dagger E = c^2 \begin{bmatrix} p_{mx}^2 & p_{mx} p_{my} & p_{mx} p_{mz} \\ p_{my} pmx & p_{my}^2 & p_{my} p_{mz} \\ p_{mz} p_{mx} & p_{mz} p_{my} & p_{mz}^2 \end{bmatrix}$$

$E^{=} qE^\dagger E - qE^\dagger E = 0$

4 SU(2) algebra and the weak force

$$E = [0, p_x + p_{mx}, p_y + p_{my}, p_z + p_{mz}]$$

Convoluting this equation with itself (matrix multiplication) effectively produces a Jacobian matrix.

Expanding out in the quaternion basis (SU(3)) to find the relationship between massive and massless particles.

$$\Psi = \frac{c^2}{|E|}$$

$$\begin{bmatrix} (p_x + p_{mx})^2 & (p_x + p_{mx})(p_y + p_{my}) & (p_x + p_{mx})(p_z + p_{mz}) \\ (p_y + p_{my})(p_x + p_{mx}) & (p_y + p_{my})^2 & (p_y + p_{my})(p_z + p_{mz}) \\ (p_z + p_{mz})(p_x + p_{mx}) & (p_z + p_{mz})(p_y + p_{my}) & (p_z + p_{mz})^2 \end{bmatrix} =$$

$$= \frac{c^2}{|E|} \begin{bmatrix} p_x^2 & p_x p_y & p_x p_z \\ p_y p_x & p_y^2 & p_y p_z \\ p_z p_x & p_z p_y & p_z^2 \end{bmatrix} + \frac{c^2}{|E|} \begin{bmatrix} p_{mx}^2 & p_{mx} p_{my} & p_{mx} p_{mz} \\ p_{my} p_{mx} & p_{my}^2 & p_{my} p_{mz} \\ p_{mz} p_{mx} & p_{mz} p_{my} & p_{mz}^2 \end{bmatrix} +$$

$$\frac{c^2}{|E|} \begin{bmatrix} p_x p_{mx} & p_x p_{my} & p_x p_{mz} \\ p_y p_{mx} & p_y p_{my} & p_y p_{mz} \\ p_z p_{mx} & p_z p_{my} & p_z p_{mz} \end{bmatrix} + \frac{c^2}{|E|} \begin{bmatrix} p_{mx} p_x & p_{mx} p_y & p_{mx} p_z \\ p_{my} p_x & p_{my} p_y & p_{my} p_z \\ p_{mz} p_x & p_{mz} p_y & p_{mz} p_z \end{bmatrix} = 0$$

Computing this element by element we see the argument is the same as earlier. Again, we require, $pp_m = -p_m p$ and $p^2 + p_m^2 = p^2 - p^2$ so that $E^2 = E^\dagger E = 0$. However, we also require $p_x p_{my} = p_y p_{mx}$, this is essentially saying they're of equal magnitude and completely interchangeable. So apparently the mass-photon components are anti commutative, not the dimension. This could be the cause of the weak force's parity inversion. When flipping the sign of the coordinate, it doesn't change the mass component, creating the requirement for a sign inversion. It may also explain the extremely short range, as the force requires overlap with matter waves, which are confined.

Rewriting after the anti-commutation of SU(3):

$$= \frac{c^2}{|E|} \begin{bmatrix} p_x^2 & p_x p_y & p_x p_z \\ p_y p_x & p_y^2 & p_y p_z \\ p_z p_x & p_z p_y & p_z^2 \end{bmatrix} + \frac{c^2}{|E|} \begin{bmatrix} -p_{mx}^2 & -p_{mx} p_{my} & -p_{mx} p_{mz} \\ -p_{my} p_{mx} & -p_{my}^2 & -p_{my} p_{mz} \\ -p_{mz} p_{mx} & -p_{mz} p_{my} & -p_{mz}^2 \end{bmatrix} +$$

$$\frac{c^2}{|E|} \begin{bmatrix} p_x p_{mx} & p_x p_{my} & p_x p_{mz} \\ p_y p_{mx} & p_y p_{my} & p_y p_{mz} \\ p_z p_{mx} & p_z p_{my} & p_z p_{mz} \end{bmatrix} + \frac{c^2}{|E|} \begin{bmatrix} -p_x p_{mx} & -p_x p_{my} & -p_x p_{mz} \\ -p_y p_{mx} & -p_y p_{my} & -p_y p_{mz} \\ -p_z p_{mx} & -p_z p_{my} & -p_z p_{mz} \end{bmatrix} = 0$$

W^+ bosons are the antiparticle of W^-. This is seen by adding the second and third matrix together. The Z^0 and γ bosons are their own antiparticles.

