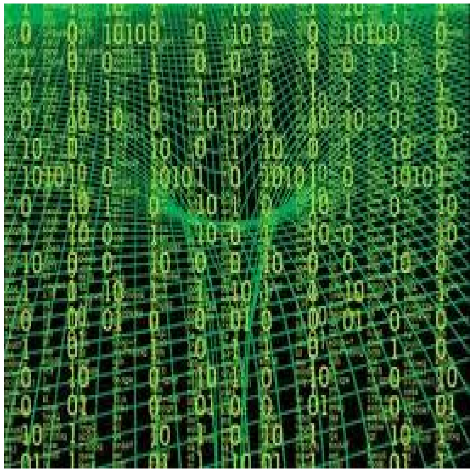 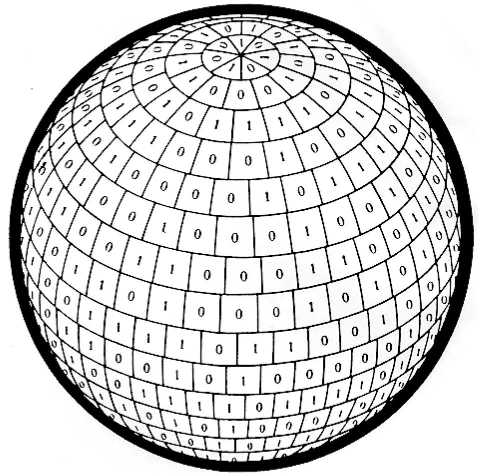 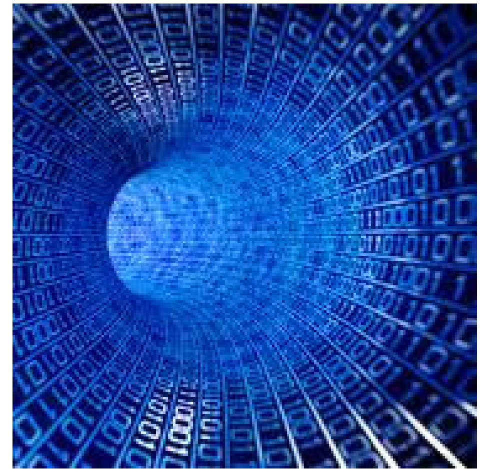

The Higgs and the Pervasive Nature of Quantum Entanglement

Dallas IEEE Computer Society
Mar 8, 2013
UT Dallas Campus

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www.TauQuernions.org

Abstract

Are you curious about the Higgs boson that captured everyone's attention last year? This talk discusses a new model of the Higgs Boson based entirely on quantum entanglement's Bell and Magic states (see www.TauQuernions.org). I will introduce and discuss:

- How entanglement originates from quantum computing (qubits are NOT part of the Standard Model),
- The nature of quantum non-locality for ebits (many things acting non-locally as one),
- Why entanglement is irreversible (due to information erasure),
- How entanglement becomes the basis for 3+1d space itself (TauQuernions are entangled Quaternions),
- How the entangled TauQuernions form the Higgs.

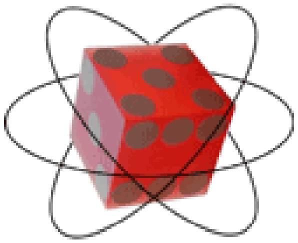
Additionally, we predict "dark bosons" (3D rotations of TauQuernions) that combine to form 4 variants of dark matter. We also predict two Higgs decay forms using our novel state classification system.

During the talk, I will demonstrate the custom Python-based symbolic math tools we developed. These tools allowed an information-theoretic analysis over all the states of our finite and discrete algebras (Geometric Algebra), leading ultimately to a novel entropically-driven Bit Bang model of the universe.

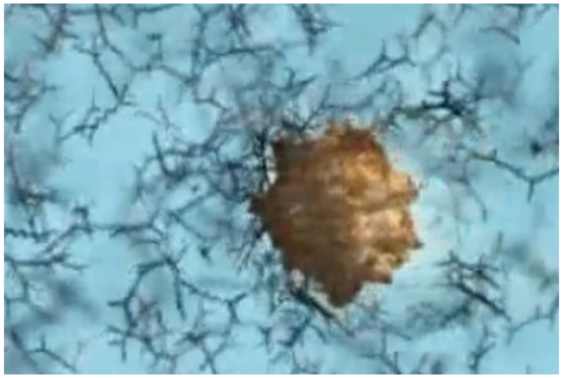
This presentation is intended for an audience of non-technical, CS, EE and Physics personnel. So everyone curious about the informational nature of entanglement, the Higgs and dark matter is welcome. This presentation is being recorded and will be available on YouTube.

Summary of Talk

- Quantum Entanglement is:
  - From Qubits/Ebits (not classical nor standard model)
  - High Dimensional for n ≥ 4
  - Probability amplitudes (non-local waves)
  - Non-local correlations (EPR/Bell's Theorem)
  - Pervasive and stable due to irreversibility

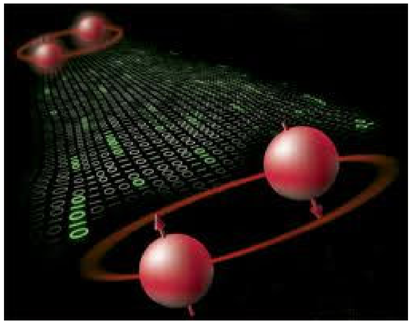


- Quantum Entanglement underlies:
  - Quantum Computing (e.g. Shor's algorithm)
  - Entangled 3D+1 TauQuernion Space
  - Higgs Field and Higgs Boson
  - Dark Bosons and Dark Matter

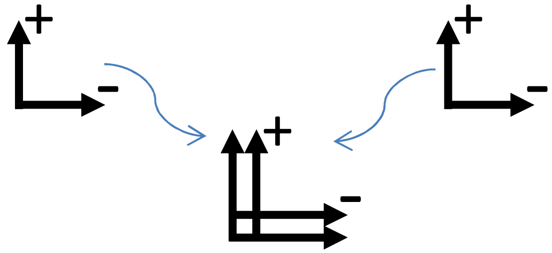


Definition of Entanglement:

Entanglement is a quantum property:

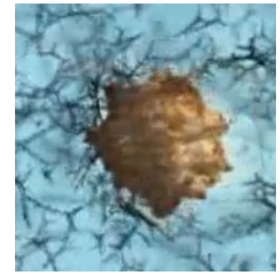


- Only Quantum systems (not classical)
- Non-local due to high dimensions
- Einstein's "Spooky action at a distance"
- EPR and Bell/Magic states/operators are well defined
- Property known as *inseparable* quantum states
- Bell/Magic Operators are irreversible in GALG*
- Multiple things (Qubits) acting as one thing (Ebit)

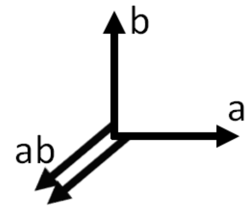


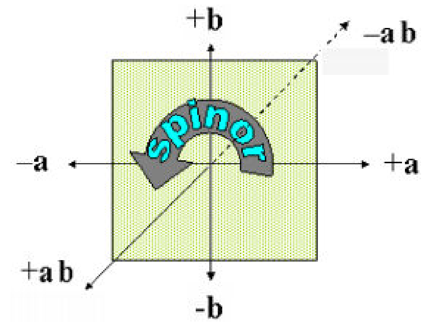
* Geometric Algebra

Geometric Algebra Summary

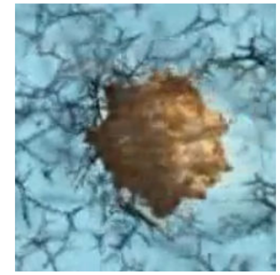


- Vectors, bivector, trivectors, n-vectors, multivectors
- Multivector Spaces (for G_n size is $3^{(2**n)}$)
  - G_0 is size 3: {0, ±1}
  - G_1 is size 9: {0, ±1, ±**a**}
  - G_2 is size 81: {0, ±1, ±**a**, ±**b**, ±**ab**}
  - G_3 is size 6,561: {0, ±1, ±**a**, ±**b**, ±**c**, ±**ab**, ±**ac**, ±**bc**, ±**abc**}
  - G_4 is size 43,046,721: {0, ±1, ±**a**, ±**b**, ±**c**, ±**d**, …, ±**bcd**, ±**abcd**}





