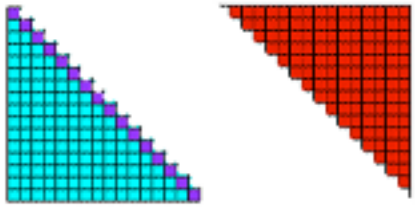
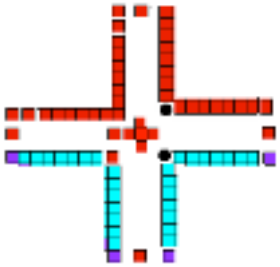
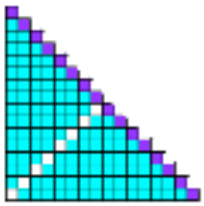
Vedic Meru and Nile Pyramid:

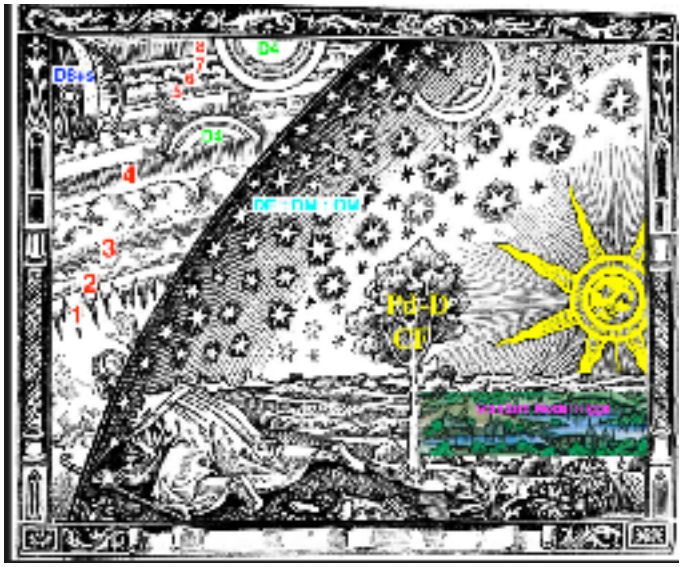
African IFA to RigVeda-Pachisi



to Tarot to Llull to E8 Physics







Flammarion's Naive Missionary Explorer sees

the intersection of Terrestrial Physics and AstroPhysics as a window
to
the Realm of Terrestrial-AstroPhysics Unification through E8 Physics.

(for details see viXra 1304.0071)

Vedic Meru and Nile Pyramid:
African IFA to RigVeda-Pachisi to Tarot
to Llull to Cartan-Dirac-Riesz-E8Physics

Frank Dodd (Tony) Smith, Jr. - 2013 - viXra 1305.0060

Abstract

Ancient Africa developed IFA divination with
256 Odu analagous to the Real Clifford Algebra Cl(8)
and 16 Orishas analagous to the 8+8 Spinors of Cl(8)
but in Africa IFA was transmitted by oral tradition and not written down.
50,000 years ago humans emerging from Africa via the Arabian Sea settled in India
where ideas of IFA were written in the Sanskrit Rig Veda and encoded in Pachisi.
40,000 years ago humans migrating down the Nile settled in Giza
where ideas of IFA were encoded in the Great Pyramid.
By about 500 B.C. Indian Vedic Pachisi evolved into Tarot.
By about 1300 A.D. Tarot and some ideas of IFA were known in Mallorca
where Ramon Llull used them to develop structures of the D4 and D8 Lie Algebras
that lived in the IFA Clifford Algebra Cl(8) and its tensor square Cl(8)xCl(8) = Cl(16).
Although Llull's work was preserved in writing in Mallorca, his ideas were rejected
by the Intellectual Establishment of Paris and remained dormant for centuries.

Around 1890 Killing and Cartan rediscovered Llull's Lie Algebras.
Only in the 1900s did the work of Cartan
as further developed mathematicaly by Jovet, Sauter, and Riesz
and as applied by Dirac to physics
show how a D8 half-Spinor could be added to D8 itself to get E8 Physics
and to see how E8 Physics lives inside IFA Cl(8).

It has taken until now (the 2000s) for the formal Written Human Culture
to catch up with the informal Oral Ancient African Culture
in understanding a realistic Unified Theory of the Laws of Nature.

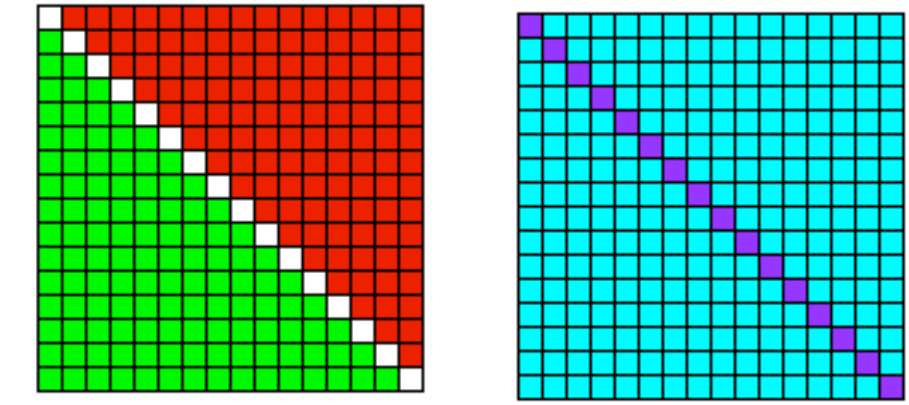
Table of Contents:

Introduction

The oldest and most comprehensive Information System of humans on Earth is
African IFA Divination based on 16x16 = 256 elements (tony5m17h.net/VoudouFA.html)
It corresponds mathematically to the Cl(8) Real Clifford Algebra
with graded structure 256 = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1
and algebraic structure of M(16,R) = 16x16 Matrices of Real Numbers.

Here is how E8 Physics of Gravity and the Standard Model is encoded in IFA:

256-dim 16x16 =
= 120-dim Antisymmetric16x16 + 136-dim Symmetric 16x16



For Antisymmetric 16x16 each red entry above the diagonal is the negative of the corresponding green entry below the diagonal and the 16 diagonal entries are zero so the number of Antisymmetric entries is 120 corresponding to the D8 Lie Algebra.

For Symmetric 16x16 each cyan entry above the diagonal is equal to the corresponding cyan entry below the diagonal and the 16 diagonal entries are non-zero so the number of Symmetric entries is 120+16 = 136.
8 of the 136 Symmetric entries of the IFA Cl(8) 16x16 Matrix do not correspond to E8
but
the other 136-8 = 128 = 64 + 64 correspond to 128-dim half-spinor of D8.

Since 248-dim E8 = 120-dim D8 + 128-dim half-spinor of D8
by E8 / D8 rank 8 Type EVIII space (OxO)P2 the Octo-Octonionic Projective Plane

256-dim IFA Cl(8) contains 120+128 = 248-dim E8
and
encodes the structure of E8 Physics of Gravity and the Standard Model.

Some details of the IFA encoding of E8 Physics is set out Appendix2.

African IFA to RigVeda-Pachisi

From its home in Africa the IFA Information System spread, like humanity itself,

throughout the Earth. Some of its descendant systems, such as

128-element Shinto Divination
64-element I Ching
16-element Ilm Al Raml

are straightforward subsets of 256-element IFA
but
the Rig Veda and its related game Pachisi has a more intricate relationship to IFA.

Within its African home IFA was never written down but was oral tradition
but
when humans left Africa they had less of the direct contact with their Ancestral Home that is useful for preservation of oral tradition.

India was settled from Africa via the Arabian Sea in very early times.
(map adapted from "Past Worlds, The Times Atlas of Archaeology" (Crescent Books 1995))

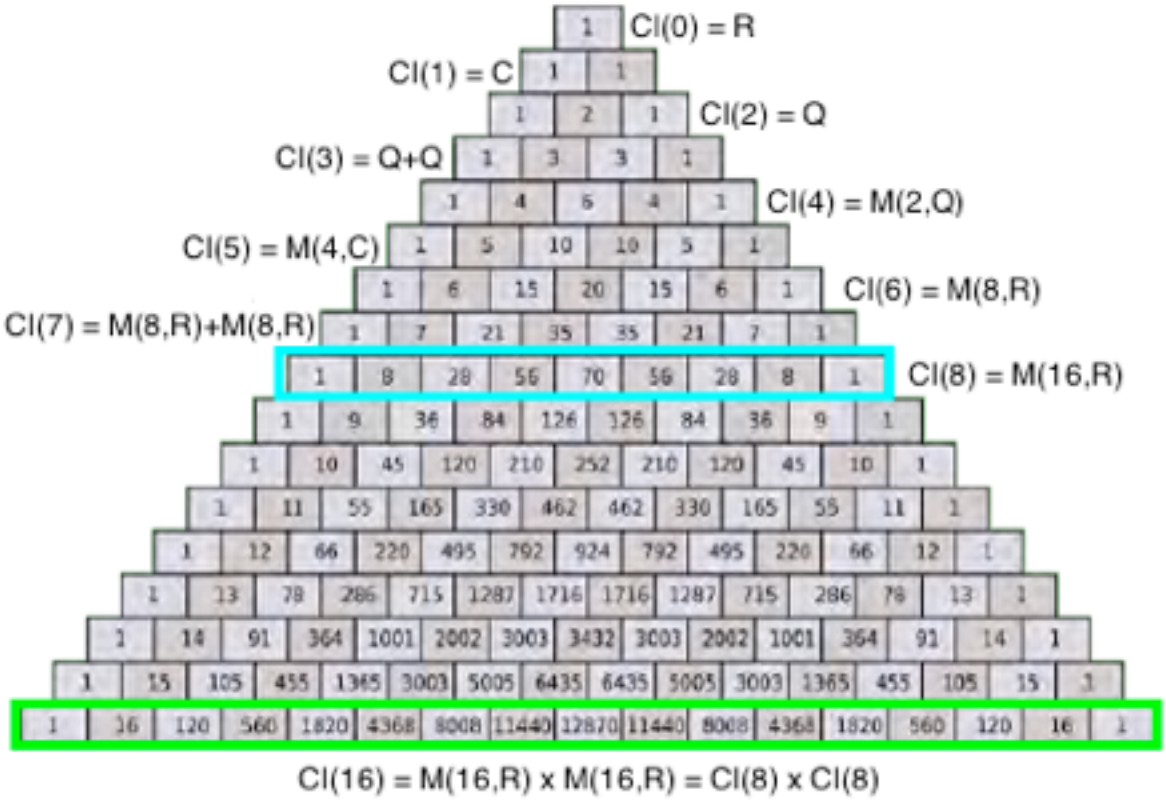
Indian priests of IFA chose to put the IFA Information System into writing,
so they developed Sanskrit from the African Geez language.

In a 16 October 2010 post to his blog at bafsudralam.blogspot.com Clyde Winters said:
"... The Naga were Semitic speaking people from Ethiopia …
The major gift of the Naga to India was the writing system: Deva-Nagari.

Nagari is the name for the Sanskrit script ... the ancient Ethiopic and Sanskrit writing are one and the same ... the name Nagari for Sanskrit betrays the Ethiopia origin of this form of writing. In Geez, the term nagar means ‘speech, to speak’. ...".

Feuerstein, Kak, and Frawley, in their book In Search of the Cradle of Civilization (Quest 1995), say "... The principal and, taken in its totality, the oldest of the four Vedic hymnbodies is the Rig-Veda. ... The Sanskrit word ric, which for euphonic reasons is changed to rig, means literally "praise". ... The Sanskrit word veda means literally "knowledge" or "wisdom". ... **The Rig-Veda is** the oldest book in the Sanskrit language ... More than that, if we are correct, it is **the oldest book in the world** ...".

The Indian National Science Academy web site insaindia.org says
"... The Vedic Civilization ... evolved around ... the Vedas ... Vedic meters ... permutations and combinations of long and short sounds ... led ... to discover[y of] the Meru Prastara ...



now known as Pascal's Triangle ...".

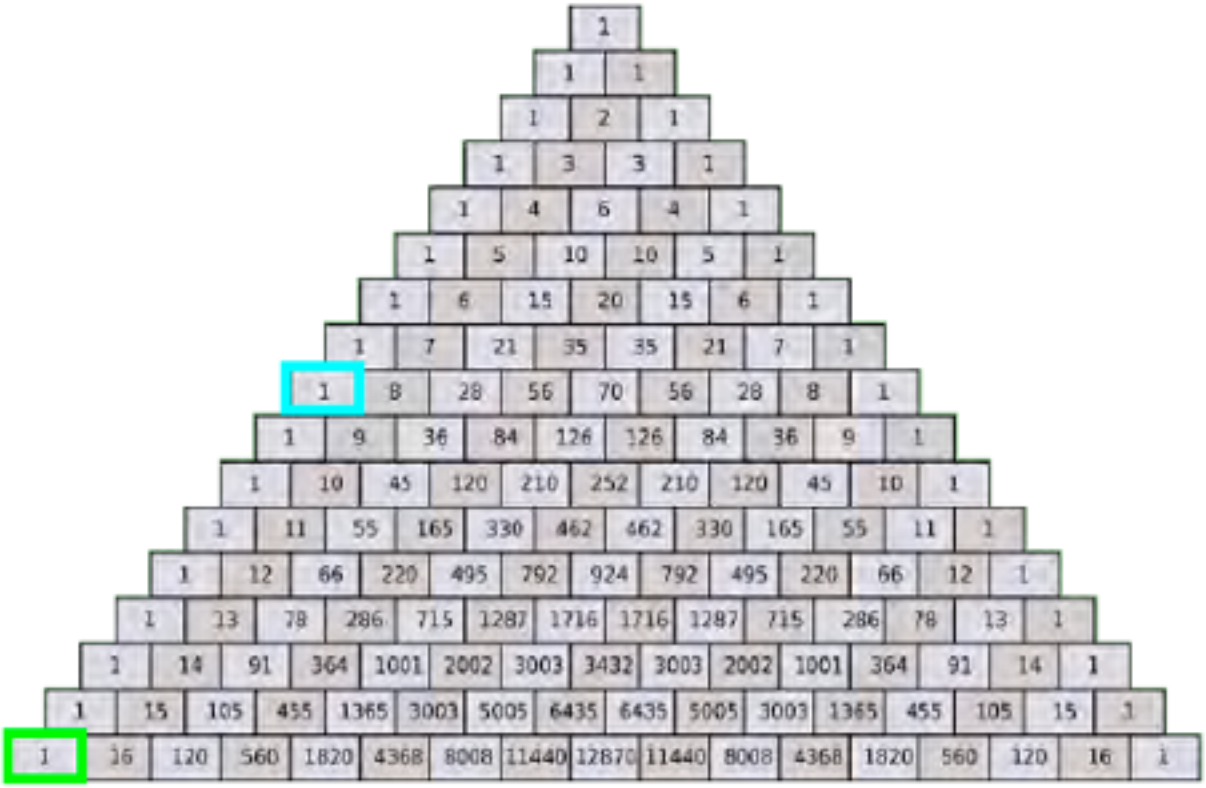
The row I have outlined in cyan contains the 1+8+28+56+70+56+28+8+1 = 256 = 16x16 elements of the Cl(8) Real Clifford Algebra of African IFA divination.
The other rows contain the 2^N elements of Cl(N) where N is the second number from the left in each row, so that the Meru Prastara describes all Real Clifford Algebras Cl(N), with the figure above showing Cl(0) through Cl(16) which I have outlined in green.

