

Hypersphere space-time model

(draft)

Abstract

The origin of the three spatial dimensions as well as that of time is deduced from fundamental principles (symmetry, homogeneity). The structure resulting from this construction looks like an hypersphere of which each energy particle constitutes a dimension. This model shall be linked to the existing theories that are in adequation with the experience.

Generation of space

Supposing that nothing (*symmetry*) generates something (*energy*), an energy quantum (a) and its opposite ($\bar{a}$) can be formalized like this :

$$a + \bar{a} = 0 \text{ (symmetry)}, a \times \bar{a} = 1 \text{ (energy)} \rightarrow a = i \text{ and } \bar{a} = -i \text{ where } i^2 = -1.$$

There are two operations : addition (+) and multiplication ($\times$ or no sign for simplification).

The quantum (a) is a complex number ($a \in \mathbb{C}$) so it behaves like a wave, more precisely like the $\pi/2$ phase of a virtual (potential) standing wave. The wavelength is the whole universe. It's the same for the opposite ($\bar{a}$).

The quantum (a) and its opposite ($\bar{a}$) form a pair of complex numbers (i,-i), commonly referred as a spinor or as a quaternion.

A quaternion (q) is defined by

$$q = s + i'x + j'y + k'z = s + iv \text{ where } s, x, y, z \in \mathbb{R}, i^2=i'^2=j'^2=k'^2=i'j'j'k'=-1, v = (x,y,z),$$

(v) is called the 3 dimensional vector part and (s) is the scalar part or the quaternion.

The result of the product of quaternions (q) and (q') has a scalar part and a vectorial part :

$$qq' = (s+iv)(s'+iv') = (ss' - v.v') + i(sv' + s'v + v \times v')$$

where the scalar part is $(ss' - v.v')$ and the vectorial part is $(sv' + s'v + v \times v')$, $v.v'$ is the scalar product of vectors and $v \times v'$ the vectorial product of vectors.

According to Pythagore theorem, (q) and (q') are orthogonal if

$$(q+q')^2 = q^2+q'^2+qq'+q'q = q^2+q'^2 \rightarrow qq'+q'q = 0$$

According to the *homogeneity* principle, all quaternions issued by the (a, $\bar{a}$) quanta are identicals and are supposed to be unitary. Such a quaternion is here called a **quantion**. A quantion has a vectorial part only. The product of quantions (q) and (q') also only has a vectorial part if they are supposed to be independant and thus orthogonal because

$$s = 0, s' = 0, v \times v' = -(v' \times v)$$

By the far from evidence hypothesis that energy is constant, so finite, there is a constant number N of quantions in the universe. If quantions are independant to each others, they are orthogonal and they form the surface of an hypersphere in a vectorial space of size N, corresponding to the number of quantions. This is the supposed structure of the universe.

$$N = \sum ||q||^2 = \sum (s^2 + x^2 + y^2 + z^2)$$

All the energy (E) of the universe is relative to the multiplication of all quantions.

$$E = \underbrace{q \times \dots \times q}_N$$

Energy can be divided into sub parts according to prime numbers of N. Each prime number can be seen as a possible set of quantions equivalent to a particle type.

Generation of time

Quantions are expressed as virtual standing waves with $\pi/2$ phase. Even if a wave has a frequency that implies time, everything is static, without change, because of the standing state.

The only thing that could change is the perspective of the observation, the projection on the observer's perspective. The change of perspective changes the direction of particles or creates particles or destroys particles.

The quantions as unitary quaternions are isomorph to SU(2) Lie group. The standard model SU(3) x SU(2) x U(1) can be based on a composition of SU(2) :

1. replacing the Gell-Mann matrix $\text{diag}(1,1,-2)$ by the two matrices $\text{diag}(1,0,-1)$ and $\text{diag}(0,1,-1)$, forming generators of U(3) where each generator is one generator of iSU(2), then $U(3) = iSU(2) \times iSU(2) \times iSU(2)$

$$\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} 0 & -i & 0 \\ i & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix} \rightarrow iSU(2)$$

$$\begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} 0 & 0 & -i \\ 0 & 0 & 0 \\ i & 0 & 0 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix} \rightarrow iSU(2)$$

$$\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & -i \\ 0 & i & 0 \end{pmatrix} \begin{pmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \rightarrow iSU(2)$$