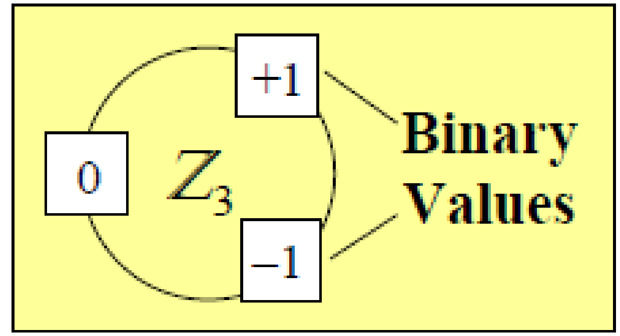
- Anti-commuting vector space
  - **ab** = –**ba** → $(\mathbf{ab})^2$ = **abab =** –1 so any bivector **xy** = $\sqrt{-1}$ is spinor *i*
- Arithmetic Operators over Z_3 = {±1=T/F, 0=does not exist}
  - +, * (geometric ~ ⊗), outer (**a**^**a**=0,**a**^**b**=**ab**), inner (**a•a**=1,**a•b**=0)
- Co-occurrence (+) & co-exclusion: (**a**-**b**)+(-**a**+**b**)=0 implies **ab**
- Row vector truth table duality (e.g. ±(1+**a**)(1+**b**)=[0 0 0 **±**]).



Geometric Algebra Tools

Custom symbolic math tools in Python (operator overloading):

C:\python -i qubits.py



>>> **a+a** ← **Mod3 addition for change based logic (xor)**

- a

>>> **b^a** ← **anticommutative bivectors**

- (a^b)

>>> **c^b^a** ← **anticommutative trivectors**

- (a^b^c)

>>> **(1+a)(1+b)(1+c)** ← **Smallest vector state contains all algebraic terms**

+ 1 + a + b + c + (a^b) + (a^c) + (b^c) + (a^b^c) ← **Row vector state equivalent [0000 000+]**

>>> **a0** ← **Single Qubit State**

+ a0

>>> **A** ← **Classical Qubit A**

+ a0 - a1

>>> **Sa** ← **Qubit Spinor**

+ (a0^a1)

>>> **Sa*Sa** ← **so Spinor = sqrt(-1)**

-1

>>> **A*Sa** ← **Superposition**

+ a0 + a1

>>> **A*B** ← **Quantum Register** (where **B = + b0 - b1**)

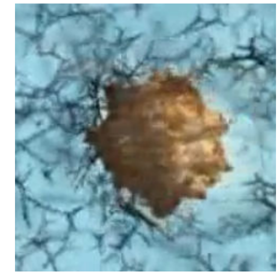
+ (a0^b0) - (a0^b1) - (a1^b0) + (a1^b1)

```
>>> gastates(ab)
<table for + (a^b)>
INPUTS: a b | OUTPUT
----------------------
ROW 00: - - | +
ROW 01: - + | -
ROW 02: + - | -
ROW 03: + + | +
----------------------
Counts for outputs of ZERO=0, PLUS=2, MINUS=2 for TOTAL=4 rows
>>> report2(ab)
2.170 ((0, 2, 2), 1) [+ - - +] = + (a^b)
>>> report2((1+a)(1+b))
1.755 ((0, 1, 3), 3) [0 0 0 +] = + 1 + a + b + (a^b)
>>> report2((1+a)(1+b)+(1-a)(1-b))
2.170 ((0, 2, 2), 1) [+ 0 0 +] = - 1 - (a^b)
>>>
```

← **Truth Table of row vector output states**

← **Bits, sig, vector, = expr**

Space and Time Proto-Physics



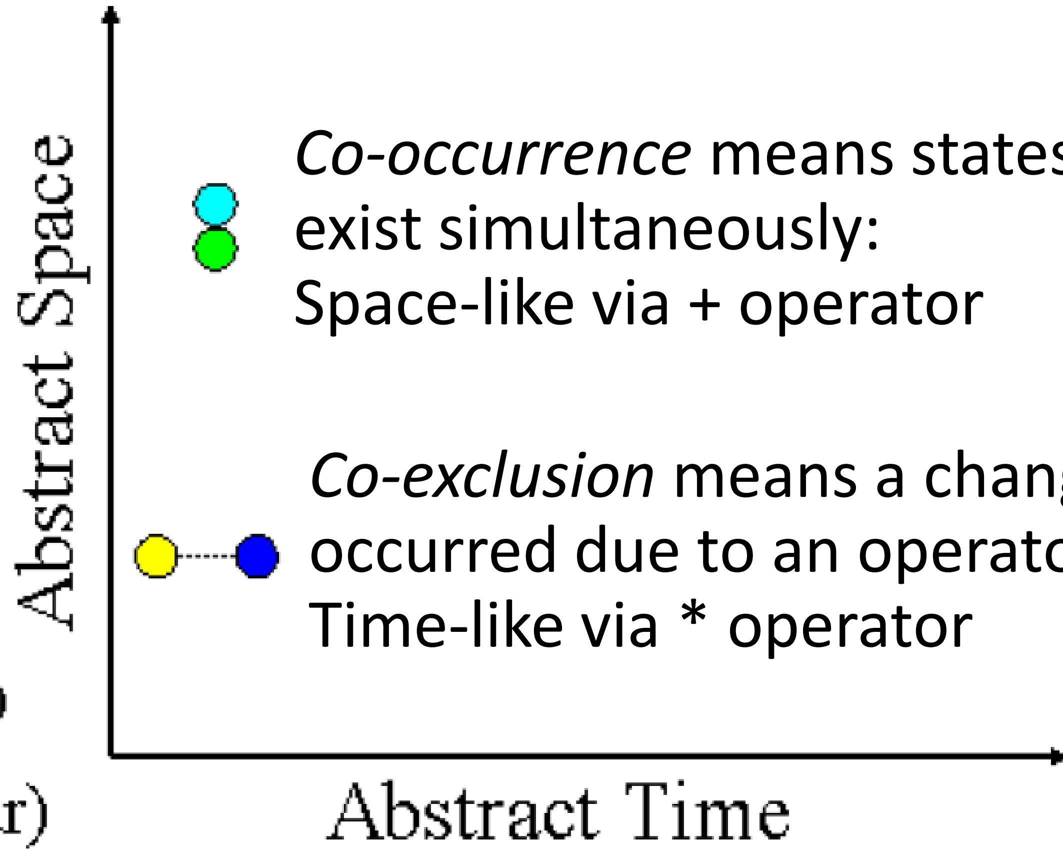
$a + b = b + a$

$c - d \longleftrightarrow d - c$

$c - d \,|\, d - c$

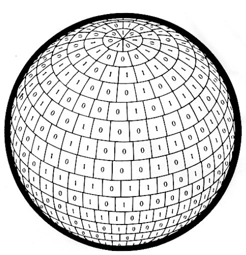
$c - d + d - c = 0$

(or cannot occur)



Co-occurrence means states exist simultaneously: Space-like via + operator

Co-exclusion means a change occurred due to an operator: Time-like via * operator



"Information is Physical" by Rolf Landauer

"It from Bit" in Black Holes by John Wheeler

Coin Demo: Act I

Setup:

Person stands with both hands behind back

Act I part A: 

Person shows hand containing a coin then hides it again

Act I part B: 

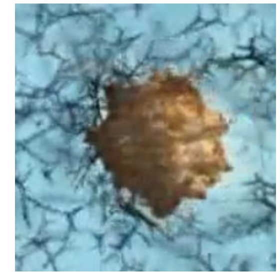
Person again shows a coin (indistinguishable from 1st)

Act I part C:

Person asks: “How many coins do I have?”