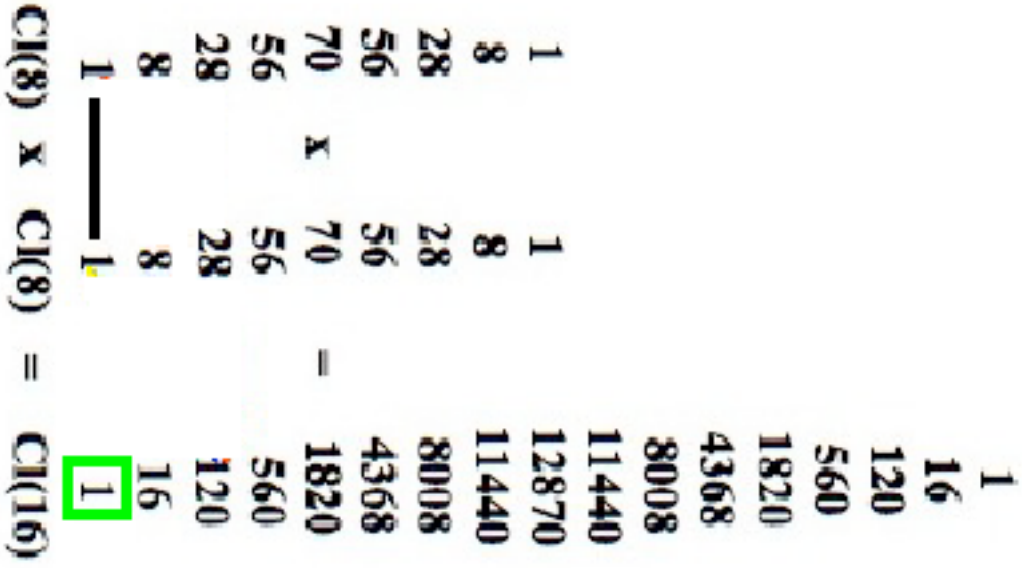
8-Periodicity of Real Clifford Algebras is shown by the Division Algebra sequence
R for Cl(0)
C for Cl(1) Q for Cl(2) Q+Q for Cl(3) Q for Cl(4)
C for Cl(5) R for Cl(6) R+R for Cl(7) R for Cl(8) = M(16,R)
so that
Cl(16) = tensor product Cl(8) x Cl(8) is the case N = 2
of Cl(8N) = Cl(8) x ...(N times tensor product)... x Cl(8).
The case Cl(16) = Cl(8) x Cl(8) graded structure is

				1
				16
				120
				560
				1820
				4368
				8008
				11440
1		1		12870
8		8		11440
28		28		8008
56		56		4368
70	x	70	=	1820
56		56		560
28		28		120
8		8		16
1		1		1
Cl(8)	x	Cl(8)	=	Cl(16)

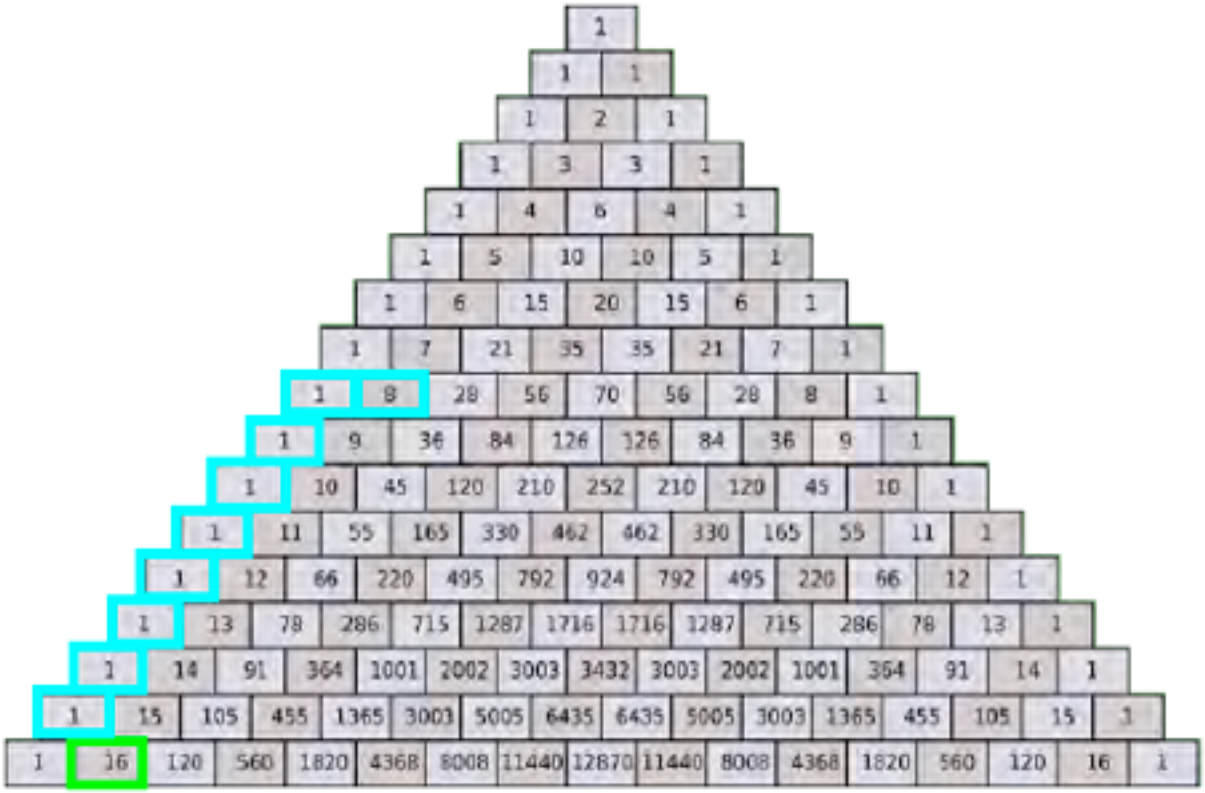
with grade 0 at the bottom, grade 16 of the top of Cl(16),
and grade 8 at the middle of Cl16) and the top of the Cl(8).
Here are more details for some illustrative examples:

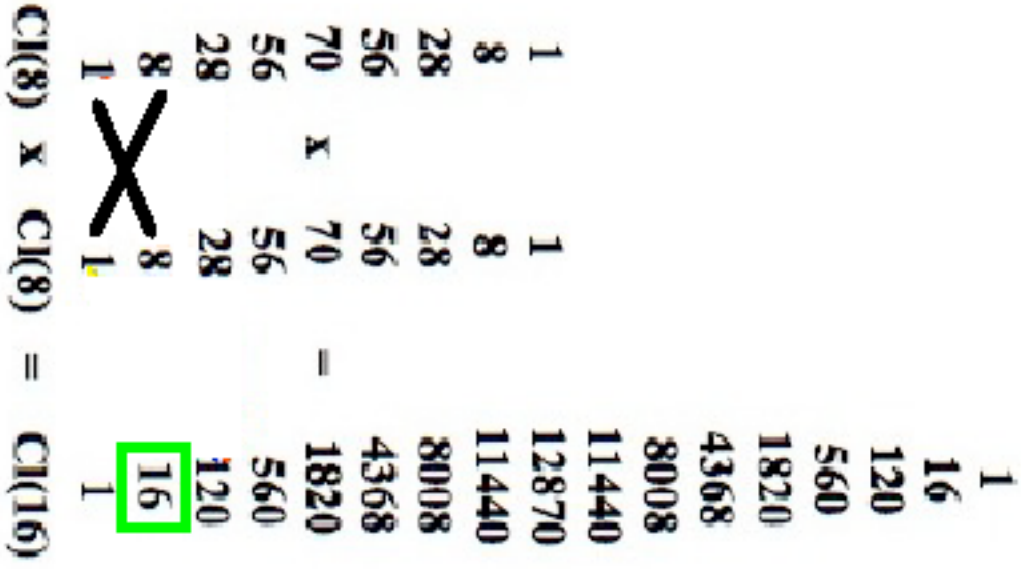
Cl(16) Grade 0 has dimension 1 = 1x1



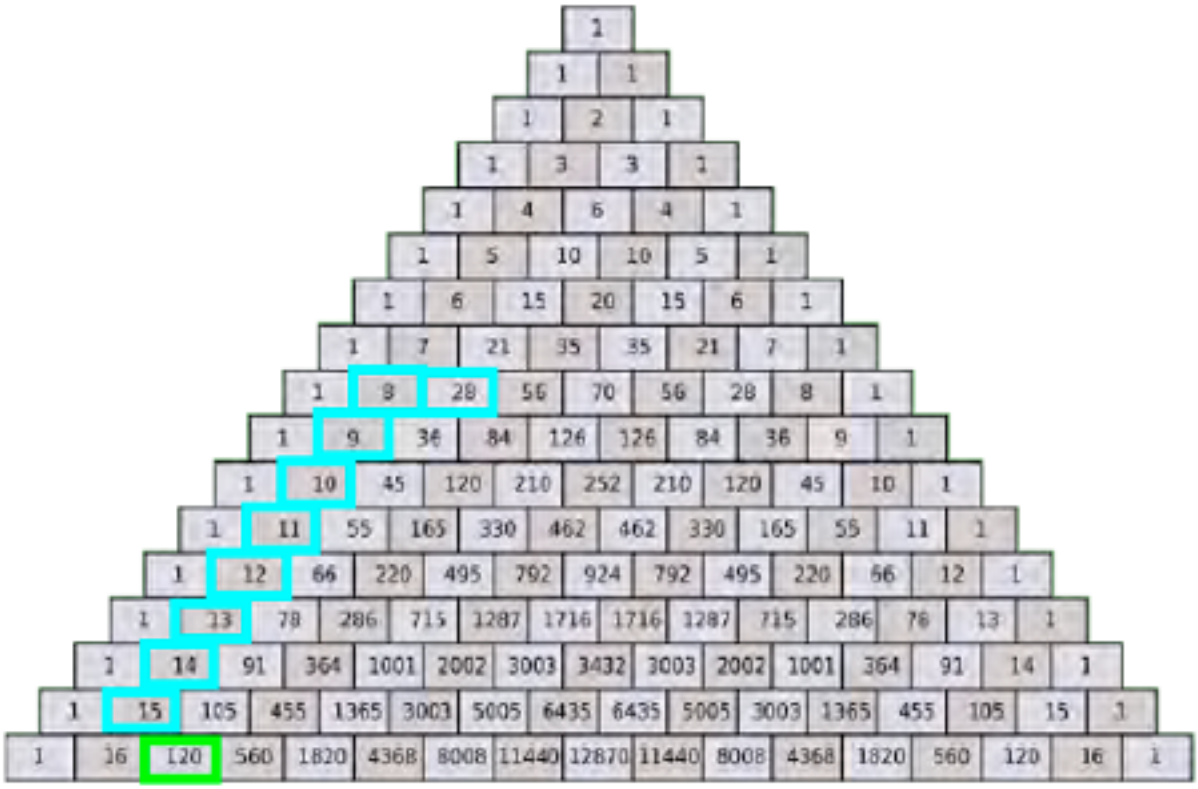


Cl(16) Grade 1 has dimension 16 = 8x1 + 1x8





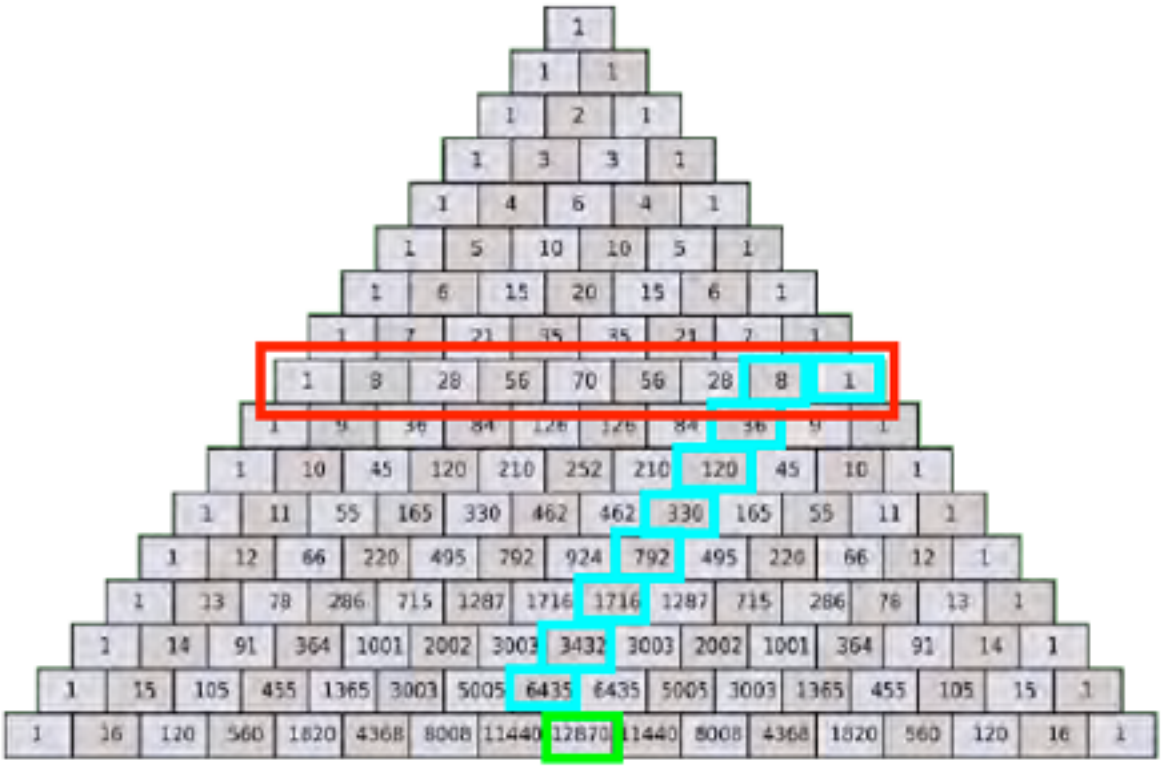
Cl(16) Grade 2 has dimension 120 = 8x8 + 1x28 + 28x1

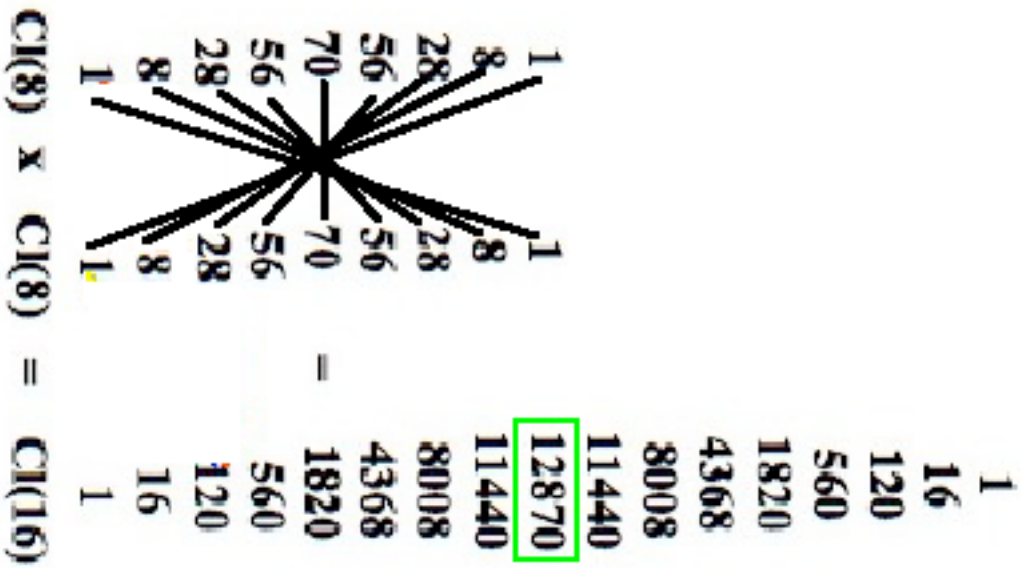


Cl(16) Grade 8 (its middle grade) has dimension

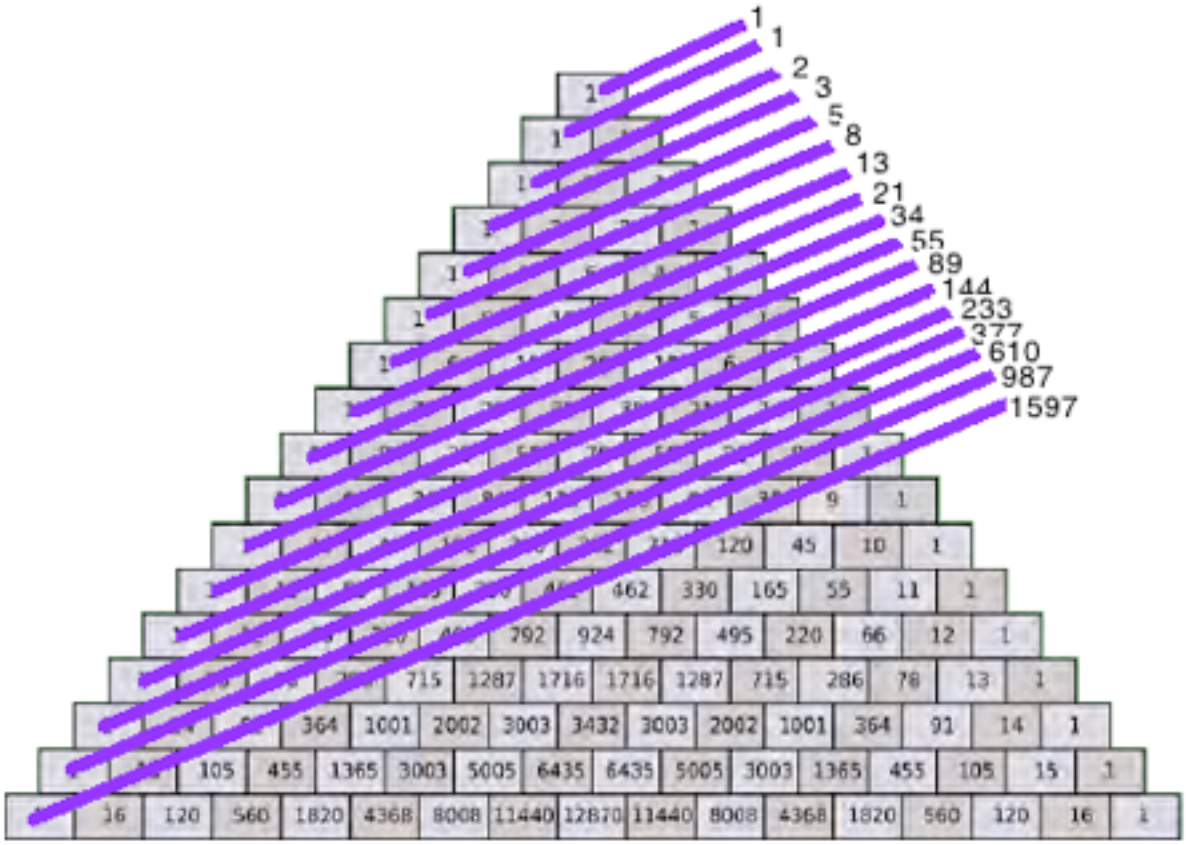
12,870 = 1x1 + 8x8 + 28x28 + 56x56 + 70x70 + 56x56 + 28x28 + 8x8 + 1x1

which is the sum of the squares of the grades of Cl(8)





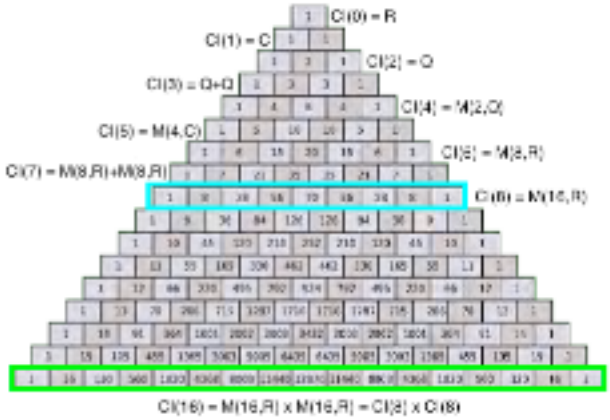
The Meru Prastara also encodes Fibonacci numbers and therefore related processes:



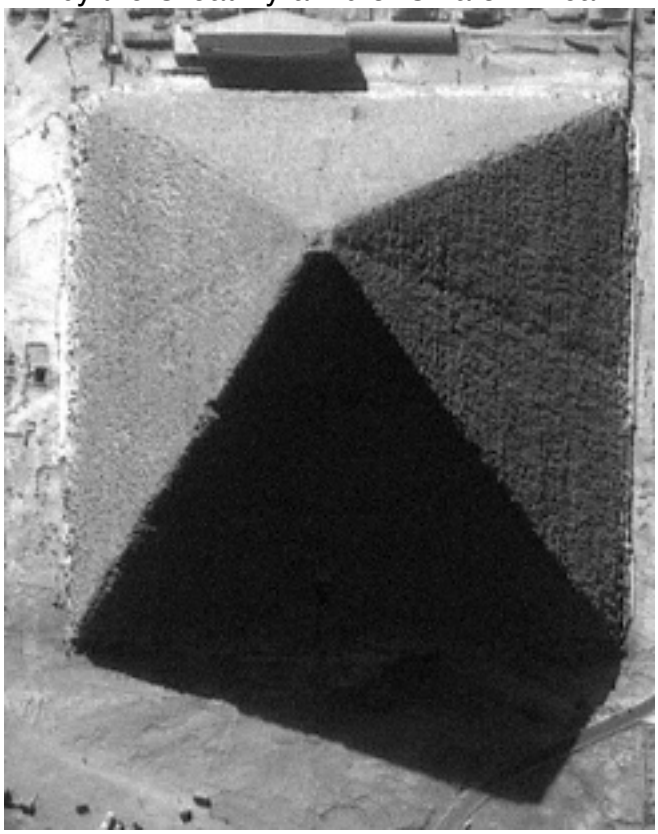
According to Wikipedia:
Prime Fibonacci numbers shown above are 1, 2, 3, 5, 13, 89, 233, and 1597.
Starting with 5, every second Fibonacci number is the length of the hypotenuse of a right triangle with integer sides, or in other words, the largest number in a Pythagorean triple. The length of the longer leg of this triangle is equal to the sum of the three sides of the preceding triangle in this series of triangles, and the shorter leg is equal to the difference between the preceding bypassed Fibonacci number and the shorter leg of the preceding triangle. The first triangle in this series has sides of length 5, 4, and 3. Skipping 8, the next triangle has sides of length 13, 12 (5 + 4 + 3), and 5 (8 – 3). Skipping 21, the next triangle has sides of length 34, 30 (13 + 12 + 5), and 16 (21 – 5).
The Fibonacci numbers occur as the ratio of successive convergents of the continued fraction for the Golden Ratio ϕ

$$\varphi = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1 + \ddots}}}$$

The Golden Ratio structure and pyramidal shape show that the representation of Ancient African IFA by the Meru Prastara of African Migrants to India 50,000 years ago (about 4 Vedic Semi-Precession periods of 4800 + 3600 + 2400 + 1200 = 12,000 years with the 4th 1200 year Dark Iron Kali Yuga ending about 2012 / 2013 to be followed by a Bright Golden 4800 year Satya Yuga of reconciliation of technology and spirituality)



corresponds to its representation
by the Great Pyramid of Giza of African Nile Migrants of 40,000 years ago

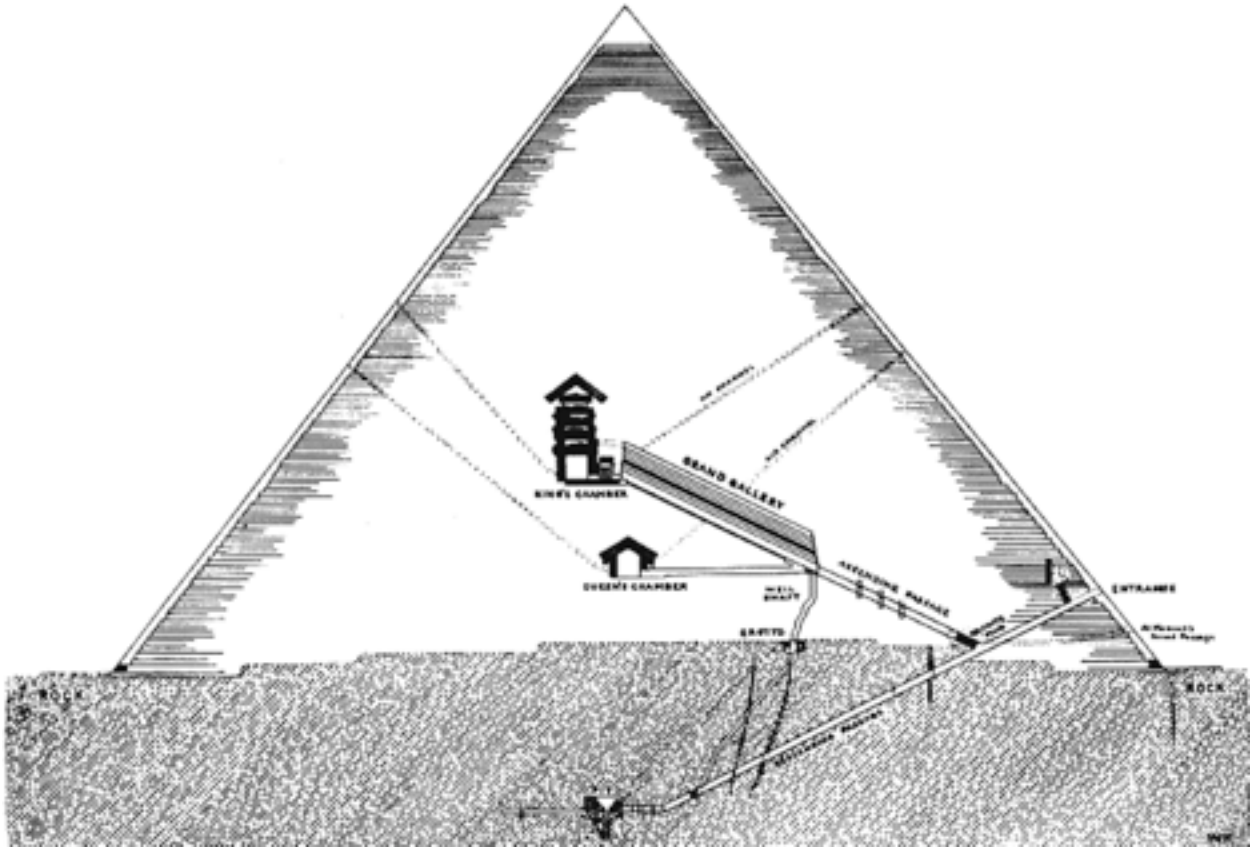


The migration from Africa to the Mouth of the Nile about 40,000 years ago
can be seen in terms of the chronology of the Egyptian historian Manetho
who lived about 2,000 years ago in which the African Nile migration would be seen as
occurring about 36,525 years ago, when the Geminga SuperNova Shock Wave hit Earth

and when began an Ice Age Civilization as the Cro-Magnons from Africa entered Europe and displacd the Neanderthals.

As to the next 24,925 years (approximately Earth precession period of 26,000 years):
13,900 years, Manetho's Rule of Gods on Earth when the Great Pyramid and Sphinx might have been built, would have lasted until about 22,625 years ago at the Last Glacial Maximum on Earth.
The following 11,025 years, Manetho's Rule by Demigods and Spirits of the Dead, would have lasted until about 11,600 years ago at the Younger Dryas Cold Snap when the Vela X SuperNova was seen on Earth, the Taurid/Encke Comet fragmented, and
a very sudden (50 years or so) Warming Event ended the Ice Age
and
began the Holocene Age warm climate with glacial retreat
and Manetho's Rule of Mortal Humans with increasing Technology but less Spirituality.

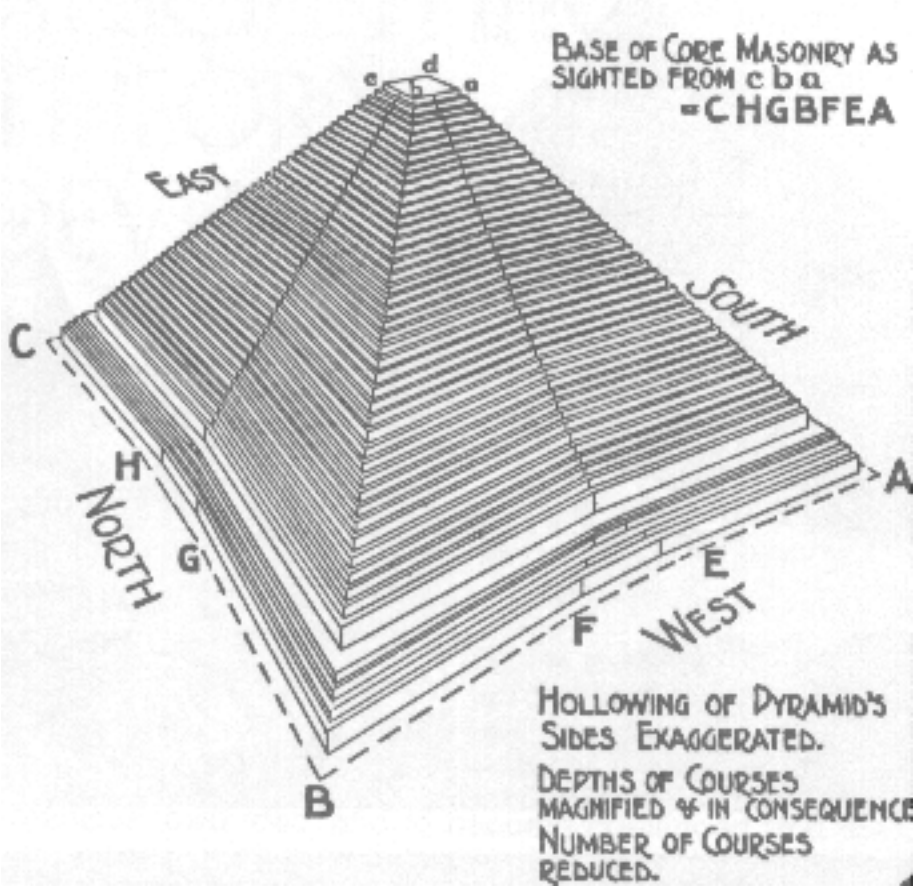
The Great Pyramid



(image due to David Davidson)

is built of 203 layers (courses) plus a now-missing capstone
for a total number of layers = 204 = 64 + 49 + 36 + 25 + 16 + 9 + 4 + 1 = SPN(8)
the Square Pyramidal Number of order 8.

Peter Tompkins in his book "Secrets of the Great Pyramid" said:
Sir Flinders Petrie noted a ... hollowing of the core masonry at the central portion of each face of the pyramid ... [in courses 1 through 168]

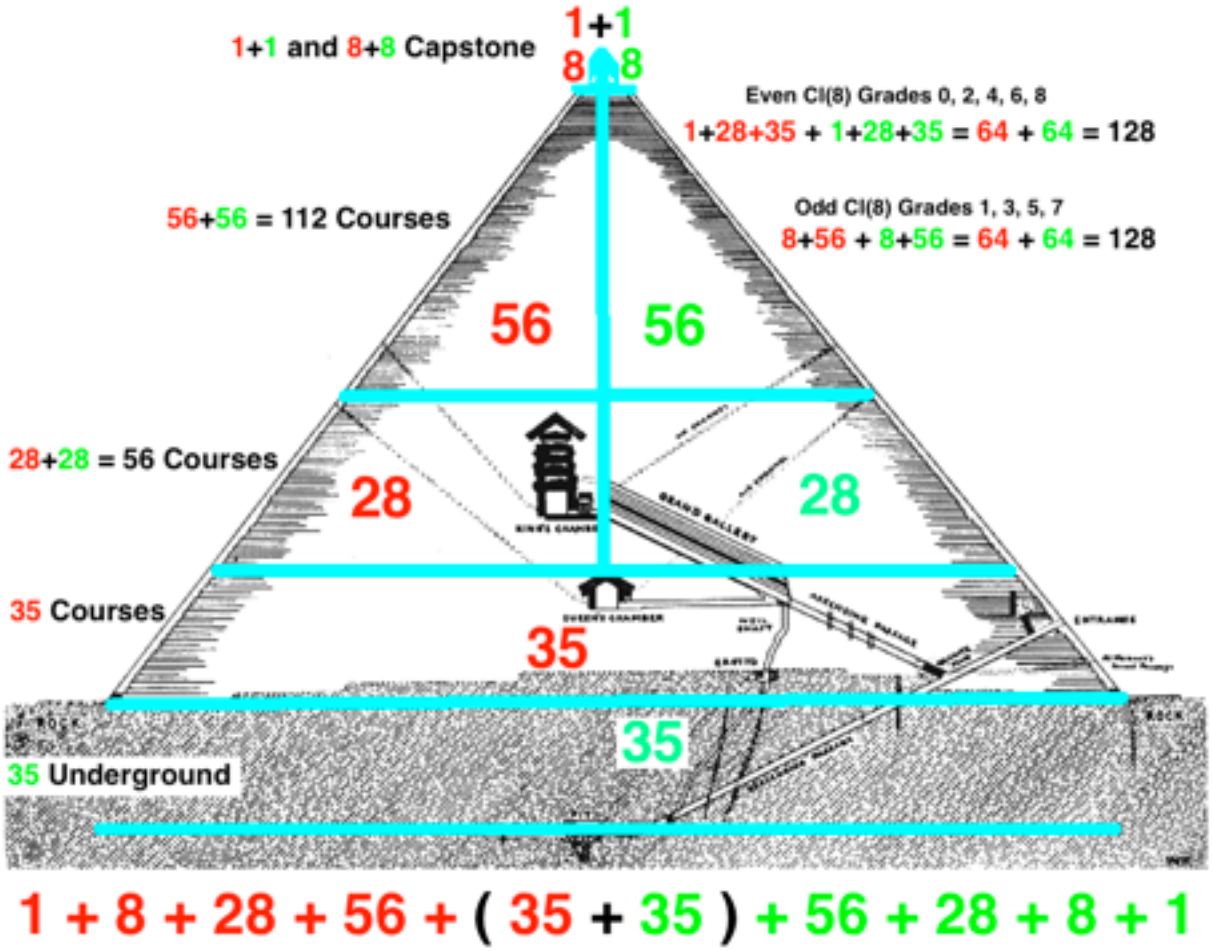


... Petrie found no evidence of hollowing along the lower-level casing stones ... [in courses 169 through 203]...".
From the top of the pyramid (course 0 in my notation) down through course 168 the mid-line of the "hollowing" splits the 4 faces in to 4+4 = 8 faces.
The mid-line corresponds to the duality splitting of the Meru Clifford Algebras whereby the middle-grade parts of Cl(N) for even N are split into two dual halves.
According to Flinders Petrie (www.ronaldbirdsall.com/gizeh/) some courses in the mid-line region down through course 168 are distinguished by thickness.
Some of them have interesting mathematical correspondences:

0 - Missing Capstone
1 - Real Numbers
2 - Complex Numbers
4 - Quaternions
8 - Octonions
24 - Leech Lattice and SPN(24) = 4900 = 70^2 is the only Square Pyramidal Number that is itself a square. In 24 dimensions it is analagous to the 2-dimensional 3-4-5 triangle whose sides square to 9+16 = 25 that gives the slope of the Second Pyramid.
168 - PSL(2,7) = SL(3,2) of Octonionic Fano Projective Plane

The top course 169 of the 35 courses 169 through 203 sitting on the ground level corresponds to the top of the Queen's Chamber

The Subterranean Pit is as deep below ground level as Queen's Chamber is above it so the Subterranean Pit depth equivalent to 35 courses is dual to the Queen's Chamber height of 35 courses just as the 70 mid-grade grade 4 elements of the Cl(8) Clifford Algebra are (35+35) 35 elements plus 35 elements, dual to each other.
(3+3) of (35+35) are the middle components of the 1+3+3+1 Higgs Primitive Idempotent whose 1+1 scalar+pseudoscalar compontents are the 1+1 of the Capstone.

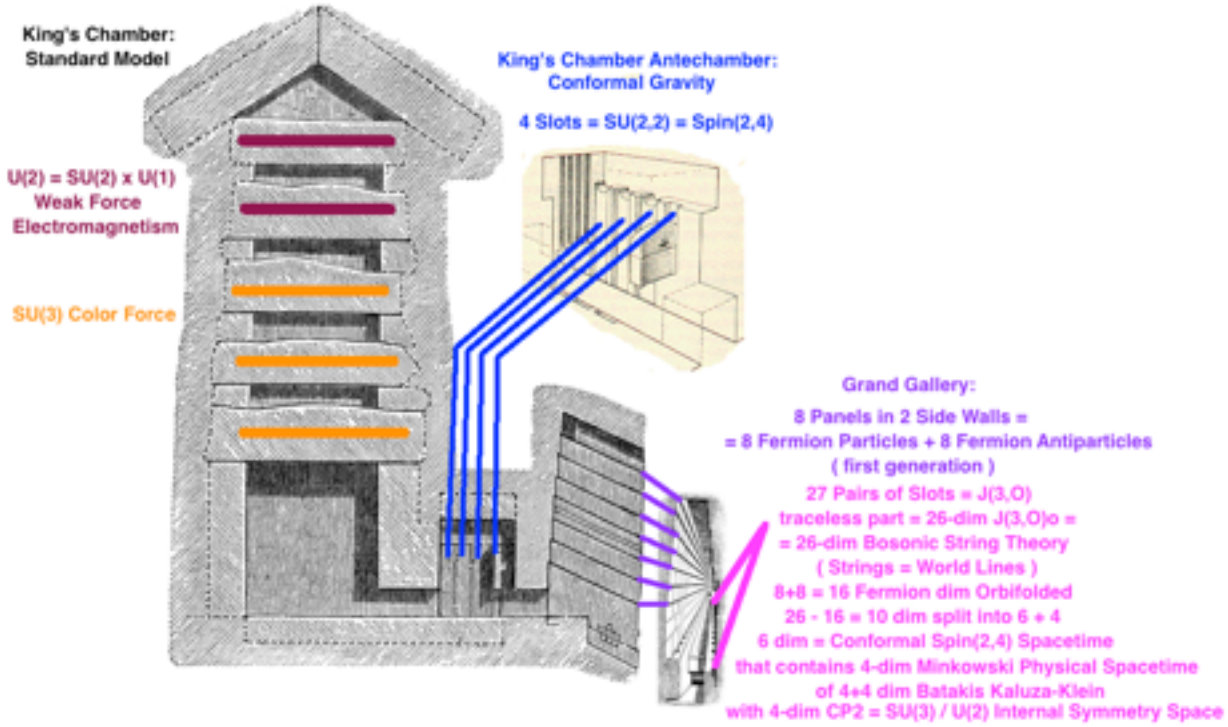


(image adapted from David Davidson image -
for a larger version of this image go to tony5m17h.net/GreatPyrCl8.png
or valdostamuseum.com/hamsmith/GreatPyrCl8.png)

The South-facing Shaft from the King's Chamber is at an angle of about 45 degrees looking at the Plane of our Milky Way Galaxy (Standard Model matter).
The North-facing Shaft from the King's Chamber is at an angle of about 32 degrees looking at the North Pole (Earth Rotation Gravity).