2. $U(3) = SU(3) \times U(1)$
3. from (1) and (3), $SU(3) \times SU(2) \times U(1) = -i (SU(2) \times SU(2) \times SU(2) \times SU(2))$

The conjugate ($\bar{q}$) of the quaternion (q) is defined by

$$\bar{q} = s - iv = s - i'x - j'y - k'z = s - v$$

The product of a quaternion (q) by the conjugate of another one (q') is defined by the Dirac brackets $\langle | \rangle$

$$q\bar{q}' = \langle q|q' \rangle = ss' + v.v'$$

and the scalar norm ($\| \|\rangle$) of the quaternion (q) is expressed thanks to the above formula

$$\|q\|^2 = \langle q|q \rangle = q\bar{q} = s.s + v.v = s^2 + \|v\|^2 = s^2 + x^2 + y^2 + z^2 \in \mathbb{R}.$$

Consequences

Field

The concept of field is immediate. It's the quantion's waves envolving the whole universe.

Antimatter

Matter and antimatter annihilation generates energy. Multiplication of matter particle with antimatter particle has to generate photon (TO BE EXPLORED).

Shape of the universe

Quantions are orthogonals in their interaction, with an euclidian norm. Then the corresponding space-time structure is euclidian, so fundamentally flat.

Relativity

Theory agrees with the special relativity (Lorentz scalar) because of its fit with the Minkowski formula : $x^2+y^2+z^2+s^2=c^2t^2$. Each elementary particle has its own 3D reference space as required by the special relativity.

According to the above special relativity, gravity is generated by the 'mass' dimension (s) that decreases space (x,y,z) for same time (t), which agrees with the slowing down because of the mass in the general relativity. It's a kind of equivalence principle. Note that the general relativity is here statistically generated from a lot of quantions.

Entaglement

Entaglement of two particles exists when the two particles are not independant (orthogonal) to each other.

Standard Model

The standard model $SU(3) \times SU(2) \times U(1)$ is based on a composition of $SU(2)$.

There is no $SU(n>2)$ group from composition of $SU(2)$ groups because :

1. $\dim(SU(n)) = n^2 - 1$
→ $\dim(SU(2)) = 3$
2. if $SU(x) = SU(m) \times SU(n)$
→ $\dim(SU(x)) = \dim(SU(m)) + \dim(SU(n))$
3. if $SU(n) = SU(2) \times \dots \times SU(2)$
→ $\dim(SU(n)) = \dim(SU(2)) + \dots + \dim(SU(2)) = 3 + \dots + 3$
→ $\dim(SU(n)) = \text{number of } SU(2) \text{ generator matrices for covering } SU(n) \text{ generators matrices}$
→ $\dim(SU(n)) \geq n \times (n-1) / 2$
4. from (1) and (3)
→ $(n^2 - 1) / 3 \geq n \times (n-1) / 2$
→ $n \leq 2$

5. if $n > 2$, then $SU(n) \neq SU(2) \times \dots \times SU(2)$

The same way can be used to demonstrate that :

- $U(N) = SU(N) \times U(1) \neq SU(2) \times \dots \times SU(2)$ if $N > 3$
- $SU(N_1) \times SU(N_2) \times \dots \neq SU(2) \times \dots \times SU(2)$ if one $N_i > 3$

So, there is no other interaction than the ones of the standard model.

Unitary electric charge

If everything looks like a rotation of $\pi/2$ phase, the negative electric charge can be defined by a phase shift of $-\pi/2$ (charge -1). **Unit electric charges** could be used for up quark with shift of $2\pi/2$ (charge +2) and down quark with shift of $\pi/2$ (charge +1) because $4\pi/2 \equiv 0$.

- up+up+down = $(2+2+1) \pi/2 \equiv 1 \pi/2$ (proton)
- up+down+down = $(2+1+1) \pi/2 \equiv 0 \pi/2$ (neutron)

By this way, a symmetry could be established between the charge of leptons (electron -1, neutrino 0) and the one of quarks (down +1, up +2).

Conclusion

Based on the hope that Nature is simple, this article introduces a new representation of space-time structure of the universe : an hypersphere structure on a multi-dimensional space, each dimension is an energy quantum with its opposite.

There is still a long way to involve the whole physic in one theory but this bottom-up approach, from simple principles to more complex structures, in adequation with the observed reality, is probably a good way to elaborate a simple and comprehensive theory. This intuitive approach tries to answer to a fundamental question : why has the universe an apparent 3 dimensional structure in addition of time, which is far from an evidence ?