Represents one bit: either has 1 coin or has >1 coin

Coin Demo (continued)



Act II:

Person holds out hand showing two identical coins

We receive one bit since ambiguity is resolved!

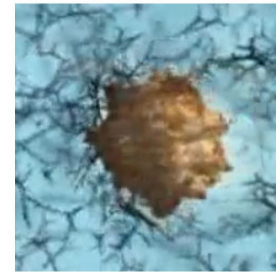
Act III:

Asks: "*Where* did the bit of information come from?"

Answer: *Simultaneous* presence of the 2 coins!

Non-Shannon space-like information derives from simultaneity!

Complexity Signatures



Multivector = Equivalent Row Vector	Multivector = Equivalent Row Vector	
abc = [− + + − + − − +]	**abc** = [− + + − + − − +]	→(0, 4, 4)
+1 = [+ + + + + + + +]	−1 = [− − − − − − − −]	
abc+1 = [0 − − 0 − 0 0 −]	**abc**−1 = [+ 0 0 + 0 + + 0]	→(0, 4, 4)

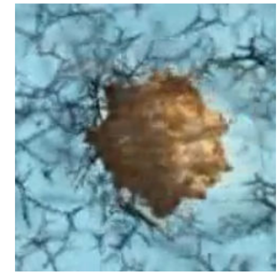
Given any multivector in $\mathbb{G}_n$ and its corresponding row vector, compute a tuple (#0s, #+s, #–s) based on the counts of elements in the row vector. The sorted tuple, represents the state complexity of the multivector.

Space	Signature	Count	Description	Structural complexity	Bits
n=0	(0, 0, 1)	3	Scalars {0, ±1} → [±]	0	0
n=1	(0, 0, 2)	3	Scalars {0, ±1} → [±±]	0	1.58
all=9	(0, 1, 1)	6	Vectors ±**x** & ±1±**x** → [±∓]	1	0.58
n=2	((0, 0, 4), 0)	3	Scalars {0, ±1} → [±±±±]	0	4.75
all=81	((0, 1, 3), 3)	24	Row Decode ±(1±**x**)(1±**y**)	3	1.75
	((0, 2, 2), 1)	18	Singletons ±**x** and ±**xy**	1	**2.17**
	((1, 1, 2), 2)	36	±**x** ± **y** and ±1 ± **x** ± **y**	2	**1.17**

Add structural complexity (singleton count) to the signature to support larger spaces.

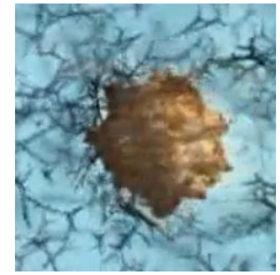
* Coin Demo 1.000 bit = 2.17 – 1.17

More Signatures in $\mathbb{G}_3$ & $\mathbb{G}_4$

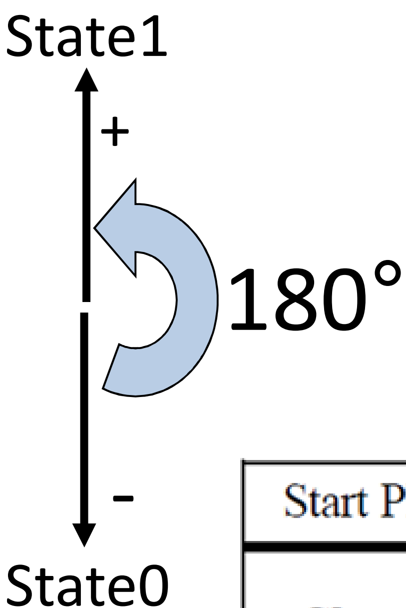


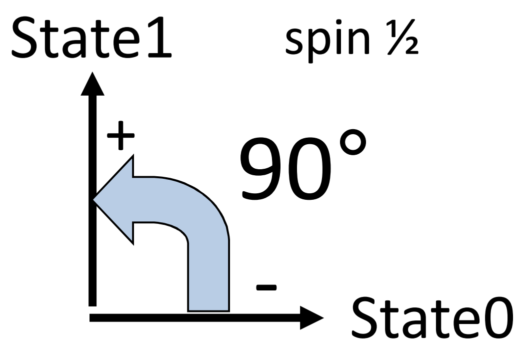
Space	Signature	Count	Description	Bits
n=3	((0, 0, 8), 0)	3	Scalars {0, ±1} → [±±±± ±±±±]	11.1
6,561	((0, 1, 7), 7)	48	Row Decode ±(1±**w**)(1±**x**)(1±**y**) →[±000 0000]	7.09
	((0, 2, 6), 3)	168	±**x** ±**y** ±**xy**	**5.29**
	((0, 3, 5), 6)	336	±**x** ±**y** ±**xy** ±**xz** ±**yz** ±**xyz**	**4.29**
	((0, 4, 4), 1)	42	Singletons ±**x**, ±**xy** and ±**xyz**	**7.29**
	((0, 4, 4), 4)	168	Some variations of ±**y** ±**z** ±**xy** ±**xz**	**5.29**
	((2, 2, 4), 2)	252	Co-occurrence ±**x** ±**y** is a qubit	4.70
	((2, 3, 3), 3)	672	Co-occurrence ±**x** ±**y** ±**z** is a photon	**3.29**
	<not shown 5 signatures of 14 total bins>			
	((1, 3, 4), 4)	1,344	Smallest information content in $\mathbb{G}_3$(e.g. ±**a**±**b**±**c**±**xy**)	2.29
n=4	((0, 0, 16), 0)	3	Scalars {0, ±1} → [±±±± ±±±± ±±±± ±±±±]	23.8
$3^{(2**n)}$	((0, 1, 15), 15)	96	Row Decode ±(1±**w**)(1±**x**)(1±**y**)(1±**z**)	18.8
	((0, 8, 8), 1)	90	Singletons ±**x**, ±**xy**, ±**xyz** and ±**wxyz**	**18.9**
	((4, 4, 8), 2)	1,260	Co-occurrence ±**x** ±**y**, ±**wx** ±**yz** , ±**w** ±**xyz**	15.1
	<not shown 81 signatures of 86 total bins>			
	((4, 5, 7), 11)	5,040K	Smallest information content in $\mathbb{G}_4$ (11 singletons)	**3.09**

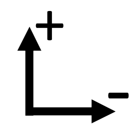
Qubit: a bit in Superposition



Classical bit states: Mutually Exclusive	Quantum bit states: Orthogonal







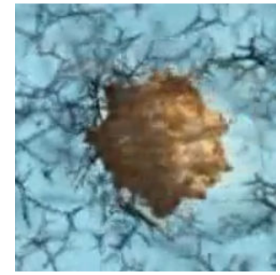
$$state0_0 = |0\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$state1_0 = |1\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