8+8 of the Capstone represent the 8 Fermion Particles and 8 Fermion Antiparticles of the first generation, with respect to the Time Component of 8-dim Spacetime.
56+56 of the top 112 Courses represent the 7 Spatial Components of the Fermions.

28+28 of the next 56 Courses represent the Standard Model and Conformal Gravity

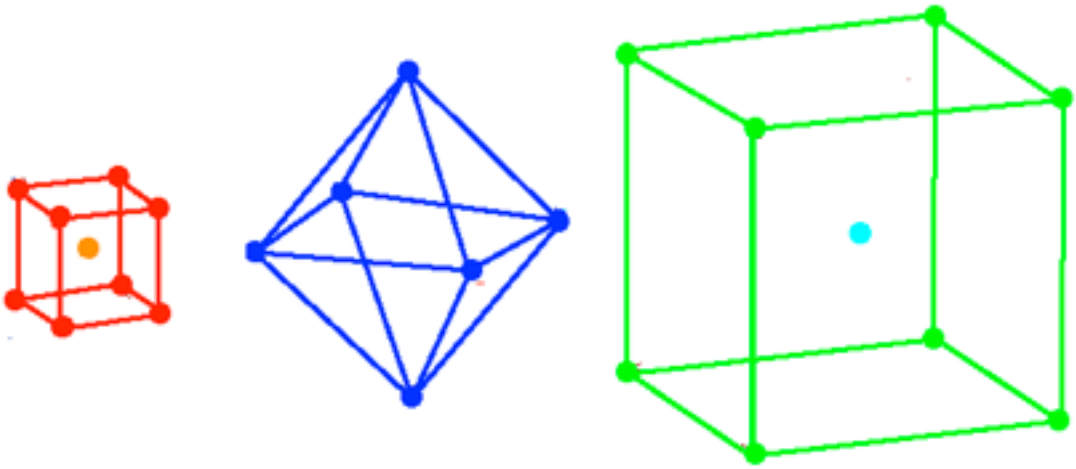


(image adapted from etc.usf.edu and Graham Hancock, Fingerprints of the Gods (Crown 1995) and gatesofegypt.blogspot -
for a larger version of this image go to tony5m17h.net/GPyrStdMConfG.png
or valdostamuseum.com/hamsmith/GPyrStdMConfG.png)

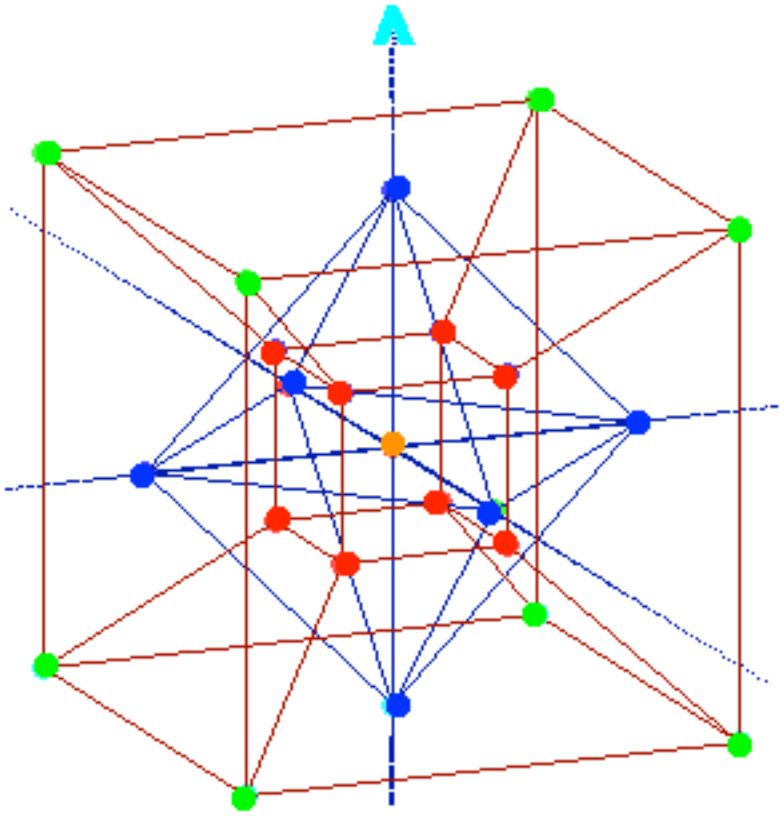
The South-facing and North-facing Shafts from the Queen's Chamber are angled at about 39 degrees, roughly the right-angle-complements of the Golden Angles of the faces of the Great Pryamid with the ground. They do not extend to the outer surface of the Great Pyramid, but only connect the Queen's Chamber Higgs with the Kings's Chamber and Antechamber of the Standard Model plus Conformal Gravity.

The Grand Gallery 26-dim Bosonic String Theory (Strings = World Lines) produces an effective Bohm-type Quantum Potential that provides the Superposition Separation Effect of Penrose-Hameroff Quantum Consciousness. Effectively, the Grand Gallery is the Loom the Weaves World-Line Histories (past, present, and future) into our Tapestry of Reality.

The Capstone 8 + 8 and 1 + 1
combined with
the 5 vertices of the Great Pyramid
plus a 6th underground vertex antipodal to the Capstone

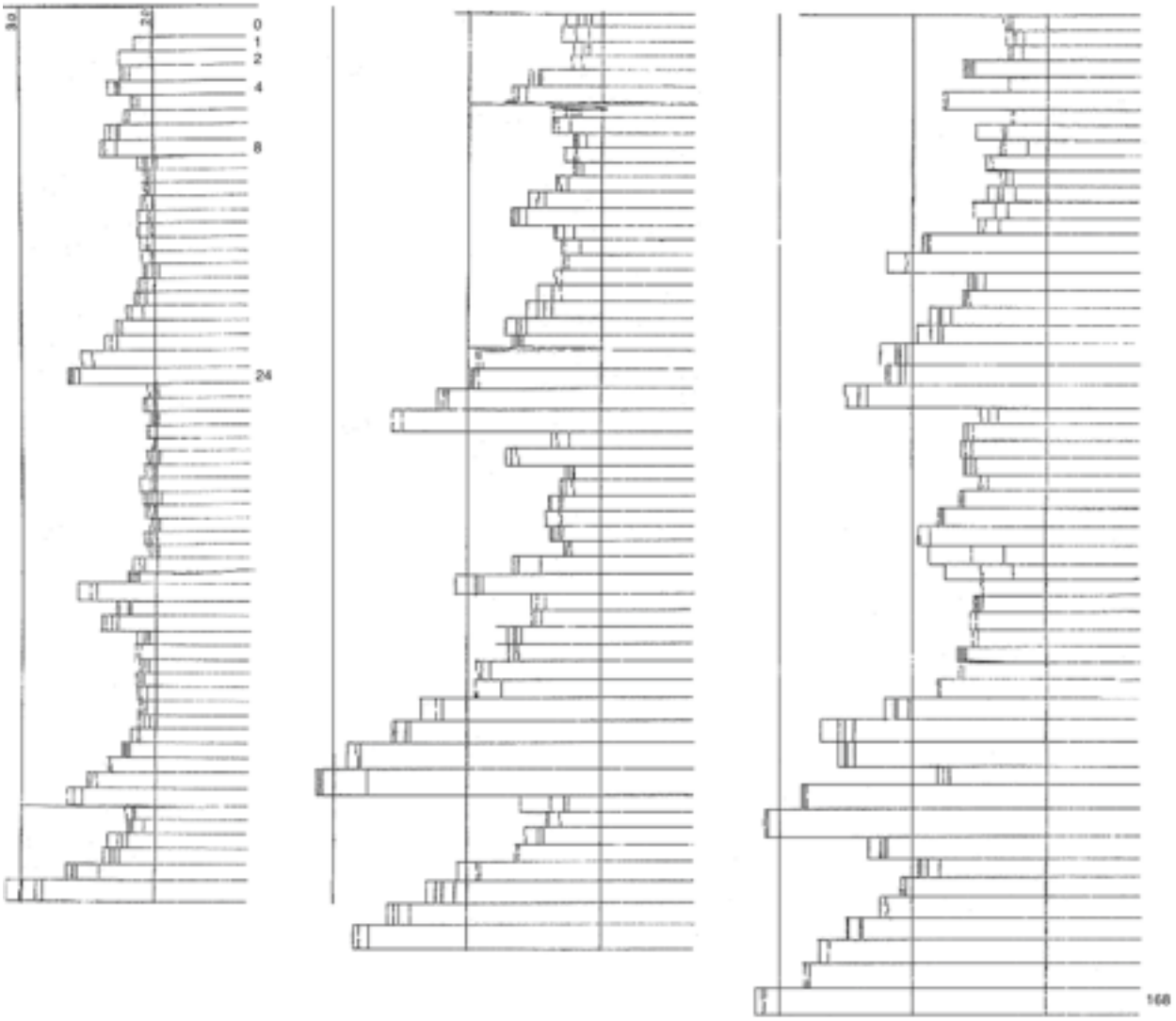


form a 24-cell (image with one vertex at infinity)

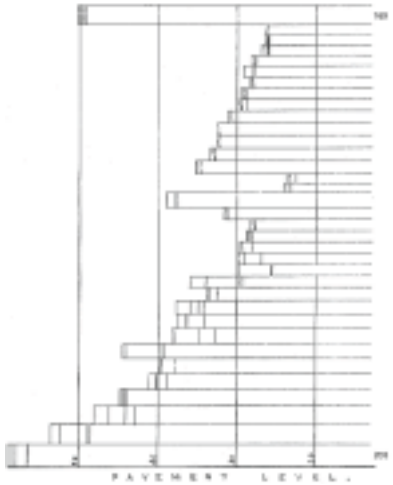


(image adapted from Frans Marcelis members.home.nl/fg.marcelis/)

Here is Flinders Petrie's chart of courses 1 through 168:



Here is Flinders Petrie's chart of the base courses 169 through 203:
(smaller scale - course 169 is almost 20% thicker than course 168)



The Vedic Civilization not only preserved ideas in Meru Prastara triangle structures and Sanskrit writing and prosody but also through games
whose structure effectively outline basic ideas.
Perhaps the most important such Vedic game is Pachisi.

In "The Indian Games of Pachisi, Chaupar,and Chausar" (Expedition Spring 1964, 32-35) W. Norman Brown said: "... The Rig-Veda ... has references to the use of dice ... cowries, which are used in pachisi, are ... as old in India as the Harappa civilization ... At Mohenjo-daro in the Indus Valley, a portion of a triple-rowed gaming-diagram on brick was recovered, dating perhaps from the last part of the third millennium B.C. ...".

In "Shells as Evidence of the Migrations of Early Culture" (Manchester University Press 1917) J. Wilfrid Jackson said: "... In India the money-cowry seem to have been regarded with special favour for amuletic and currency purposes from very early times ... a cowry game ... is ... related to the Hindu game of Pachisi, also played with cowries. The shells are thrown as dice ... Games like Pachisi, in which cowries are used as dice, are known in the Maldive Islands ... Among the Nagas ... a warrior, having slain an enemy, had the privilege of wearing a kilt decorated with cowry-shells ... A similar custom ... is to be found in East Central Africa, where the Djibba tribe wear ... cowries ...".

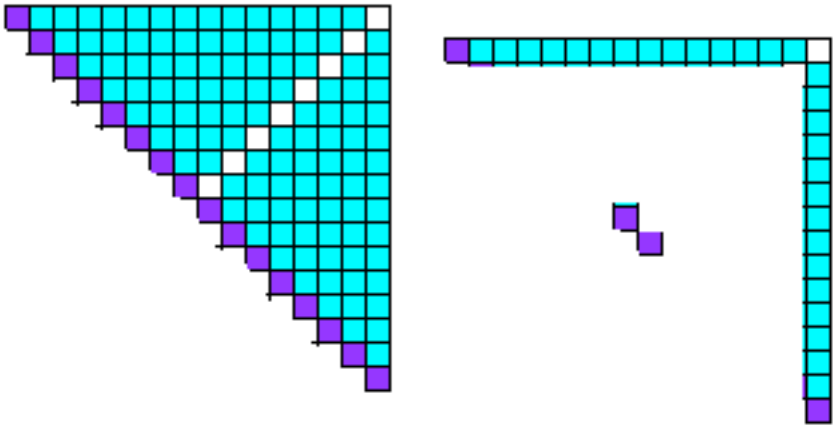
Cowries provide evidence not only for an early and strong Africa-India connection, but also for the world-wide reach of trade and ideas in ancient times. For example, Jackson also said: "... The money-cowry ... is, and has been for centuries, a sacred object among the Ojibwa and Menomini Indians of North America, and is employed in initiation ceremonies of the Grand Medicine Society. The use of this particular cowry by these Indians is of peculiar interest; in the first place, owing to it being alien to the American continent, and in the second place, in view of its intimate association with so many remarkable ... beliefs and practices in different parts of the Old World. ...". Since Lake Superior is the primary source on Earth of native copper, the Indians there had world-wide trade in ancient times even preceding the Bronze Age.

To preserve their heritage of the African IFA Information System,
priests of India not only wrote down the Sanskrit Rig Veda
(tony5m17h.net/RgVeda.html)
but
they also developed the game Pachisi
to keep the dynamics of IFA in popular culture.

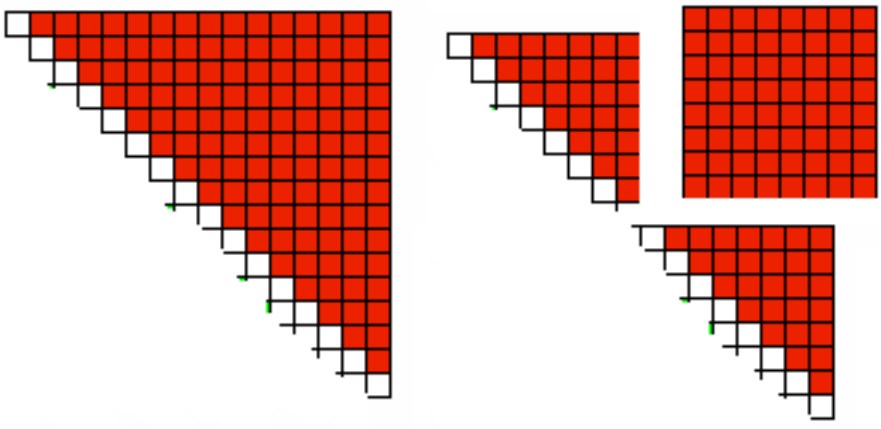
Here is how the structure of the IFA Information System has been simplified for transmission to Pachisi:

First, due to the diagonal-reflection symmetry of Antisymmetric and Symmetric matrices, only the upper triangular parts of the matrices need to be preserved:

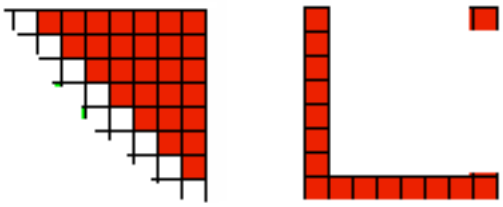
The Symmetric part was simplified by ignoring the part of Cl(8) not in E8
and then using only 32 entries (from outer shell and diagonal) of those 128 entries



The Antisymmetric part was first cut into 3 sections

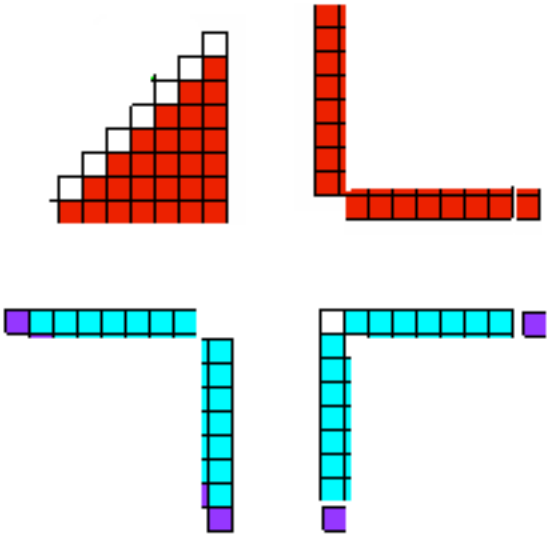


two similar triangular each with 28 entries and one square with 64 entries.
Using only one of the two similar 28-entry triangles plus 16 from the square (outer shell)

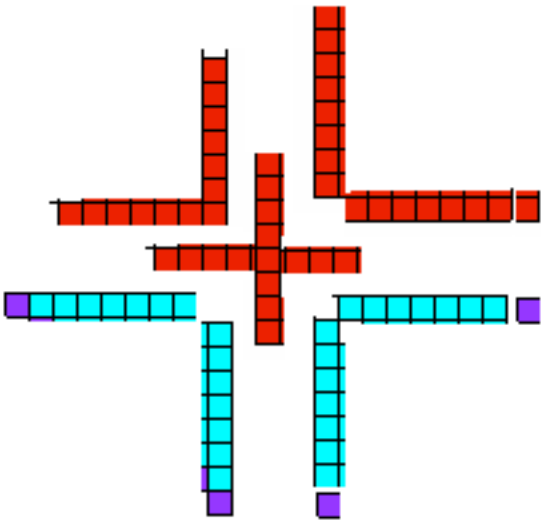


reduced the 120 Antisymmetric entries to 28 + (64-49) = 28+16 = 44 entries

thus reducing 248-dim E8 to 28 + 16 + 32 = 76 entries.
Since most of the IFA E8 structures are outer boundaries of square regions
it is natural to construct Pachisi as a boundary-progession board game
so the 30-entry Symmetric outer shell is broken into two parts which,
when added to the 28-entry and 15-entry Antisymmetric parts,
naturally fit together in this configuration