This is seen by recognising that they are hermitian as they are no longer of complex nature. They also have no polarity as $p^2 - p_m^2$ is equivalent to $p_m^2 - p^2$, i.e. $E^\dagger E = EE^\dagger$. Their probabilities can now be encoded into each of the i,j,k basis vectors.

5 SU(2)xU(1) and the Yang-Mills field

Assuming the previous matrix can be decomposed into complex components we obtain:

END

At a location, the probability to measure a specific momentum vector can be found from multiplying the corresponding unit momentum vector by this matrix.

$$\hat{p}\Psi = \frac{1}{|p|}\begin{bmatrix}0, p_{mx}, p_{my}, p_{mz}\end{bmatrix}\begin{bmatrix}0 & 0 & 0 & 0\\ 0 & p_{mx}^2 & p_{mx}p_{my} & p_{mx}p_{mz}\\ 0 & p_{my}pmx & p_{my}^2 & p_{my}p_{mz}\\ 0 & p_{mz}p_{mx} & p_{mz}p_{my} & p_{mz}^2\end{bmatrix}$$

Holistically, this can be interpreted as the amount the real energy-momentum vector is in the same direction as the operator. The imaginary components are effectively the values that store the "fake" copies of all possible configurations.

This is a surjective homomorphism from SU(2) to the rotation group SO(3) with kernel/spin states $\{I, -I\}$ representing the "handedness" of the 3D space.

It is technically a subring of the 4x4 matrix created by multiplying a quaternion by itself in matrix format, which I use for the stress energy tensor.

6 Pressure increase

The effects of gravity on a system can be calculated by making all complex components the same dimension as was done in the superposition of two waves. This represents the radial pressure on the mass.

$$T^{\mu\nu} = qq^T = \begin{bmatrix} a^2 & a_1b_2i & a_1c_2j & a_1d_2k\\ b_1ia_2 & -b^2 & b_1ic_2j & b_1id_2k\\ c_1ja_2 & c_1jb_2i & -c^2 & c_1jd_2k\\ d_1ka_2 & d_1kb_2i & d_1kc_2j & -d^2\end{bmatrix}$$

$$T^{\mu\nu} = qq^T = \begin{bmatrix} a^2 & a_1b_2i & a_1c_2i & a_1d_2i\\ b_1ia_2 & -b^2 & b_1c_2i & b_1id_2i\\ c_1ia_2 & c_1b_2i & -c^2 & c_1d_2i\\ d_1ia_2 & d_1b_2i & d_1c_2i & -d^2\end{bmatrix}$$

7 Dispersion relation

8 plugging into S.E.

9 pressure increase in gravitational field

$$\Psi = Ae^{ik_x x + jk_y y + kk_z z}$$

$$\Psi = Ae^{ik_x x}e^{jkk_y y + kk_z z}$$

$$\Psi = \Psi_0 e^{jkk_y y + kk_z z}$$

It effects the radial vector pushing probabilities towards the mass. If we represent the wave function in spherical coordinates:

$$\Psi = \frac{A}{r}e^{ikr}$$

$$r = \sqrt{x^2 + y^2 + z^2}$$

$$\Psi_g = \frac{A}{r}e^{ikr}$$

The gravitational effects are those which are not measurable at the quantum scale, ie. the pilot wave.

$$\Psi = \frac{A}{r}e^{ikx}\frac{A}{r}e^{jky} =$$

$$\Psi = \frac{A^2}{r^2}e^{ikx + jky}$$

Then adding the contributing components towards the mass becomes:

$$\Psi = \frac{A}{r}e^{i(k - \Delta k)x)} \propto \frac{A}{r}e^{i(kx - \omega t))}$$

10 time evolution by continuity and stochastic