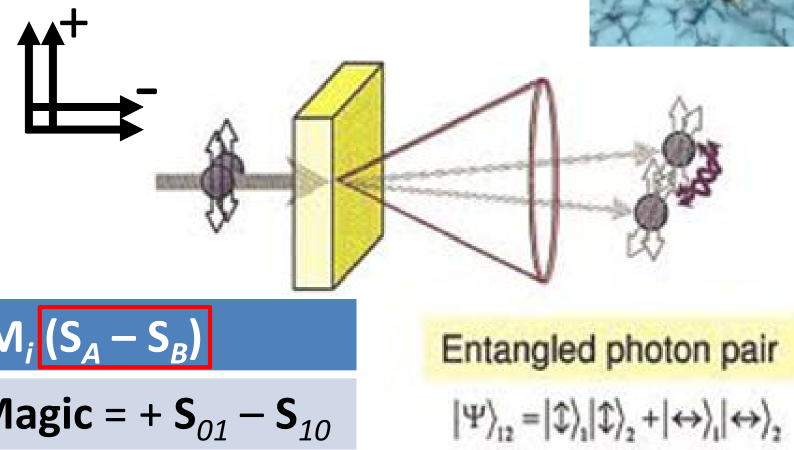
$$c_0 |0\rangle + c_1 |1\rangle$$

Start Phase	Qubit State	Each times spinor	Final State	Final Phase
Classical	**+ a0 – a1**	+**a0 (a0 a1) =** +**a1**	**+ a0 + a1**	*Superposed*
	– a0 + a1	–**a0 (a0 a1) =** –**a1**	**– a0 – a1**	
Superposed	**+ a0 + a1**	+**a1 (a0 a1) =** –**a0**	**– a0 + a1**	**Classical**
	– a0 – a1	–**a1 (a0 a1) =** +**a0**	**+ a0 – a1**	

Ebits: Entangled Qubits



- Bell/Magic Operators (in $\mathbb{G}_4$):
  - **Bell** operator = $\mathbf{S_A + S_B = a0\ a1 + b0\ b1}$
  - **Magic** operator = $\mathbf{S_A - S_B = a0\ a1 - b0\ b1}$
- Bell/Magic States B_i and M_i form rings:

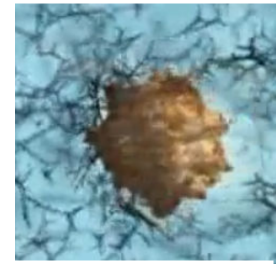


$B_{(i+1)mod4} = B_i\,(S_A + S_B)$	$M_{(i+1)mod4} = M_i\,(S_A - S_B)$
$B_0 = \mathbf{A_0\ B_0}$ **Bell** $= -\mathbf{S}_{00} + \mathbf{S}_{11} = \Phi^+$	$M_0 = \mathbf{A_0\ B_0}$ **Magic** $= +\mathbf{S}_{01} - \mathbf{S}_{10}$
$B_1 = B_0$ **Bell** $= +\mathbf{S}_{01} + \mathbf{S}_{10} = \Psi^+$	$M_1 = M_0$ **Magic** $= -\mathbf{S}_{00} - \mathbf{S}_{11}$
$B_2 = B_1$ **Bell** $= +\mathbf{S}_{00} - \mathbf{S}_{11} = \Phi^-$	$M_2 = M_1$ **Magic** $= -\mathbf{S}_{01} + \mathbf{S}_{10}$
$B_3 = B_2$ **Bell** $= -\mathbf{S}_{01} - \mathbf{S}_{10} = \Psi^-$	$M_3 = M_2$ **Magic** $= +\mathbf{S}_{00} + \mathbf{S}_{11}$
$B_0 = B_3$ **Bell** $= -\mathbf{S}_{00} + \mathbf{S}_{11} = \Phi^+$	$M_0 = M_3$ **Magic** $= +\mathbf{S}_{01} - \mathbf{S}_{10}$

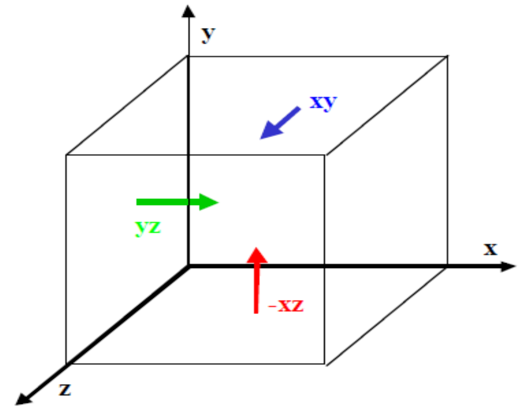
$$\Phi^{\pm} = |00\rangle \pm |11\rangle$$
$$\Psi^{\pm} = |01\rangle \pm |10\rangle$$

- Cannot factor: $-\mathbf{a0\ b0} + \mathbf{a1\ b1}$ (Inseparable)
- **Bell** and **Magic** operators are irreversible in $\mathbb{G}_4$ (different from Hilbert spaces)
  - See proof that $1/(\mathbf{S_A} \pm \mathbf{S_B})$ does not exist for Bell (or Magic) operators
- Multiplicative Cancellation – *Information erasure is irreversible*
  - **Qubits** $\mathbf{A_0\ B_0 = + a0\ b0}$ $\underline{\mathbf{- a0\ b1 - a1\ b0}}$ $\mathbf{+ a1\ b1}$ $= \underline{B}_3 + M_3$
  - $0 =$ **Bell** * **Magic** = **Bell** * M_j = **Magic** * $B_i = B_i * M_j$

TauQuernions: Entangled Quaternions



- **TauQuernions ($\mathcal{T}_i$, $\mathcal{T}_j$, $\mathcal{T}_k$ & conjugate set $\mathcal{T}_i'$, $\mathcal{T}_j'$, $\mathcal{T}_k'$):**
  - Entangled Quaternion isomorphs
  - $\mathcal{T}_i$ = **ab – cd**, $\mathcal{T}_j$ = **ac + bd** and $\mathcal{T}_k$ = **ad – bc**
  - $\mathcal{T}_i'$= **ab + cd**, $\mathcal{T}_j'$= **ac – bd** and $\mathcal{T}_k'$= **ad + bc**
  - Anti-Commutative: $\mathcal{T}_x \mathcal{T}_y = -\mathcal{T}_x \mathcal{T}_y$
  - $\mathcal{T}_i \mathcal{T}_j \mathcal{T}_k$ = 1 + **abcd** = "–1" (sparse –1)
  - ("–1")^2 = "+1" = –1 ±**abcd** (sparse +1:idempotent)



Quaternions i,j,k:
{xy, xz, yz}

```
>>> report4(1-abcd)
18.868 ((0, 8, 8), 1) [0 - - 0 - 0 0 - - 0 0 - 0 - - 0] = + 1 - (a^b^c^d)
>>> report4(-1-abcd)
18.868 ((0, 8, 8), 1) [+ 0 0 + 0 + + 0 0 + + 0 + 0 0 +] = - 1 - (a^b^c^d)
```

*	$\mathcal{T}_i$	$\mathcal{T}_j$	$\mathcal{T}_k$
$\mathcal{T}_i$	1 + **abcd**	**–ad + bc**	**ac + bd**
$\mathcal{T}_j$	**ad – bc**	1 + **abcd**	**–ab + cd**
$\mathcal{T}_k$	**–ac – bd**	**ab – cd**	1 + **abcd**

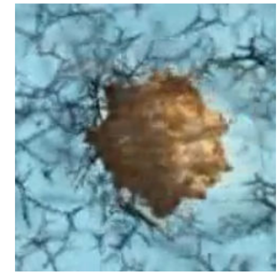
*	$\mathcal{T}_i$	$\mathcal{T}_y$	$\mathcal{T}_k$
$\mathcal{T}_i$	"–1"	$-\mathcal{T}_k$	$\mathcal{T}_j$
$\mathcal{T}_j$	$\mathcal{T}_k$	"–1"	$-\mathcal{T}_i$
$\mathcal{T}_k$	$-\mathcal{T}_j$	$\mathcal{T}_i$	"–1"