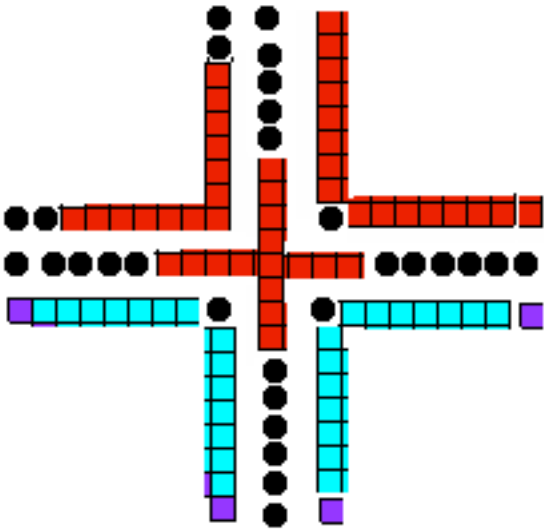


with 3 quadrants that look like a boundary-progression board game
but with one triangular quadrant that looks out of place. To make the board look more nearly consistent, move the interior 15 elements of the triangle to the interior of the board to get



with 8+8+8+8+8+8+7+6 = 61 outer plus 15 inner = 76 entries

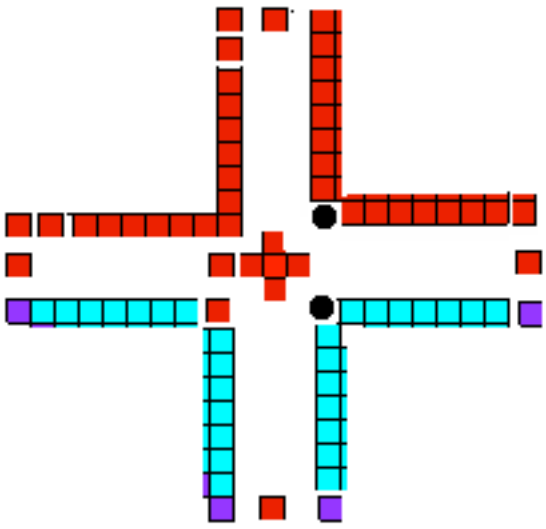
In order to fill out the Pachisi board 29 more entries are needed as filler



to get the total of 105 entries on the full game board for Pachisi.

RigVeda-Pachisi to Tarot

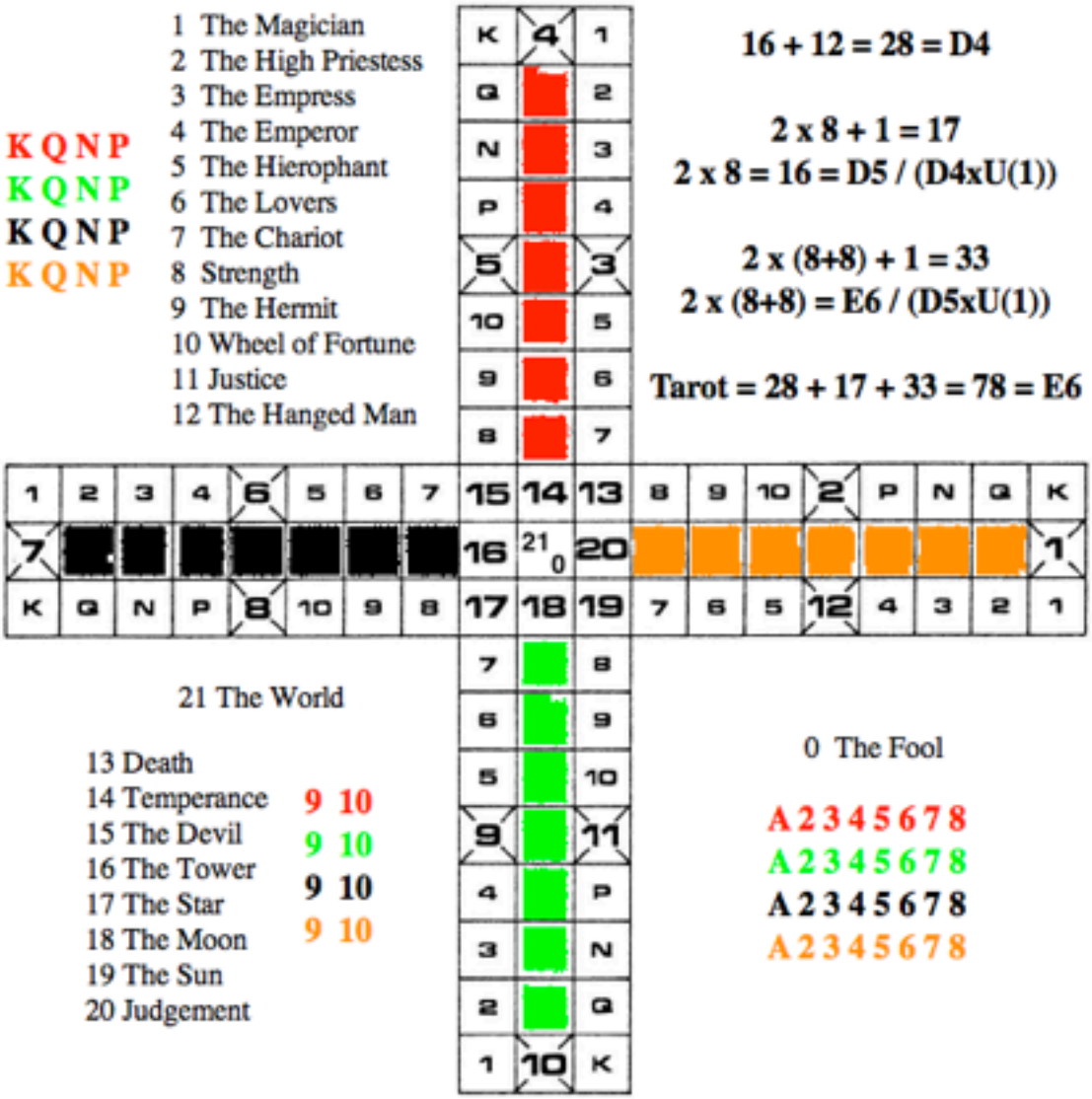
Tarot was developed from Pachisi by getting rid of 26 filler entries
and using the 15 inner entries: 4 to complete the exterior arms of D4;
4 to bridge between arms; 1 as an inner corner; and 6 in central configuration,
with the remaining 2 filler entries used for the U(1) of D5 / D4xU(1) and E6 / D5xU(1)
The red entry at the corner of the left-side blue pair of arms corresponds to
the Antisymmetric U(1) in the U(2,2) = U(1)xSpin(2,4) subalgebra of the D4 which
physically represents the propagator phase of Fermions from the Symmetric sector.



Tarot has 105 - 27 = 78 cards, corresponding to the 78-dim E6 Lie Algebra.

Stephen E. Franklin in "Origins of the Tarot Deck" (www.lordbalto.com) said:
"... Games are at their most basic level symbol systems not unlike simplified languages ... Pachisi may ... be thought of as inscribed in a 19x19 square ... the outer rim of which has been compressed around the central cross ...
The Tarot must ... have been created between 654 and 403 B.C. and the probability is high that it first appeared sometime very near the year 540 B.C. ...
the Tarot was not invented to play card games but survived ... in the same twilight zone ... as Latin, Old Church Slavonic and biblical Hebrew ...
The similarity of ... Tarot ... court cards to ... four-handed proto-chess ... and the resemblance between the four suits and the four varnas or classes of Hindu society, which appear at least as early as the Rigveda, all point to an Indian origin ... transported to the West ... by the Arabs or the Gypsies ...".

(image modified version of figure from Franklin's article)



Tarot E6 Lie Algebra structure is used in Realistic Physics Model construction.

(tony5m17h.net/stringbraneStdModel.html)

(in this paper I am oversimplifying many things, such as by ignoring signature)

The 16 KQNP correspond to a U(4) Conformal Lie Algebra for Gravity

K Q N P
K Q N P
K Q N P
K Q N P

These 12 cards correspond to a symmetric space Spin(8) / U(4) for the Standard Model Gauge Groups

1 The Magician
2 The High Priestess
3 The Empress
4 The Emperor
5 The Hierophant
6 The Lovers
7 The Chariot
8 Strength
9 The Hermit
10 Wheel of Fortune
11 Justice
12 The Hanged Man

which can be thought of as the completion of Spin(8) from a foundation of U(4)
so that
taken together those 16+12 = 28 cards correspond to the D4 Lie Algebra Spin(8)
which
is the grade-2 bivector part of the IFA Cl(8) Clifford Algebra with graded structure

256 = (8+8)x(8+8) = 1 + 8 + **28** + 56 + 70 + 56 + 28 + 8 + 1

These 1 + 8 + 8 = 17 cards correspond to two copies of 8-dim spacetime

21 The World

13 Death
14 Temperance 9 10
15 The Devil 9 10
16 The Tower 9 10
17 The Star 9 10
18 The Moon
19 The Sun
20 Judgement

plus
one card for the Complex U(1) needed to glue them together into a Complex spacetime
that is 8-Complex-dimensional (16-real-dimensional)
corresponding to a symmetric space Spin(10) / Spin(8) x U(1)
which can be thought of as the completion of Spin(10) from a foundation of Spin(8)
so that
taken together all 28 + 17 = 45 cards correspond to the D5 Lie Algebra Spin(10)
which
appears in the IFA Cl(8) Clifford Algebra with graded structure

256 = (8+8)x(8+8) = **1** + **8** + **28** + 56 + 70 + 56 + 28 + **8** + 1

These 1 + (8+8) + (8+8) = 33 correspond to two copies of (8+8)-dim spinors

(representing 8 fermion particles + 8 fermion antiparticles)

plus
one card for the Complex U(1) needed to glue them together into Complex spinors
corresponding to a symmetric space E6 / Spin(10) x U(1)
which can be thought of as the completion of E6 from a foundation of Spin(10)

so that

all 28 + 17 + 33 = 78 Tarot cards correspond to the E6 Lie Algebra

which appears in the IFA Cl(8) Clifford Algebra

as spinor structure plus a U(1)

256 = (**8+8**)x(**8+8**) = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + **1**

Tarot to Llull

Ramon Llull (1232-1316) of Mallorca lived in a time and place of
a unique confluence of Islamic, Christian, and Jewish mystical ideas
on a Mediterranean island between Iberia and Africa
so
he was exposed to ideas including
Islamic 16-element Ilm al Raml derived from African 256-element IFA,
Christian-Crusader Troubadour 78-element Tarot,
Jewish Urim v'Thummim system revealed to Moses for decoding the 72 letters
on the 12 stones of the Breastplate of Judgment,
and
he was able to travel easily to Africa, the home of 256-element IFA.

According to Anthony Bonner's book Doctor Illuminatus (Princeton 1993):
"... In the history of Western mysticism,
there is nothing quite like ...[Llull's Quaternary Phase (1274-89)]...
with its curious blend of Troubadour, Franciscan, and Islamic influences,
mixed with Llull's own special outlook based on the Art ...".

"Llull's own special outlook" may have been to see that

72 letters of the Urim v'Thummim Breastplate are contained in the 78-element Tarot

the 78-element Tarot fits inside the 256-element IFA D4 Real Clifford Algebra as

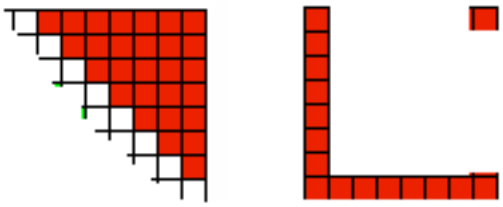
1 + 8 + 28 + ... + 8 + 1
fits inside
256 = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1

and as

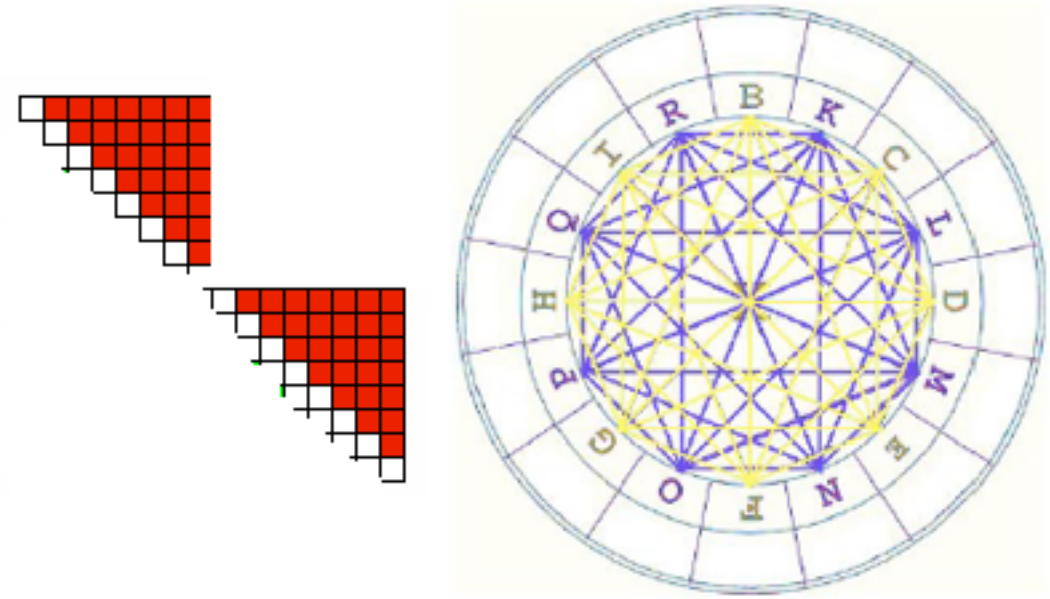
(8+8) + (8+8)
fits inside
256 = (8+8)x(8+8)

Troubadours propagated songs, poetry, and games such as Tarot.
Ramon Llull (1232-1316) of Mallorca studied the Islamic 16-element Ilm al Raml,
the Troubadour 78-element Tarot,
and the 256-element IFA
and
found a structure that he summarized in Wheel Diagrams with 16 vertices
connected to each other by lines such as (some images adapted from lullianarts.net web site)

Of **the 120-dim Antisymmetric Part of 16x16 Real matrices**
the 78-dim Tarot contains only a 16-dim partial boundary of its 64-dim U(8) square
and one 28-dim D4 triangle plus a single 1-dim U(1) from D5 / D4xU(1)

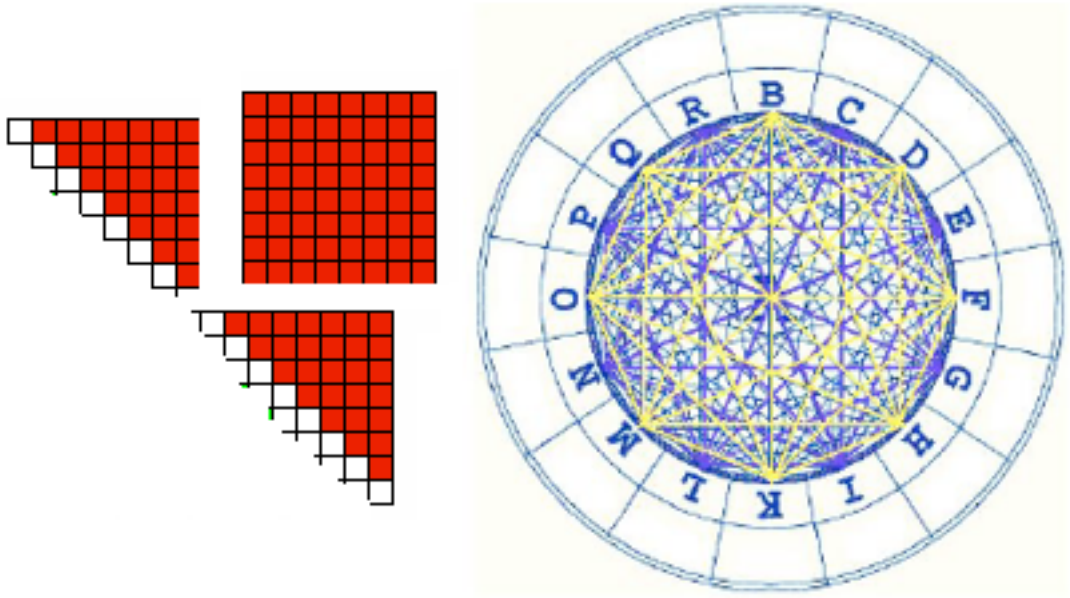


Llull expanded that 45-dim part of the Tarot to include the second D4 triangle
and to represent them in his Wheel Diagram X as two sets of 8 vertices,
for a total of 16 vertices, around the X-Wheel within which each set of 8 vertices
was connected with the other 7 of that set by 28 lines,
each line representing one generator of each of the two copies of 28-dim



The 28 gold lines represent the D4 containing U(2,2) that gives Conformal Gravity
and
the 28 purple lines represent second D4 containing the SU(3)
that when combined with Kaluza-Klein Internal Symmetry Space CP2 = SU(3) / U(2)
gives by the Batakis mechanism the Standard Model Gauge Groups SU(3)xSU(2)xU(1).