To explain the universe, the ether is not necessary, perhaps neither is space-time.

Puzzle :

- **TODO :**
 - expliquer l'interaction → lié à fréquence de résonance, vitesse, probabilité (constante de structure) → intrication, particule, effondrement
- **Indices :**
 - bi-spineur de Dirac ($\mathbb{C} \times \mathbb{H}$), ce qui devrait être lié au temps, à la masse, à la particule
 - le -i introduit une rotation dans la masse → rapport avec produit de Dirac, le boson de Higgs ?
 - lien entre 's' (Minkowski) et 'm' via analyse dimensionnelle
 - 's' pourrait être négatif et la masse 'm' le carré d'un nombre éventuellement négatif
 - replacer dans le texte les quaternions gauches ou droits
 - l'inversion du 's' dans le quaternion inverse la chiralité
 - quaternion droit ou gauche, changement si 's' change de signe
 - Étudier lien entre produit scalaire $qq' + q'q$ et norme $\langle q|q \rangle$ pour orthogonalité
 - étudier collision dans chaque point de vue $(q, q') \rightarrow q'q\bar{q}$ et $qq\bar{q}$
 - le produit scalaire $\langle | \rangle$ n'est pas associatif (temps) si le résultat est un complexe (boson higgs) → notion de temps
 - montrer ainsi que le mécanisme BEH crée les particules et le temps non stationnaire
 - lien entre produit $(s^2 - v^2 + \dots)$ et produit Dirac $(s^2 + v^2) \rightarrow$ Lagrangien et énergie ?
 - brisure de symétrie : $SU(2) \times \dots \rightarrow U(1) \times SU(3) \rightarrow$ création du boson de Higgs, des masses, du temps lorsque l'espace augmente, la densité d'énergie diminue
 - tenir compte de l'impulsion
 - masse négative pour inversion chiralité sans inversion de charge
 - Intervalle genre espace → pas d'interaction → commutation
 - distance = probabilité de rencontrer une particule virtuelle ?
 - Brisure C aussi pour quarks ?
 - Axe réel = énergie cinétique, axe imaginaire = énergie potentielle
 - neutrino = 2 ? quel lien entre la particule et la charge (électrique, couleur) ?
 - Quel rôle joue le i dans $i SU(2) \times i SU(2) \times i SU(2) = U(1)$?
 - addition : perte d'information par addition, probabilité (tout ce qui est possible), dérivée de la multiplication, position si addition d'ondes d'énergie (Fourier)
 - multiplication : interaction, garde information grâce aux nombres premiers mais la non commutativité perd l'information
 - s constante (pourquoi), pas de degré de liberté
 - $C = P$, presque car T joue un rôle (symétrie CPT) ?
 - brisure de symétrie → symétrie cachée car choix aléatoire de direction (symétrique si un grand nombre de fois), pas de rotation possible mais peut-être induite par nombre de quaternions (modèle Ising)
 - masse imaginaire boson de Higgs → chapeau mexicain
 - relation of all virtual waves (addition) and interaction (multiplication)
 - Higgs = mélange (alternance) des particules gauches et droites → vitesse $< c$ et changement de chiralité
 - angle Weigner définit masse bosons W et Z : $M_W = \cos \theta_W M_Z$, définit aussi complotage avec Z (voir livre LHC p55)
 - radioactivité lié à entropie, effet tunnel, chiralité gauche
 - utilisation de norme comme produit → anti-associativité, propagation (probabilité) 2D

- *particule sans masse = propagation 2D*
- *Particule droite/gauche selon isospin nul ou non*
- *théorie renormalisable : aucune constante de couplage de dimension puissance négative de la masse*
- *neutrino : pseudovecteur (produit vectoriel)*
- *quaternion as exponential ($\exp(ivt)$ où v vecteur) $\rightarrow \exp(\exp(ix))$? $\rightarrow \exp(-x^2)$?*
- *modules différents avec phase sans importance équivalent à phases différentes et module = 1 ???*
- *reflet miroir = rotation dans dimension supplémentaire*
- *pseudoscalaire de Clifford = espace commun*
- $\bar{q} = -1/2 (q + iqi + jqj + kqk) \rightarrow$ utile ? bof