$\mathcal{T}_i$	$\mathcal{T}_j$	$\mathcal{T}_k$
Magic	$M_3 = -M_1$	$M_0 = -M_2$
Magic	$M_3 = -M_1$	$M_2 = -M_0$
Magic	$M_1 = -M_3$	$M_0 = -M_2$
Magic	$M_1 = -M_3$	$M_2 = -M_0$

$\mathcal{T}_i'$	$\mathcal{T}_j'$	$\mathcal{T}_k'$
Bell	$B_2 = -B_0$	$B_1 = -B_3$
Bell	$B_2 = -B_0$	$B_3 = -B_1$
Bell	$B_0 = -B_2$	$B_1 = -B_3$
Bell	$B_0 = -B_2$	$B_3 = -B_1$

use $-\mathcal{T}_i$ as the Higgs own anti-particles

Bosons $X^2=0$ (Nilpotents)

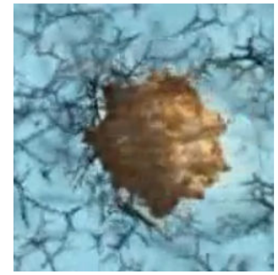


Find all bosons in $\mathbb{G}$ using: gasolve([a,b, …], lambda X: X*X, 0)

Space	Count	Boson Multivector	Boson Description
$\mathbb{G}_0$ & $\mathbb{G}_1$	**Total** 0	Exclude 0 from this table	$0^2=0$
$\mathbb{G}_2$	**Total** 8		(qubit space)
	8	**±x ±xy** = **±x***(1 ± **y**)	Weak Force Bosons W/Z
$\mathbb{G}_3$	**Total 80**	***quarks are: ±x ±yz**	**(Standard model Space)**
	8	**±a ±b ±c**	Photonic Boson (Qutrit)
	24	**±x ±xy**	Weak Force Bosons in $\mathbb{G}_3$
	8	**±ab ±ac ±bc**	Quaternions are bosonic
	24	**±x ±z ±xy ±yz**	Mesons are two quarks
	16	**±x ±y ±z ±xy ±xz ±yz**	Strong Force (Gluons)
$\mathbb{G}_4$	**Total 7,280**		**30 Different signatures**
	80	**±x ±xy** and **±w ±xyz**	Weak and Dark Bosons
	528	(**ab** - **cd**) + (**ac** + **bd**) + (**ad** - **bc**) & …	16 Higgs Boson & others
	…	…	28 more signatures

$\mathbb{G}_3$ is equivalent to Pauli Algebra and $\mathbb{G}_4$ contains Dirac Algebra. Also Parsevals Identity

Particles $X^2=1$ (Unitary)

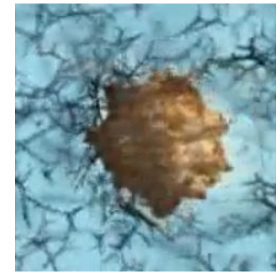


Find all Unitaries in $\mathbb{G}$ using: gasolve([a,b, ...], lambda X: X*X, 1)

Space	Count	Unitary Multivector	Particle Description
$\mathbb{G}_1$	**Total** 2	± **a**	Exclude scalar value of ±1
$\mathbb{G}_2$	**Total** 12		(qubit space)
	4	±**x**	Vectors are distinctions
	8	±**a** ±**b** ±**ab**	Neutrinos
$\mathbb{G}_3$	**Total 90**	***quarks are: ±x ±yz**	**(Standard model Space)**
	6	±**x**	Vectors are distinctions
	24	±**x** ±**y** ±**xy**	Neutrinos (3x8=24)
	12	±**xy** ±**xz**	Electrons (3x4=12)
	48	±**x** ±**y** ±**z** ±**xy** ±**xz**	Protons (neutrons = xyz protons)
$\mathbb{G}_4$	**Total 12,690**		**17 Different signatures**
	10	±**x** and ±**wxyz**	Vectors and Mass Carrier
	…	…	16 more signatures

For $\mathbf{X}^2 = \mathbf{X}$ (Idempotent) and $\mathbf{U}^2 = 1$ (Unitary) then $\mathbf{X} = -1 \pm \mathbf{U}$ (proof $\mathbf{X}^2 = (-1 \pm \mathbf{U})^2 = \mathbf{X}$)

Standard Model in $\mathbb{G}_2$ & $\mathbb{G}_3$



Name	U	D	$\bar{U}$	$\bar{D}$
Form	$a+bc$	$-a+bc$	$-a-bc$	$a-bc$
Charge	$+\frac{2}{3}$	$-\frac{1}{3}$	$-\frac{2}{3}$	$+\frac{1}{3}$
Color	r	$\bar{r}$	$\bar{r}$	r

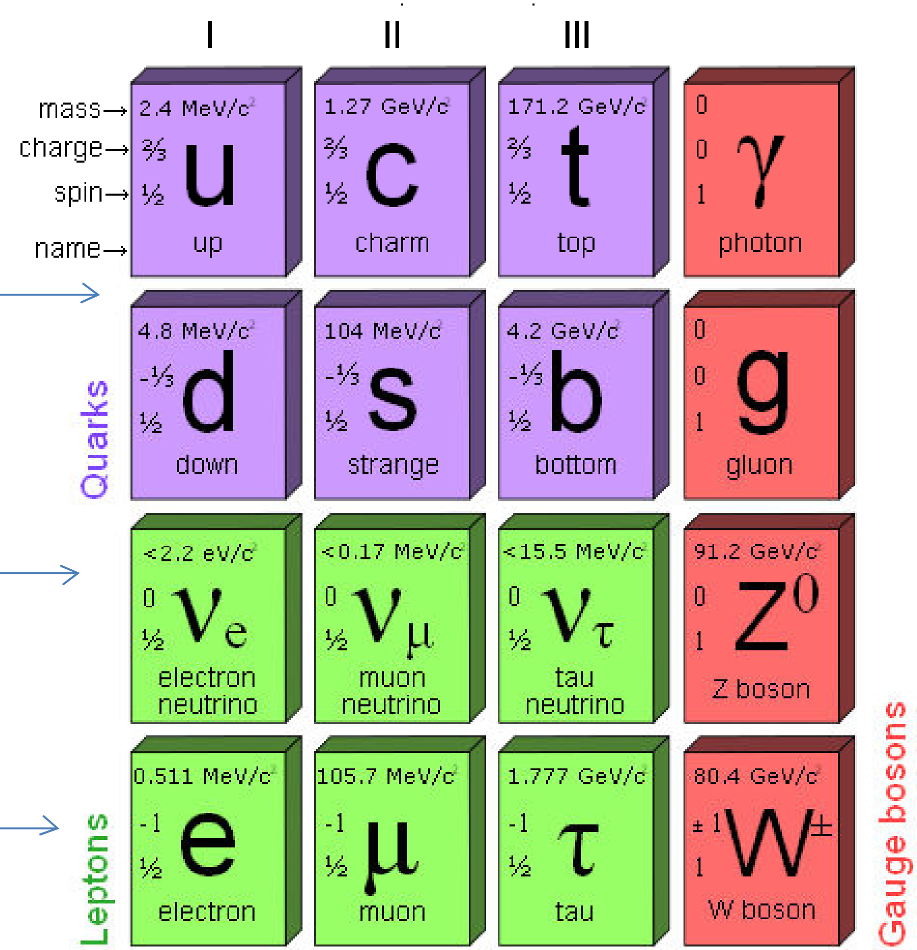
Name	C	S	$\bar{C}$	$\bar{S}$
Form	$b+ac$	$-b+ac$	$-b-ac$	$b-ac$
Charge	$+\frac{2}{3}$	$-\frac{1}{3}$	$-\frac{2}{3}$	$+\frac{1}{3}$
Color	g	$\bar{g}$	$\bar{g}$	g