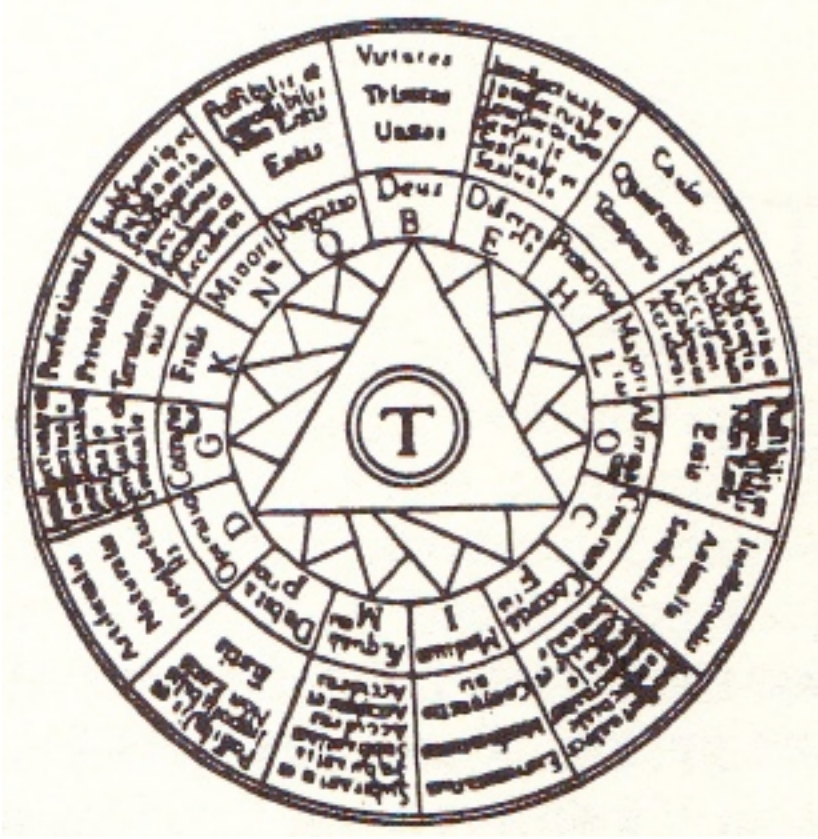
Llull further expanded the 16-dim square-partial-boundary to full square 64-dim size
by adding the 64 blue lines that connect a vertex of one D4 with a vertex of the other D4



Adding in 64 blue lines gives 28+28+64 = 120 lines of the Llullian A-'wheel
that represents the Spin(16) bivector Lie Algebra D8
of the Clifford Algebra Cl(16) = Cl(8) x Cl(8)

As to the details of the U(2,2) Conformal Gravity of the 28 Gold Lines,
Llull constructed a T-Wheel

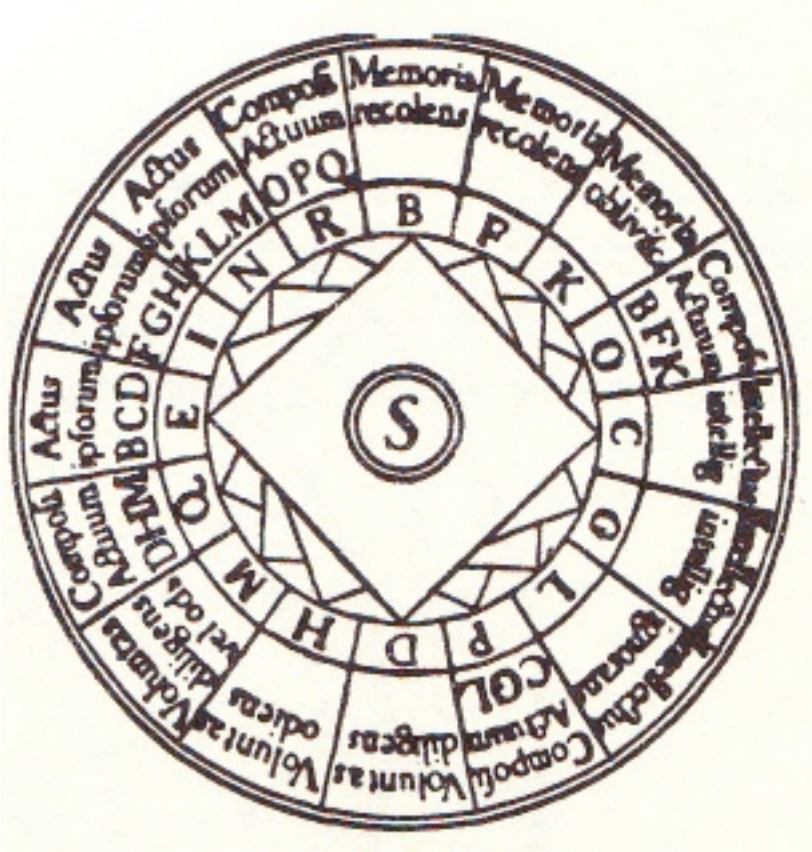
(image from quisestlullus.narpan.net web site)



The 3 vertices of the T-triangle in Llull's T-wheel correspond
to a 3-dimensional Cartan subalgebra of
the 15-dimensional Conformal Group SU(2,2) = Spin(2,4)
that lives in U(2,2) as U(2,2) = U(1) x U(2,2).
The other 4 triangles in Llull's T-wheel correspond
to the 12 vertices of the Cuboctahedron Root Vector Polytope
of the Conformal Group SU(2,2) = Spin(2,4).

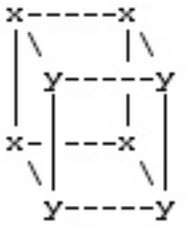
As to the details of the Standard Model of the 28 Purple Lines,
Llull constructed an S-wheel

(image from quisestlullus.narpan.net web site)

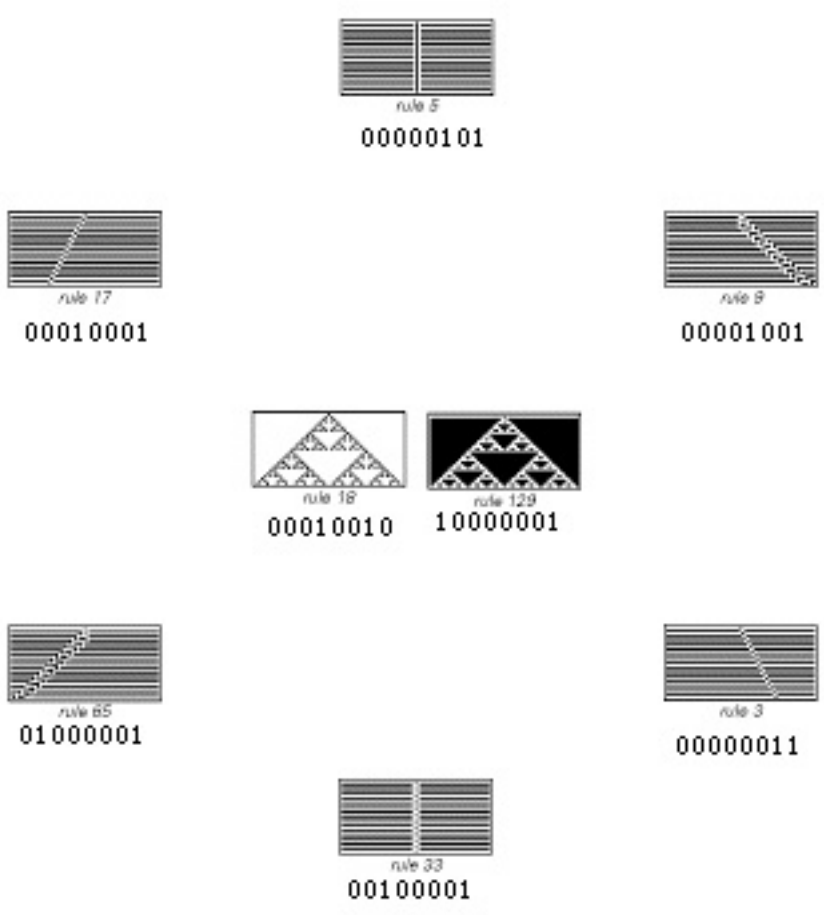


The 4 vertices of the S-square correspond to the 4-dimensional Quaternionic subspaces that emerge below the Planck energy to break Octonionic 8-dim Spacetime
into (4+4)-dim Kaluza-Klein spacetime with 4-dim Minkowski Physical Spacetime plus 4-dim Internal Symmetry Space CP2 = SU(3) / SU(2)xU(1)

Two of the remaining 3 squares of Llull's S-wheel form the vertices of a cube



Looking at the cube along a diagonal axis and projecting all 8 vertices onto a perpendicular plane



you see the Root Vector Diagram of SU(3) and its 8 gluons. (here I have identified the vertices with their corresponding Cellular Automata using a correspondence between the 256 Elementary Cellular Automata and the 256 Odu of IFA - for details see vixra.org/pdf/0907.0040v3.pdf).

Since each gluon links 4-dim Physical Spacetime to color Internal Symmetry Space, the gauge group SU(3) acts globally on CP2 Internal Symmetry Space, as can be seen by the fibration CP2 = SU(3) / U(2)

The third of the remaining squares, that is the final square, corresponds to the 3 SU(2) weak bosons and the U(1) electromagnetic photon. Since SU(2)xU(1) = U(2), and since CP2 = SU(3) / U(2), they act locally on CP2 Internal Symmetry Space.

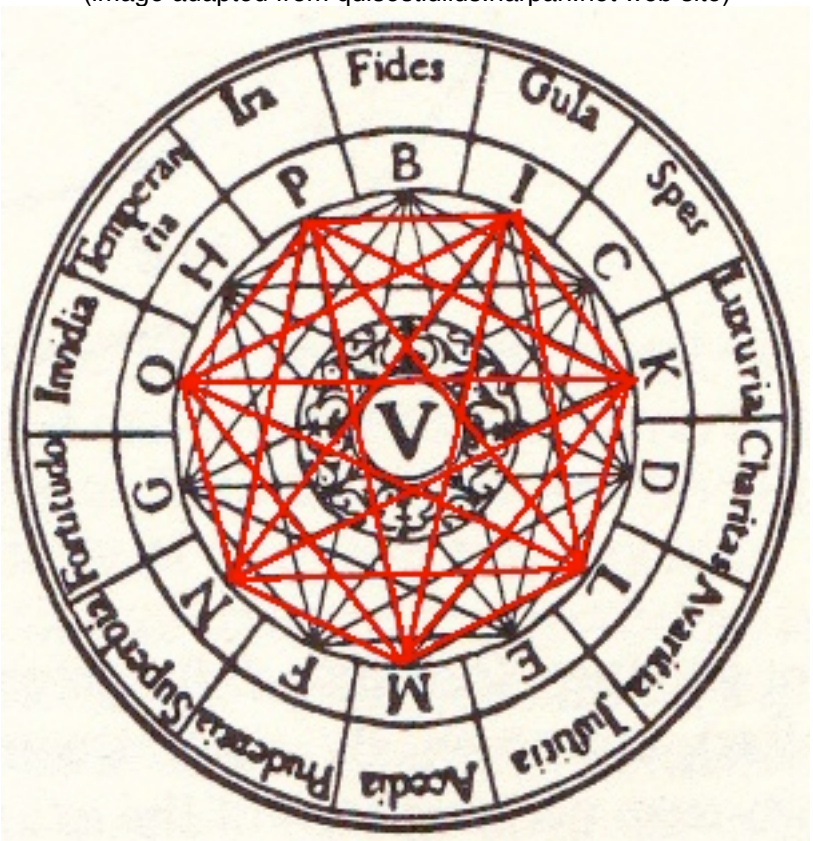
Each D4 Lie Algebra generates the 28 rotations of the 7-sphere S7 that lives
in 8-dim Euclidean space.
Although the 1-sphere S1 is the Lie Group U(1) based on Complex Numbers
and
the 3-sphere S3 is the Lie Group Sp(1) = SU(2) = Spin(3) based on Quarternions,

the Non-Associativity of Octonions prevents the 7-sphere S7 from forming a Lie Group.

If you try to make a Lie Algebra out of the 7 generators of S7
you find that the products do NOT form a closed 7-dim Lie Algebra
but
that you generate two more things:
a 14-dim G2 Lie Algebra that generates the Automorphisms of the Octonions and
a second 7-sphere S7.
If you put all those things together the S7 combines with the new 21-dim G2 x S7
to form the 28-dim D4 Lie Algebra.

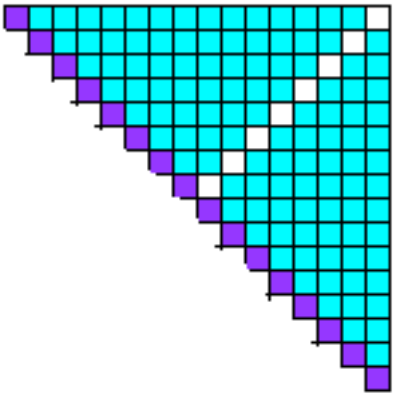
Ramon Llull describe that Octonion structure for the full two copies of D4 in Cl(8)
in terms of his V-wheel with 7+7 = 14 vertices

(image adapted from quisestlullus.narpan.net web site)



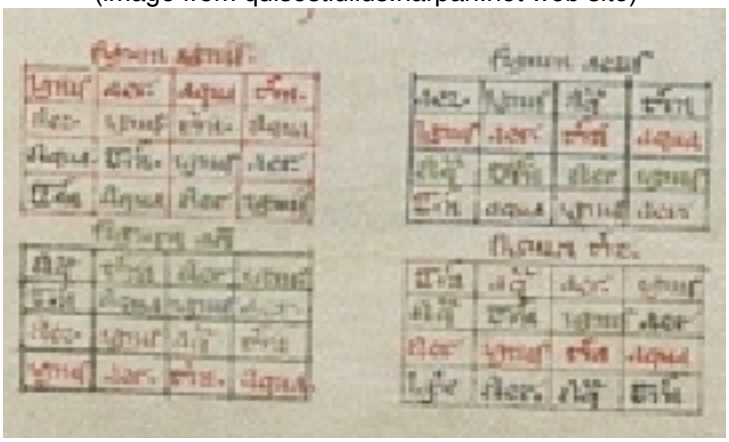
where 21 red lines connect the vertices of one set of 7 vertices of one D4
and 21 black lines connect the vertices of the other 7 vertices of the other D4.
Each heptagon can be used to describe the 480 different Octonion Products.

As to **the 136-dim Symmetric part of 16x16 Real matrices**
the 78-dim Tarot does not contain any of the 8 antidiagonal elements
but contains a single 1-dim U(1) from E6 / D5xU(1)
plus 16 of 64 entries in each of two 64-element triangular blocks



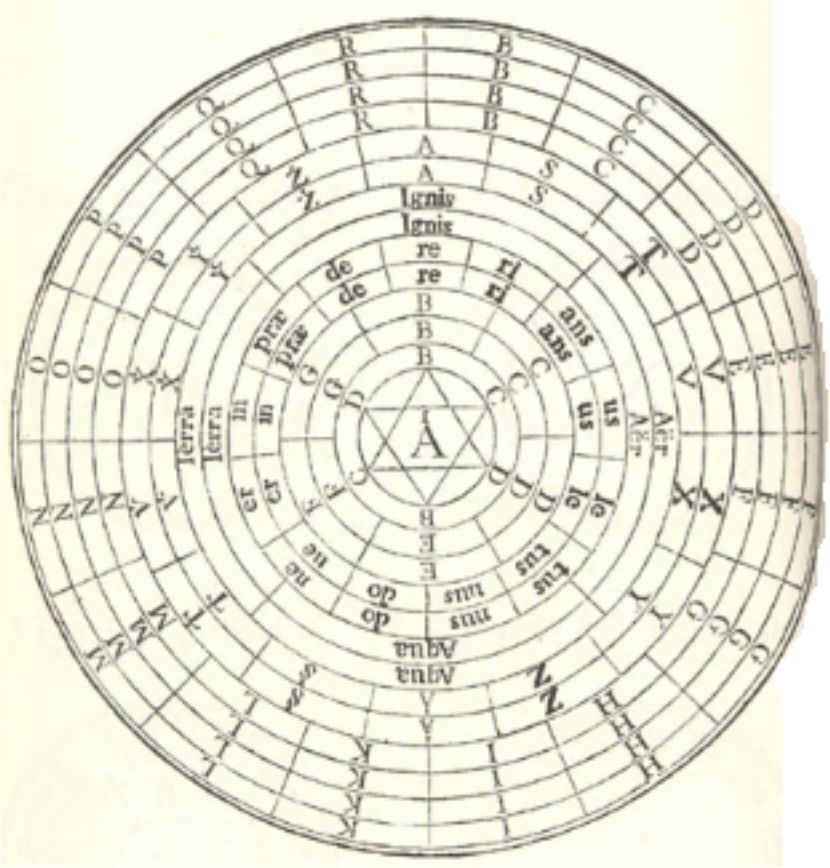
Physically one of the 64-element blocks of the Symmetric Part of Tarot corresponds to
the 8 components (with respect to 8-dim Kaluza-Klein spacetime)
of the 8 First-Generation Fundamental Fermion Particles
and
the other 64-element block corresponds to the components of the Fermion Antiparticles.

Ramon Llull's 64-element Elemental Figure is effectively an 8x8 matrix corresponding to
(image from quisestlullus.narpan.net web site)



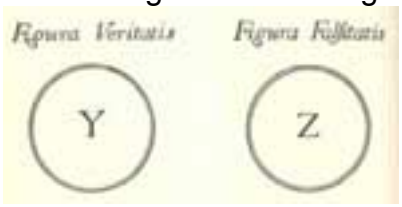
the Fermion Particle and Fermion Antiparticle 64-element Symmetric Tarot blocks
thus
constructing a 64+64 = 128-dimensional D8 half-Spinor space
that when combined with the 120-dimensional D8 of the Llullian A-Wheel produces
120-dim D8 + 128-dim D8 half-Spinor = 248-dim E8 Lie Algebra

As to how all the parts of Llull's model fit together, Lull used a system of revolving concentric circles - his Universal Figure (image from quisestlullus.narpan.net web site)



The outer 4 rings of 16 elements each represent the Elemental Figure Fermion Particles
The next (going in toward the center) 2 rings of 14 elements each represent the D4 and its Lie subalgebras producing the Gauge Groups of Gravity and the Standard Model.
The next 2 rings of 4 elements each represent the 4+4 = 8 dimensions of Spacetime.
The next 2 rings of 13 elements each represent the 26-dimensional String Theory with Strings seen as World-Lines of Fermions, producing a Bohm-type Quantum Theory.
At the center are 3 rings of 6 elements each surrounding a 6-vertex Star of David whose 3x6 + 6 = 24 elements correspond to the vertices of the 24-cell that is the basic element of the Integral Domain Lattice of Integral Quaternions that describe each of the 4-dimensional parts of (4+4)-dimensional Kaluza-Klein Spacetime.

The binary overall structure of Clifford Algebras including Cl(8) is described by Llull



in terms of his True-False Y-wheel and Z-wheel.

In his time around 1300 A.D. Ramon Llull could not use the language of 2000 A.D. math and physics to explain his Tarot-type model to the world. As Anthony Bonner' said in his book Doctor Illuminatus (Princeton 1993):
"... Even ...[Llull's]... disciple, le Myesier, complained ... about "the confusion caused by the meanings of the alphabet of the Ars demonstrativa and its sixteen figures, which confound the mind." ...
Llull ... tr[ied] to persuade the Parisian schoolmen ...[by]... us[ing] the bizarre vocabulary more sparingly, and modify[ing] the Art itself so that it would not look so alarming. ...
Towards the beginning of 1290 in Montpelier, therefore, Llull set about ... beginning a new phase of the Art ...
As a result of the "weakness of human intellect", the number of figures [wa]s reduced and the algebraic notation vanishe[d] ...
Llull's last works were written in December 1315 in Tunis, at which point he disappears from history. ... he must have died sometime between then and March 1316
...
the Dominican inquisitor general of Aragon, Nicholas Eymerich (1320-99), began a campaign against the doctrines of Ramon Llull ...[that]... culminated ... in two events:
The first was the publication in January ... 13676 ... of the Directorium inquisitorum, his notorious manual on inquisitorial methods ... it contained a list of a hundred errors of Ramon Llull ... on February 6, a papal bull was promulgated censuring Llull and condemning twenty of his books ... Llull's followers ... won in 1416 ... the promulgation by the Papal Court ... invalidating the bull of forty years earlier. ... Veneration of Llull was ... permitted withn the Franciscan Order and locally in Majorca ... his feast day was set on 3 July ...
The second condemnation of Llullist doctrines came from ... the Faculty of Theology of the University of Paris. In 1390 ... the Faculty of Theology publish[ed] an edict prohibiting the teaching of Llullist doctrines. ...[It]... cut off ... considerable interest in Llull in Paris ...".

In short:

Ramon Llull expanded the 78-dim Tarot outline structure to the old full 256-dim IFA
including the E8 Lie Algebra and the realistic structure of E8 Physics
but
he was 600 years ahead of rediscovery of his mathematics
and
700 years ahead of the time of detailed experimental confirmation
with the result that
the Paris-based Establishment of his time ignored and attacked his work
even when he tried to dumb it down to their level.

Llull to Cartan-Dirac-Riesz-E8Physics

Llull's description of the D8 Lie Algebra of dimension 120 = 8 (16-1)
remained undeveloped and unappreciated for 600 years
until Killing and Cartan classified Lie Groups.
Roger Penrose in his book "The Road to Reality" (Knopf 2004) said:
"... classification ...[of]... Lie groups ... started with Wilhelm Killing ... whose basic papers appeared in 1888-1890, and was essentially completed in 1894 ... by ... Elie Cartan ...
It turns out that there are four families, known as Am, Bm, Cm, Dm ... of respective dimension m(m+2), m(2m+1), m(2m+1), m(2m-1), called the classical groups ...
and five exceptional groups known as E6, E7, E8, F4, G2,
of respective dimension 78, 133, 248, 52, 14. ...".
The connection of the 248-dim Lie Algebra E8 with the Clifford Algebra Cl(16)
and its 120-dim bivector algebra D8 and 128-dim half-spinor space
only became clear in the 1900s based on the work of Cartan
as further developed by Jovet, Sauter, and Riesz mathematically
and applied by Dirac to physics.
Pertti Lounesto in his article on "History of Clifford Algebras"
in the book "Clifford Numbers and Spinors" by Marcel Riesz (Kluwer 1993) said:
"... E. Cartan 1908 ... identified the Clifford algebras Cl(p,q) as matrix algebras with entries in R [Real Numbers], C [Complex Numbers], H [Quaternions], R+R, H+H
and found a periodicity of 8 ...
Cartan also observed spinor modules of orthogonal Lie algebras in 1913 ...
Jovet 1930 and Sauter 1930 replaced column spinors by square matrices in which only the first column was non-zero -
thus spinor spaces became minimal left ideals in a matrix algebra.
Riesz 1947 used primitive idempotents of Clifford algebras to construct spinor spaces as minimal left ideals in Clifford algebras ...".

Roger Penrose in his book "The Road to Reality" (Knopf 2004) said:
"... One reason that Clifford Algebras are important is for their role in defining spinors. In physics, spinors made their appearance in Dirac's equation for the electron (Dirac 1928), the electron's state being a spinor quantity ...".
In the 1900s, Irving Ezra Segal showed the connection between the Conformal Group and the Dark Energy of Gravity; MacDowell and Mansouri showed how gauging the Conformal Group produces Gravity; and the Dirac Equation was generalized to the Standard Model. During the 2000s Dark Energy was observed by WMAP and Planck and the LHC discovered a Higgs state, confirming the basic Standard Model structure so

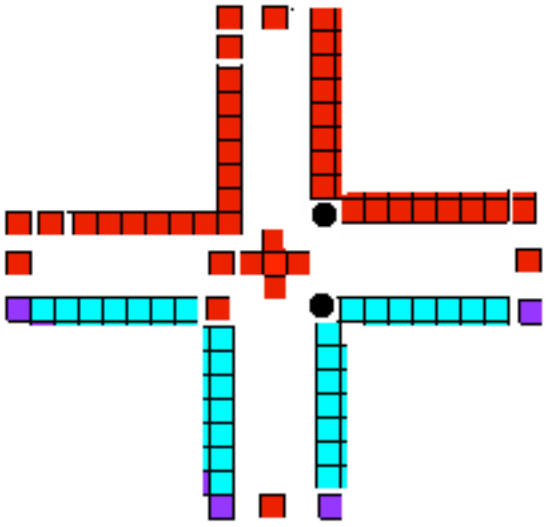
**it is only now (the 2000s) that the formal Written Human Culture
has caught up with the informal Oral Ancient African Culture
and the 700-year old model of Ramon Llull
in understanding a realistic Unified Theory of the Laws of Nature.**

Appendix1: E6 to D4

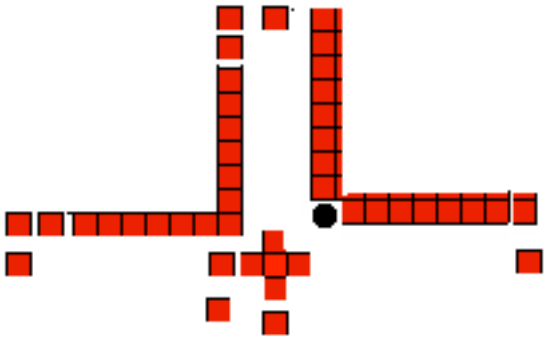
There are two chains from E6 to D4:

The chain E6 to D5 to D4

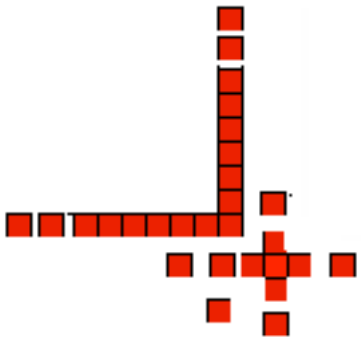
78-dim E6



contains 45-dim D5 by E6 / D5xU(1) rank 2 Type EIII space (CxO)P2 whose related Type V Exceptional Complex Domain is not of Tube Type. In E8 Physics its Shilov Boundary is seen as a bundle with fibre S1xS7 and base space whose own fibration is S1 -> S9 -> CP4. It is used in E8 Physics as a representation space for first-generation Fermion Particles and AntiParticles.

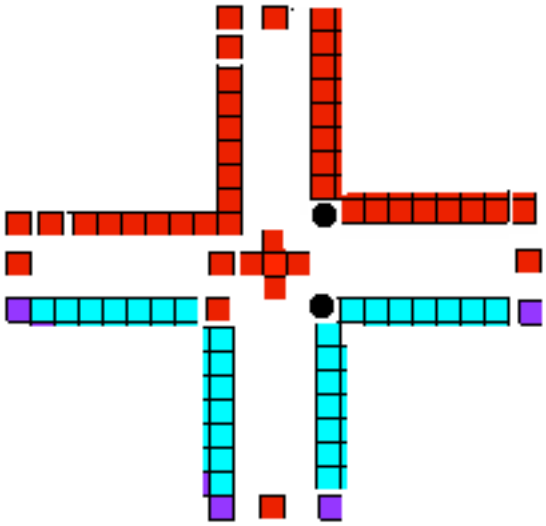


which contains 28-dim D4 by D5 / D4xU(1) Lie sphere rank 2 Type BDI space whose related Type IV(8) Complex Domain is Tube Type with Shilov Boundary RP1 x S7.
It is used in E8 Physics as a representation for 8-dimensional Spacetime.

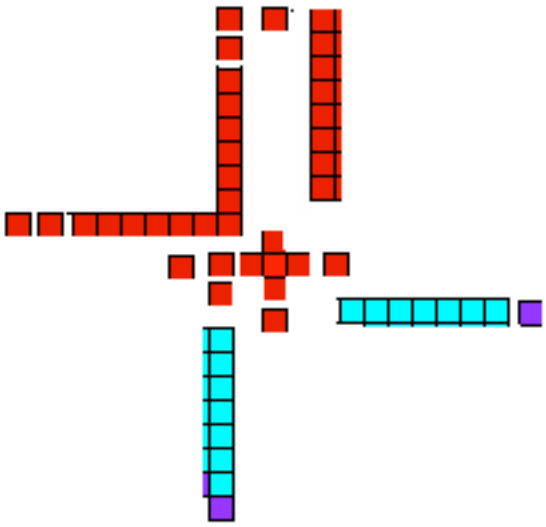


The chain E6 to F4 to B4 to D4

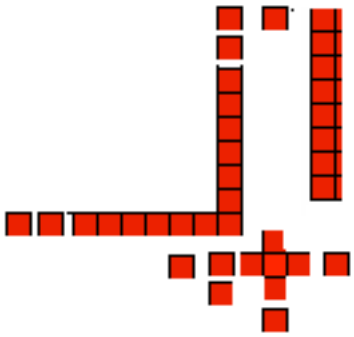
78-dim E6



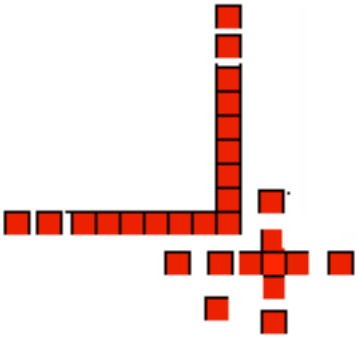
contains 52-dim F4 by E6 / F4 Type EIV rank 2 space that is the set of OP2 in (CxO))2 and is related to the 26-dim traceless part J(3,O)o of the 27-dim Jordan Algebra J(3,O)



which contains 36-dim B4 by F4 / B4 = OP2 = Octonionic Projective Plane

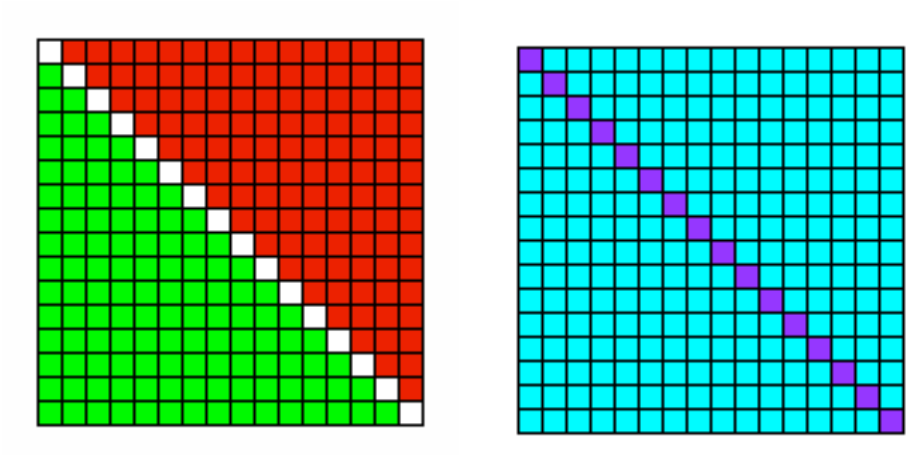


which contains 16+12 = 28-dim D4 by B4 / D4 = OP1= the 8-sphere S8



Appendix2: Some Details of E8 encoding in IFA

IFA Cl(8) = 256-dim 16x16 Real Matrices M(16,R) =
= 120-dim Antisymmetric16x16 + 136-dim Symmetric 16x16



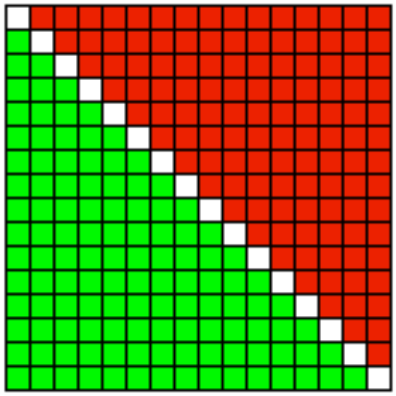
For Antisymmetric 16x16 each red entry above the diagonal is the negative of the corresponding green entry below the diagonal and the 16 diagonal entries are zero so the number of Antisymmetric entries is 120 corresponding to the D8 Lie Algebra.

For Symmetric 16x16 each cyan entry above the diagonal is equal to the corresponding cyan entry below the diagonal and the 16 diagonal entries are non-zero so the number of Symmetric entries is 120+16 = 136.
8 of the 136 Symmetric entries of the IFA Cl(8) 16x16 Matrix do not correspond to E8 but
the other 136-8 = 128 = 64 + 64 correspond to 128-dim half-spinor of D8.

Since **248-dim E8 = 120-dim D8 + 128-dim half-spinor of D8 =**
= 120-dim Antisymmetric part + 128 of 136-dim Symmetric part of M(16,R)

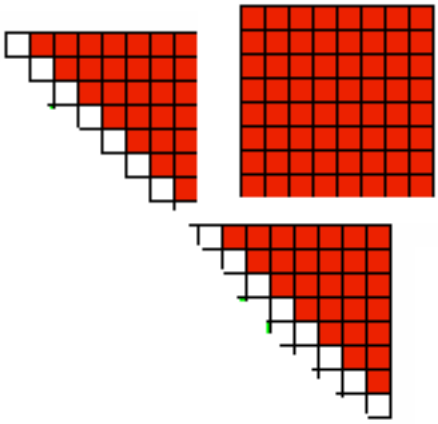
256-dim IFA Cl(8) contains 120+128 = 248-dim E8
and so
encodes the structure of E8 Physics of Gravity and the Standard Model.

Antisymmetric Part:



Due to the diagonal-reflection symmetry of Antisymmetric and Symmetric matrices, only the upper triangular parts of the matrices need to be used in visualization.

The 120-dim Antisymmetric part corresponds to the 120-dim D8 Lie Algebra.
It has 3 components: a 64-dim Square plus two 28-dim Triangles.



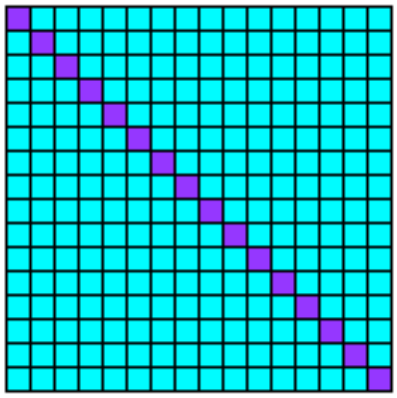
Each 28-dim Triangle corresponds to a 28-dim D4 Lie Algebra
so that
the 64-dim Square corresponds to the Coset Space D8 / D4xD4

The 64-dim Square also corresponds to a U(8) subalgebra of D8
representing relationships between 8-dim Position and 8-dim Momentum
of 8-dim Spacetime that obtains a (4+4)-dim Kaluza-Klein structure.

One of the 28-dim D4 contains a 15-dim A3 = D3 Lie Algebra of the Conformal Group
that produces Gravity by a generalized MacDowell-Mansouri mechanism.

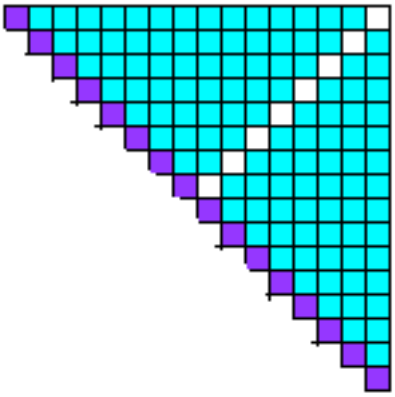
The other 28-dim D4 contains a 15-dim A3 = D3 Lie Algebra with an A3 = SU(3)
subalgebra that in conjunction with 8-dim Kaluza-Klein spacetime containing
4-dim Internal Symmetry Space part CP2 = SU(3) / SU(2)xU(1)
produces the Standard Model gauge groups by the Batakis mechanism.

Symmetric Part:

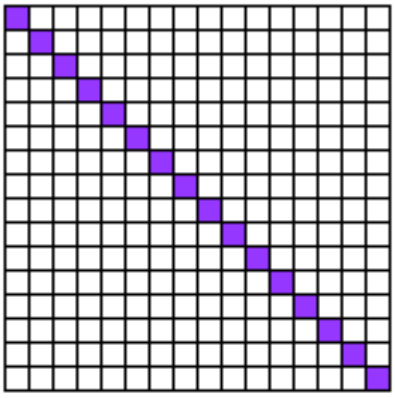


Due to the diagonal-reflection symmetry of Antisymmetric and Symmetric matrices, only the upper triangular parts of the matrices need to be used in visualization.