Name	T	B	$\bar{T}$	$\bar{B}$
Form	$c+ab$	$-c+ab$	$-c-ab$	$c-ab$
Charge	$+\frac{2}{3}$	$-\frac{1}{3}$	$-\frac{2}{3}$	$+\frac{1}{3}$
Color	b	$\bar{b}$	$\bar{b}$	b

Z_5

Name	*Form*	*Vector* ($\mathcal{G}_2$)	*Signature*	*Bits*
ν	$a+b+ab$	$[---0]$	$(0,1,3),3$	1.75
ν_μ	$a-b-ab$	$[--0-]$	"	"
ν_τ	$-a+b-ab$	$[-0--]$	"	"
$\Sigma\ =$	$a+b-ab$	$[0+++]$	"	"
$\bar{\nu}$	$-a-b-ab$	$[+++0]$	"	"
$\bar{\nu}_\mu$	$-a+b+ab$	$[++0+]$	"	"
$\bar{\nu}_\tau$	$a-b+ab$	$[+0++]$	"	"
$\Sigma\ =$	$-a-b+ab$	$[0---]$	"	"

Name	*Form*	*Vector* ($\mathcal{G}_3$)	*Signature*	*Bits*
e	$ab+ac$	$[-00++00-]$	$(2,2,4),2$	4.70
$\bar{e}$	$-ab-ac$	$[+00--00+]$	"	"
e^-	$ab-ac$	$[0-+00+-0]$	"	"
$\bar{e}^-$	$-ab+ac$	$[0+-00-+0]$	"	"
μ	$ab+bc$	$[-0+00+0-]$	"	"
$\bar{\mu}$	$-ab-bc$	$[+0-00-0+]$	"	"
μ^-	$ab-bc$	$[0-0++0-0]$	"	"
$\bar{\mu}^-$	$-ab+bc$	$[0+0--0+0]$	"	"
τ	$ac+bc$	$[-+0000+-]$	"	"
$\bar{\tau}$	$-ac-bc$	$[+-0000-+]$	"	"
τ^-	$ac-bc$	$[00-++-00]$	"	"
$\bar{\tau}^-$	$-ac+bc$	$[00+--+00]$	"	"



Higgs Bosons are Entangled

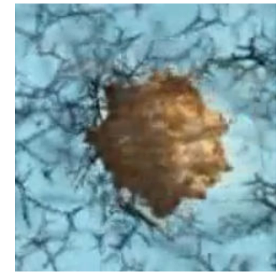
- The proposed Higgs Boson in $\mathbb{G}_4$:
  - $\mathcal{H} = \boldsymbol{\mathcal{T}}_i + \boldsymbol{\mathcal{T}}_j + \boldsymbol{\mathcal{T}}_k$ (where $\mathcal{H}^2 = 0$)
  - Eight triples: $\pm\boldsymbol{\mathcal{T}}_i \pm\boldsymbol{\mathcal{T}}_j \pm\boldsymbol{\mathcal{T}}_k$ (and 8 more for $\pm\boldsymbol{\mathcal{T}}_i' \pm\boldsymbol{\mathcal{T}}_j' \pm\boldsymbol{\mathcal{T}}_k'$)
- Also various factorizations:
  - $\mathcal{H} = (\pm 1 \pm \mathbf{abcd})(\mathbf{ab} + \mathbf{ac} + \mathbf{bc})$ Time-like mass acts on Space
  - $\mathcal{H} = (\mathbf{a} + \mathbf{b} - \mathbf{c})\mathbf{d} + \mathbf{ab} + \mathbf{ac} - \mathbf{bc}$ Light and space
  - $\mathcal{H}$ is its own anti-particle (when using $-\boldsymbol{\mathcal{T}}_i$)
- The Higgs $\mathcal{H}$ and proto-mass $\mathcal{M}$ cover even subalgebra:
  - $\mathcal{H} = \{\mathbf{X} = \pm\, \mathbf{ab} \pm \mathbf{ac} \pm \mathbf{bc} \pm \mathbf{ad} \pm \mathbf{bd} \pm \mathbf{cd} \mid \mathbf{X}^2 = 0\}$ (16)

    For X = $\mathcal{H}$ then $\mathbf{X\ abcd} = \mathbf{abcd\ X} = \pm\, \mathbf{X}$
  - $\mathcal{M} = \{\mathbf{X} = \pm \mathbf{ab} \pm \mathbf{ac} \pm \mathbf{bc} \pm \mathbf{ad} \pm \mathbf{bd} \pm \mathbf{cd} \mid \mathbf{X}^2 = \pm \mathbf{abcd}\}$ (48)

    For X = $\mathcal{M}$ then only $\mathbf{X\ abcd} = \mathbf{abcd\ X}$

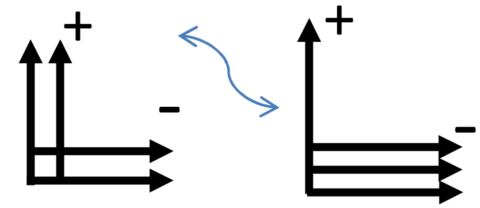
    sig ((4, 6, 6), 6) = 32 and sig ((0, 6, 10), 6) = 16

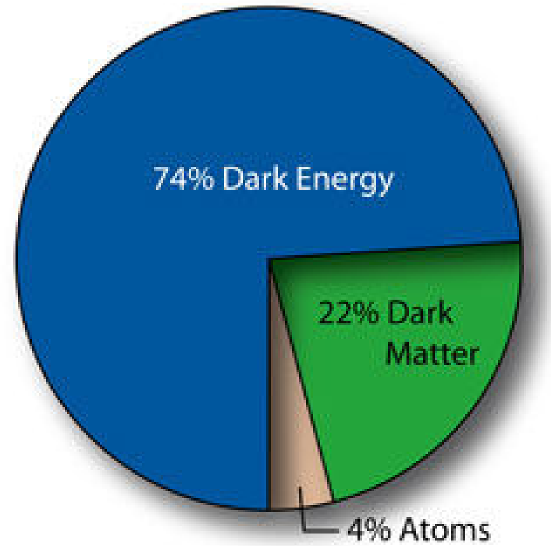
Dark Bosons are also Entangled



(**wx**+**yz**)(**xyz**) = (–**x**+**wyz**) and also (**w**+**xyz**)(**wxy**) = (**wz**+**xy**)

State Name	Entangled State	$\mathcal{D}_B$ = State * (wxy)†
Bell	+ **wx** + **yz**	– **y** – **wxz**
B0	– **wy** + **xz**	– **x** + **wyz**
B1	+ **wz** + **xy**	– **w** – **xyz**
B2	+ **wy** – **xz**	+ **x** – **wyz**
B3	– **wz** – **xy**	+ **w** + **xyz**
Magic	+ **wx** – **yz**	– **y** + **wxz**
M0	+ **wz** – **xy**	+ **w** – **xyz**
M1	– **wy** – **xz**	– **x** – **wyz**
M2	– **wz** + **xy**	– **w** + **xyz**
M3	+ **wy** + **xz**	+ **x** + **wyz**

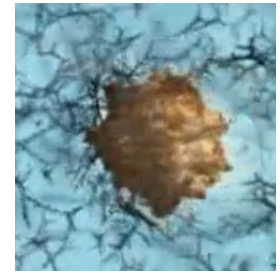




Quarks: ± **w** ± **xy**
Dark bosons: ± **w** ± **xyz**

† Results are dark bosons $\mathcal{D}_B$ where $(\mathcal{D}_B)^2 = 0$ and are entangled since $\mathcal{D}_B$ are not separable.

Dark Matter is Entangled



- Define set $\mathcal{D}$ as sum of 4 dark bosons (count 256) :

$\mathcal{D}$ = {(±**w** ±**xyz**) + (±**x** ±**wyz**) + (±**y** ±**wxz**) + (±**z** ±**wxy**)}

where $\mathcal{D}$ is the largest *odd sub-algebra* of $\mathbb{G}_4$ and rotations {**xyz** $\mathcal{D}$} = {–1 + **wxyz** + $\mathcal{H} \cup \mathcal{M}$}

- The elements of $\mathcal{D}^2$ form three (four) subsets:

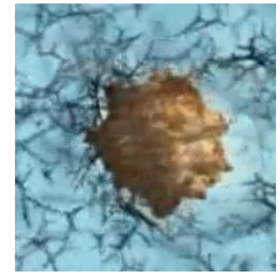
$\mathcal{D}_q$ = {$\mathcal{D}$ ∈ D | D^2 **=** **xy** + **xz** + **yz**} (count 128, sig ((2, 7, 7), 8), 6.87 bits)

$\mathcal{D}_0$ = {$\mathcal{D}$ ∈ D | D^2 **=** 0} (Bosons) (count 32, sig ((4, 4, 8), 8), 5.53 bits)

$\mathcal{D}_u$ = {$\mathcal{D}$ ∈ D | D^2 **=** (**w** + **x**)(**y** + **z**) & D^8 **=** 1 (2 qubits) (count 96)

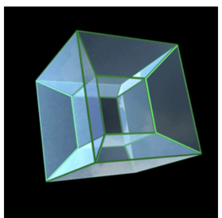
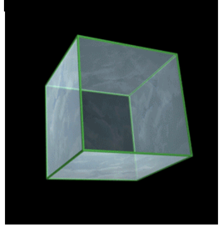
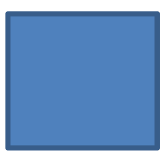
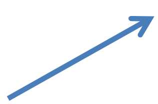
  - $\mathcal{D}_u$ with (count 80, sig ((4, 4, 8), 8), 5.53 bits)
  - $\mathcal{D}_u$ with (count 16, sig ((1, 1, 14), 8), 15.9 bits)

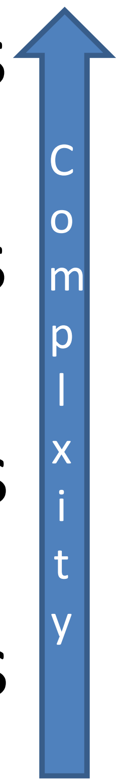
Big Bang Energy from Bit Bang?



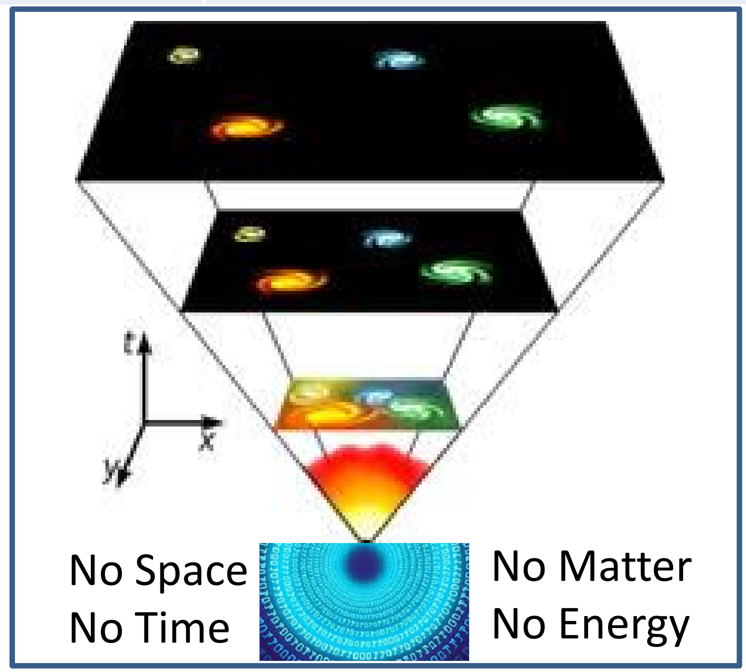
Bit Bang information growth as source of energy:

- Space-like co-occurrence of vectors (+) creates non-Shannon bits
- Time-like operator (*) creates new n-vectors, increasing diversity

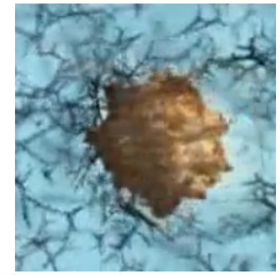
Space	Dims	Vectors
G_4		18.9 bits
G_3		7.29 bits
G_2		2.17 bits
G_1		0.58 bits



Operator	Informational Effect
+	Non-Shannon Information
*	Creates new n-vectors



Big Bang Fueled by Bit Bang

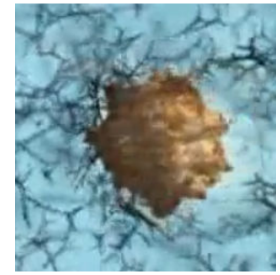


Particle/Form		Vector samples ($\mathbb{G}_3$)	Signature(s) ($\mathbb{G}_3$)	$\mathbb{G}_1$	$\mathbb{G}_2$	$\mathbb{G}_3$	$\mathbb{G}_4$
$\mathbb{G}_0$ (of size 3)							
Void → 0	is	[0 0 0 0 0 0 0 0]	∈ ((0, 0, 8), 0)	1.58	4.75	11.1	23.8
±1	are	[± ± ± ± ± ± ± ±]	∈ ((0, 0, 8), 0)	1.58	4.75	11.1	23.8
$\mathbb{G}_1$ (of size 9)							
a	±exist	[– – – – + + + +]	∈ ((0, 4, 4), 1)	0.58	2.17	7.29	18.9
1–**a**	measure	[– – – – 0 0 0 0]	∈ ((0, 4, 4), 1)	0.58	2.17	7.29	18.9
Row 0 (1-w)…(1-z)		[+ 0 0 0 0 0 0 0]	(0,1,1),(0,1,3),(0,1,7),(0,1,15)	0.58	1.75	7.09	18.8
$\mathbb{G}_2$ (of size 81)							
ab	±spin carrier	[+ + – – – – + +]	∈ ((0, 4, 4), 1)	-	2.17	7.29	18.9
1+**ab**		[– – 0 0 0 0 – –]	∈ ((0, 4, 4), 1)	-	2.17	7.29	18.9
a+**b**+**ab**	neutrino	[– – – – – – 0 0]	∈ ((0, 2, 6), 3)	-	1.75	5.29	15.6
a+**b**	qubit, co-occ	[+ + 0 0 0 0 – –]	∈ ((2, 2, 4), 2)	-	1.17	4.70	15.1
a+**ab**	Weak W,Z†	[0 0 + + 0 0 – –]	∈ ((2, 2, 4), 2)	-	1.17	4.70	15.1
$\mathbb{G}_3$ (of size 6561)							
abc	±charge carrier	[– + + – + – – +]	∈ ((0, 4, 4), 1)	-	-	7.29	18.9
a+**bc**	quarks	[0 + + 0 – 0 0 –]	∈ ((2, 2, 4), 2)	-	-	4.70	15.1
ab+**ac**	electron	[– 0 0 + + 0 0 –]	∈ ((2, 2, 4), 2)	-	-	4.70	15.1
a+**b**+**c**+**ab**+**ac**	proton	[– – – – 0 + + –]	∈ ((1, 2, 5), 5)	-	-	2.70	11.5
a+**b**+**c**	photon	[0 – – + – + + 0]	∈ ((2, 3, 3), 3)	-	-	3.29	12.1
ab+**ac**+**bc**	3-space	[0 – – – – – – 0]	∈ ((0, 2, 6), 3)	-	-	5.29	15.6
a+**b**+**c**+**ab**+**ac**+**bc**	gluon	[0 + + 0 + 0 0 0] g**2 = ±**abc**	∈ ((0, 3, 5), 6)	-	-	4.29	13.1
a+**b**+**c**+**ab**-**ac**+**bc**	EMF	[+ 0 – – 0 + – +] g**2 = 0	∈ ((2, 3, 3), 6)	-	-	2.70	7.08

† Tentative; bosons (nilpotent)

Higher Entropy | Lower Entropy

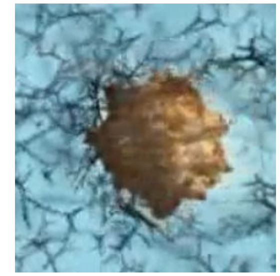
Entanglement, Mass & Higgs in $\mathbb{G}_4$

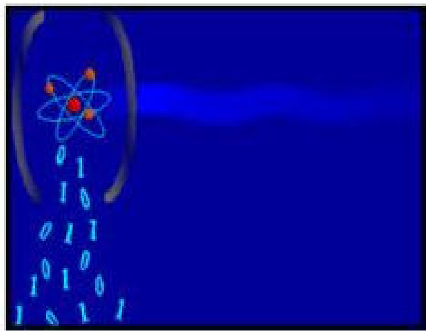


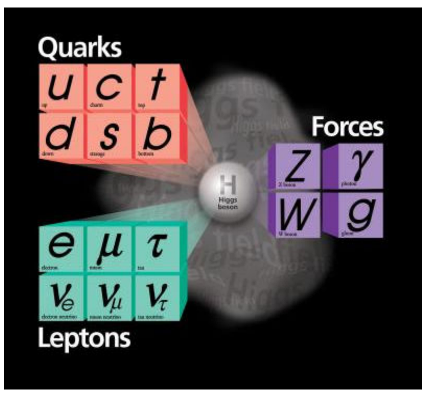
Particle/Form	Vector samples ($\mathbb{G}_4$)	Signature(s) ($\mathbb{G}_4$)	$\mathbb{G}_1$	$\mathbb{G}_2$	$\mathbb{G}_3$	$\mathbb{G}_4$
$\mathbb{G}_4$ (of size 43,046,721)						
abcd ±mass carrier	[+ − − + − + + − − + + − + − − +]	∈ ((0, 8, 8), 1)	-	-	-	18.9
1 − **abcd**	[0 − − 0 − 0 0 − − 0 0 − 0 − − 0]	∈ ((0, 8, 8), 1)	-	-	-	18.9
$\mathbf{A_0}$ $\mathbf{B_0}$ 2-qubits	[0 0 0 0 0 + − 0 0 − + 0 0 0 0 0]	∈ ((2, 2, 12), 4)	-	-	-	14.1
a+b+c+d	[− + + 0 + 0 0 − + 0 0 − 0 − − +]	∈ ((5, 5, 6), 4)	-	-	-	10.1
(a+b+c)d	[0 0 + − + − − + + − − + − + 0 0]	∈ ((4, 6, 6), 3)	-	-	-	12.1
$\mathcal{M}_1$ (16/64) proto-mass	[0 0 0 + 0 + + 0 0 + + 0 + 0 0 0]	∈ ((0, 6, 10), 6)	-	-	-	13.1
$\mathcal{M}_2$ (32/64) proto-mass	[+ + − 0 − 0 − + + − 0 − 0 − + +]	∈ ((4, 6, 6), 6)	-	-	-	7.08 *
$\mathcal{H}$ (16/64) Higgs	[− 0 + + 0 − + − − + − 0 + + 0 −]	∈ ((4, 6, 6), 6)	-	-	-	7.08 *
ab+cd = Bell = $\mathcal{T}_x'$	[− 0 0 − 0 + + 0 0 + + 0 − 0 0 −]	∈ ((4, 4, 8), 2)	-	-	-	15.1
ab−cd = Magic = $\mathcal{T}_x$	[0 − − 0 + 0 0 + + 0 0 + 0 − − 0]	∈ ((4, 4, 8), 2)	-	-	-	15.1
−ac + **bd** = $\mathbb{B}_0$	[0 + − 0 + 0 0 − − 0 0 + 0 − + 0]	∈ ((4, 4, 8), 2)	-	-	-	15.1
ad − **bc** = $\mathbb{M}_0$	[0 + − 0 − 0 0 + + 0 0 − 0 − + 0]	∈ ((4, 4, 8), 2)	-	-	-	15.1
a+bcd dark boson	[+ 0 0 + 0 + + 0 0 − − 0 − 0 0 −]	∈ ((4, 4, 8), 2)	-	-	-	15.1
$\mathcal{D}_0$ dark matter	[− 0 − 0 0 − 0 + − 0 + 0 0 + 0 +]	∈ ((4, 4, 8), 8)	-	-	-	5.53 *
$\mathcal{D}_q$ dark matter	[+ + − 0 + + − − + + − − 0 + − −]	∈ ((2, 7, 7), 8)	-	-	-	6.87 *
$\mathcal{D}_u$ (80/96) dark matter	[− − 0 0 0 0 − + − + 0 0 0 0 + +]	∈ ((4, 4, 8), 8)	-	-	-	5.53 *
$\mathcal{D}_u$ (16/96) dark matter	[+ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 −]	∈ ((1, 1, 14), 8)	-	-	-	15.9

* Higgs & dark matter states are *very common*; simple entangled states & **others** are *less so*

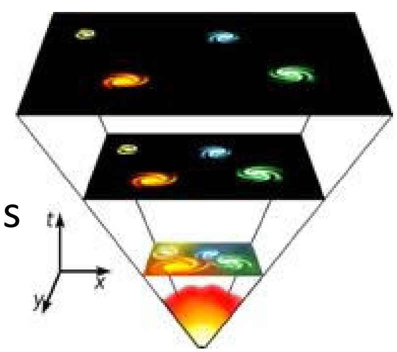
Novel Conclusions & Predictions







- ★ *Geometric Algebra* is useful computer science paradigm for quantum computing, and enables tool construction
- ★ Space/time proto-physics is connected to *non-Shannon* space-like information creation and release (Coin-Demo)
- ★ Data mining of nilpotents/idempotents/unitaries in $G_1 – G_3$ identifies the *Standard Model* bosons/fermions (*4 neutrinos*)
- ★ Qubits (in G_2) construct ebits (in G_4) and lead to novel results about *irreversibility* of Bell/Magic operators/states
- ★ *TauQuernions* form entangled 3-space with its entangled Higgs field supporting the proposed *Higgs Boson* in G_4
- ★ Odd sub-algebra of rotated Higgs produces entangled *Dark Bosons* and 4 forms of proposed *Dark Matter* (some bosons)
- ★ Complexity *Signatures* and Bit Content in $G_1 – G_4$ fuel information creation of *Bit Bang*
- ★ *Particle/Antiparticle* are co-exclusions (P+A=0)
- ★ *Entanglement pervades* Space, Higgs & Dark States



★ Means *novel* results reported in Dec 2012