The 120 + 16 = 136-dim Symmetric part of the Cl(8) matrix algebra M(16,R)



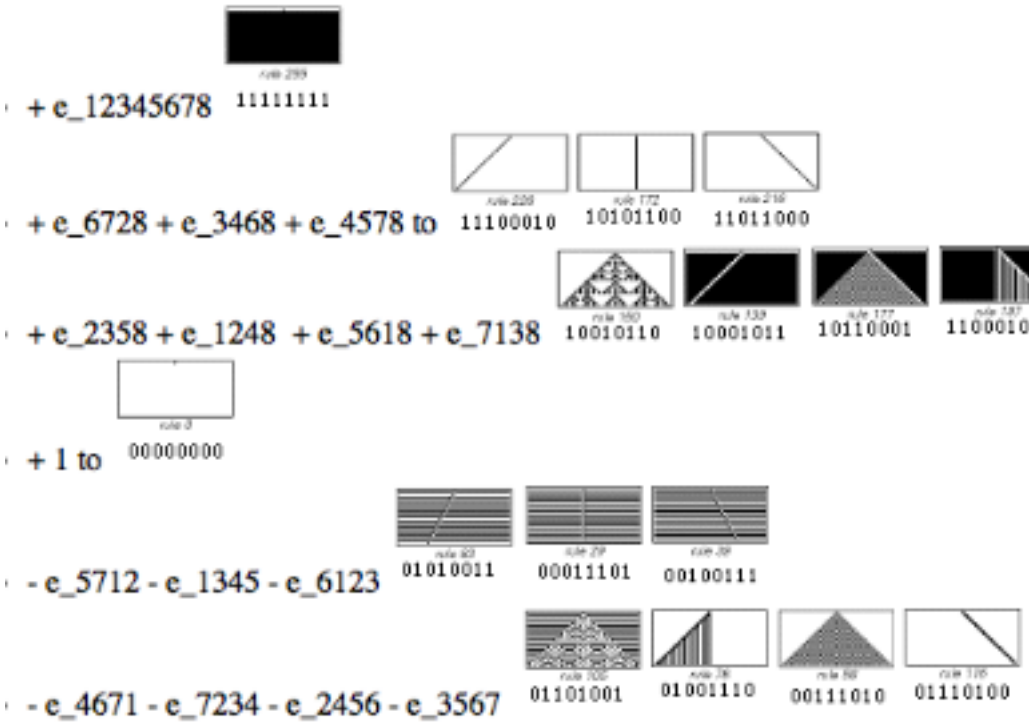
contains 8 anti-diagonal elements that are not contained in the E8 Lie Agebra, but both Cl(8) and E8 contain the 16-element Diagonal whose elements



give 16 terms Cl(8) = 16x16 Real Matrix Algebra Primitive Idempotent

f = (1/2)(1 + e_1248) (1/2)(1 + e_2358) (1/2)(1 + e_3468) (1/2)(1 + e_4578) =
= (1/16)(1 + e_1248 + e_2358 + e_3468 + e_4578 + e_5618 + e_6728 + e_7138
- e_3567 - e_4671 - e_5712 - e_6123 - e_7234 - e_1345 - e_2456 + e_J)

which in terms of the 256 Elementary Cellular Automata are



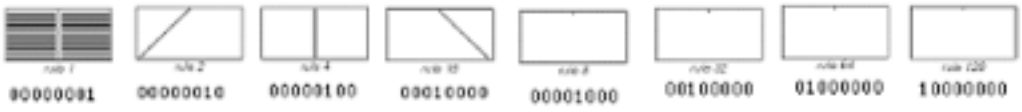
which are related to the two 8-dim Cl(8) half-spinors

the 8 +half-spinors

the 8 -half-spinors

which in turn are related by Triality to the 8-dim Cl(8) vectors

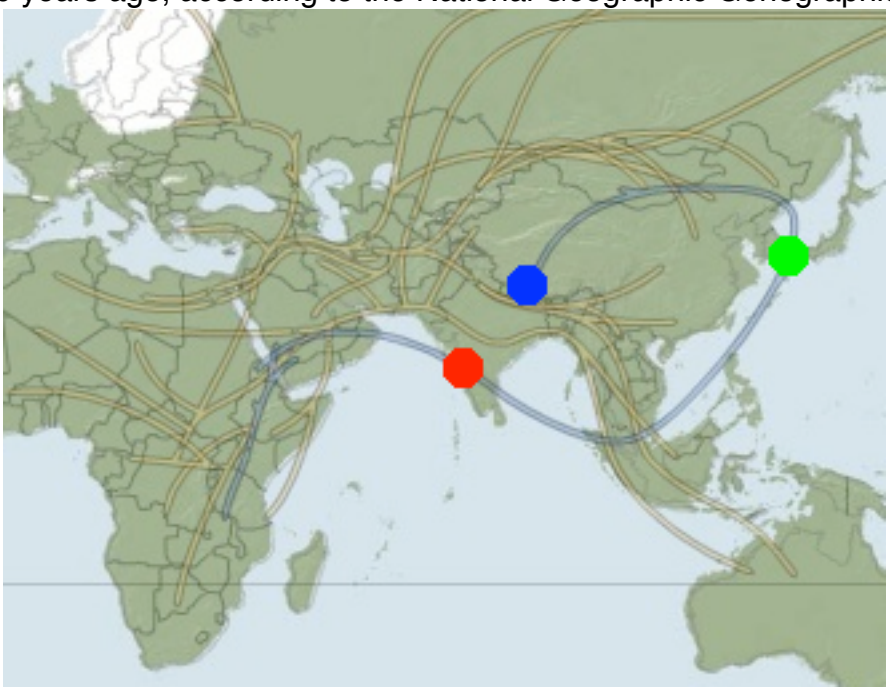
the 8 vectors



When the 56 + 56 off-diagonal elements are added to the 8 + 8 Cl(8) half-spinors you get the 64 + 64 = 128 elements of a half-spinor space of Cl(16) = Cl(8) x Cl(8).

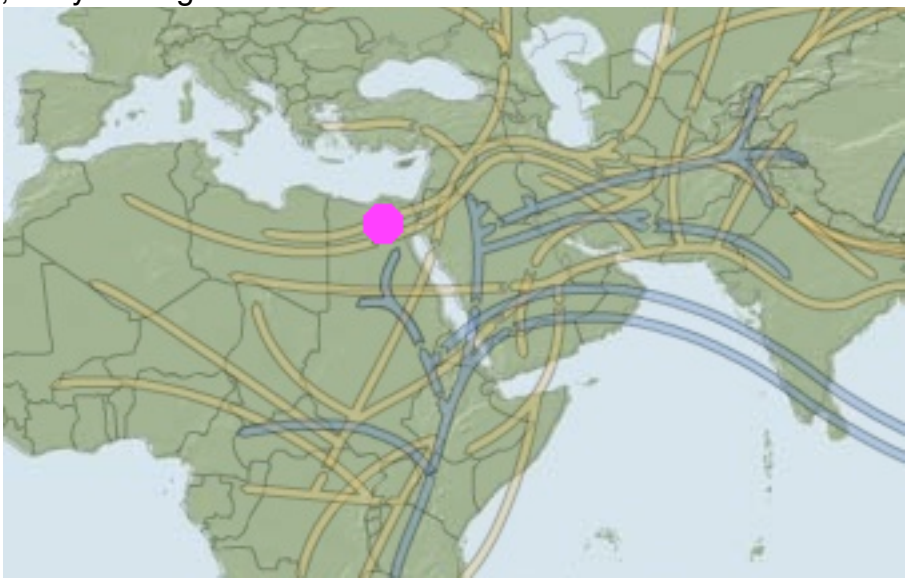
Appendix3 - Comparison of Arabian Sea Africa-India connection with Nile River Africa-Egypt connection

About 50,000 years ago, according to the National Geographic Genographic project,



Y-chromosome DNA indicated that basic human physiology had emerged from Africa to India then to Japan and on to Tibet

By about 40,000 years ago



Y-chromosome DNA population M96 had branched into the Nile River Valley

Around 50,000 years ago
Japanese were separated from their African Homeland by
the East Pacific Ocean, the Sunda Shelf, the Indian Ocean, and the Arabian Sea
which was so great a distance that contact with Africa was so tenuous
that they only retained about 1/2 of their IFA Cultural Heritage as evidenced
by the fact that Shinto Futomani Divination uses 128 elements, 1/2 of the 256 of IFA
Tibetan were separated from their African Homeland by Mountains and Land of China,
the East Pacific Ocean, the Sunda Shelf, the Indian Ocean, and the Arabian Sea
which was so great a distance that contact with Africa was so much more tenuous
that they only retained about 1/4 of their IFA Cultural Heritage as evidenced
by the fact that the I Ching uses 64 elements, 1/4 of the 256 of IFA
Indians were separated from their African Homeland by the Arabian Sea
which was close enough to Africa to maintain regular contact
but far enough that they felt isolated from the very close contact needed
to maintain the details of the oral traditions of IFA, so the Indian priests of IFA chose
to put the IFA Information System into writing and to do so developed Sanskrit
and wrote the Rig Veda.

About 10,000 years later (around 40,000 years ago)
the Builders of the Great Pyramid had migrated throughout the length of the Nile,
along which substantially contiguous settlements enabled them to maintain
enough contact to maintain the details of the oral traditions of IFA so that
when they built the earliest of the pyramids, the Great Pyramid,
they did not deface it with any writing.
However,
the Great Pyramid was a huge engineering project requiring coordinated work

(image from Wikipedia)

by large numbers of people, so an engineering language developed among
the builders, first based upon hand signals (see Stan Tenen's www.meru.org)
and then translated into a written alphabetical language, Hebrew.
After the Great Pyramid complex had been completed,
the Tower of Babel breakdown occurred, the cooperative community fragmented,
skills became diluted so that later pyramids were not up to Great Pyramid standards,
and a less-sophisticated heiroglyphic writing evolved and was used on later structures.

Appendix4 - Poster

The poster on the following page was produced for the NSBP/NSHP 2010
Joint Annual Conference of the
Nartional Society of Black Physicists
and the
National Society of Hispanic Physicists
to be held 10-14 February 2010.

The conference was cancelled
so
the poster is put here so that it might be seen by anyone interested.

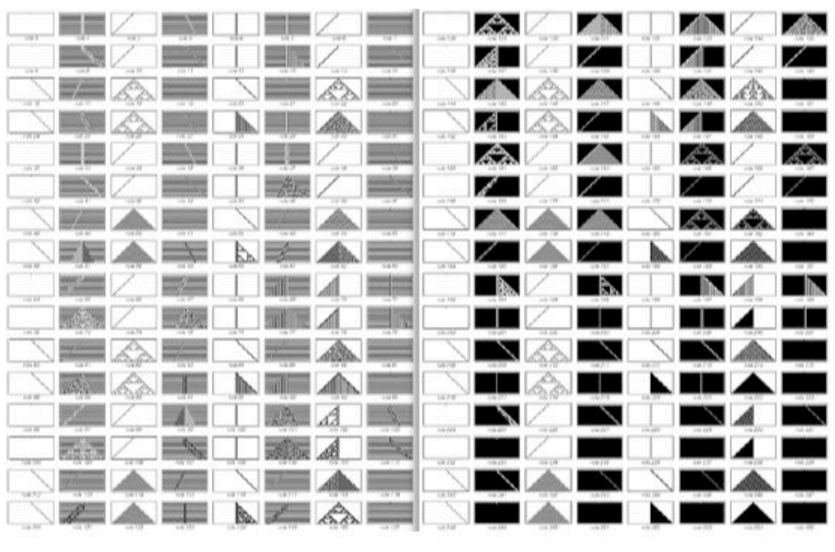
African Origins

Africans developed IFA Oracle divination based on the square of 16 = 16x16 = 256 = 2^8 corresponding to the vertices of an 8-dimensional hypercube and to the binary 2-choice Clifford algebra Cl(8) and so to related ones such as Cl(8)xCl(8) = Cl(16).

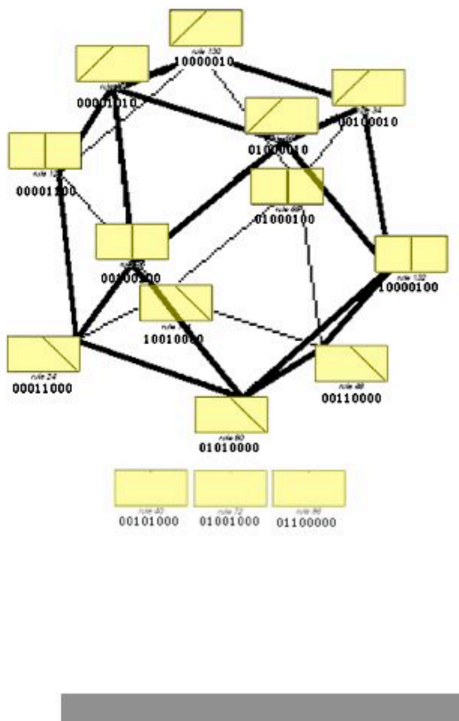
Since the number of sub-hypercubes in an 8-dimensional hypercube is 6,561 = 81x81 = 3^8, the IFA Oracle has N=8 ternary 3-structure as well as binary 2-structure:

N	2^N	3^N
0	1	
1	2 3	
2	4 =2x2	9 = 3x3
3	8	27
4	16 = 4x4	81 = 9x9
5	32	243
6	64 = 8x8	729 = 27x27
7	128	2187
8	256 = 16x16	6561 = 81x81

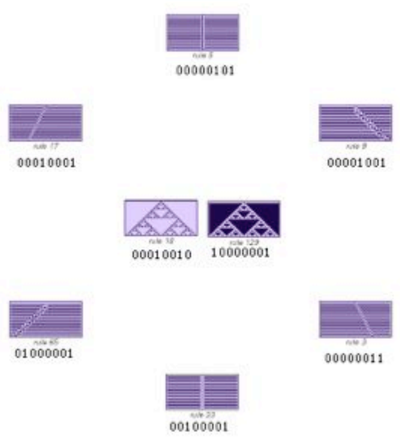
As ancient African games such as Owari show, binary 2-structure corresponds to static states and ternary 3-structure corresponds to dynamic states. Mathematically, using binary 2-choice static states to define dynamics on 3 ternary neighbor states produces the 256 Elementary Cellular Automata:



15 of the elements represent Conformal Spin(2,4) of Gravity:

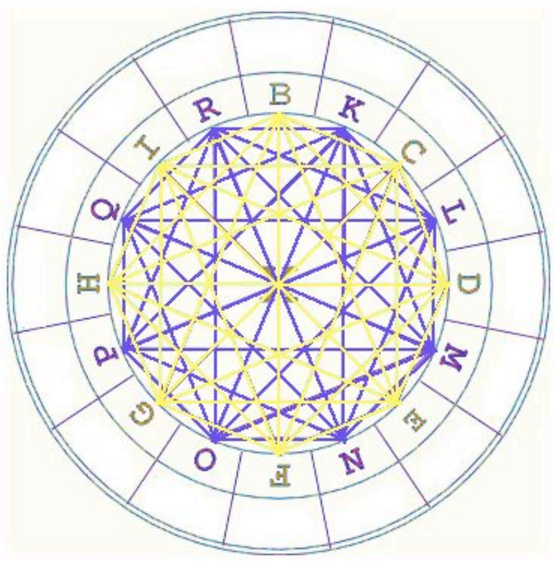


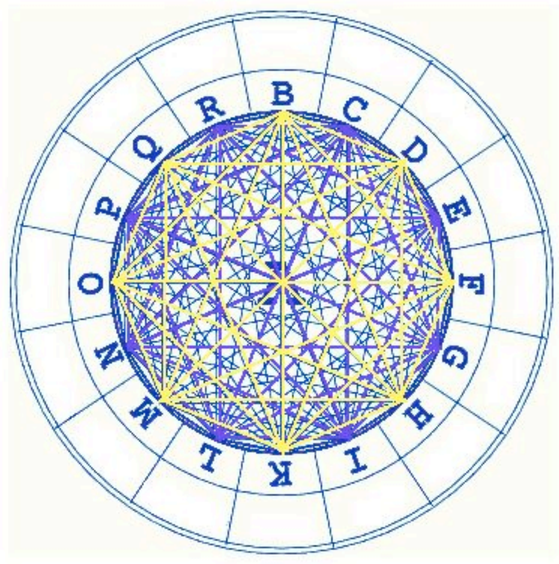
8 of the elements represent the SU(3) Color Force:



Hispanic Development

Ramon Llull (1232-1316) of Mallorca studied the 16 possibilities of the Ilm al Raml, which are derived from 16 of the 16x16 = 256-element African IFA divination system, and found a structure that he summarized in Wheel Diagrams with 16 vertices connected to each other by lines and in Cubic 4x4x4 = square 8x8 = 64-element Elemental Figures (images adapted from lullianarts.net web site):





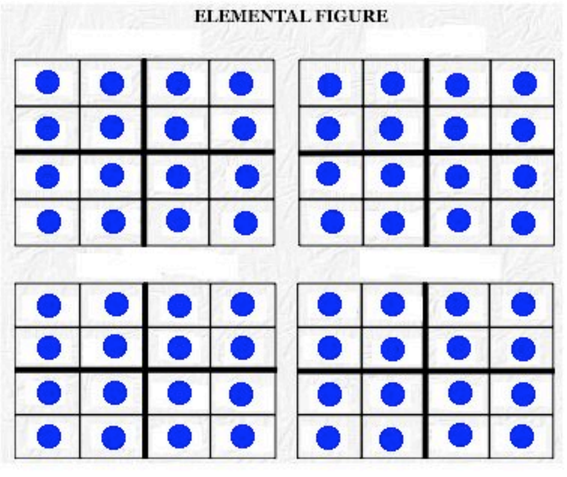
The 28 gold lines (gold 8-HyperCube points) represent Gravity and the 28 purple lines (purple 8-HyperCube points) represent the Standard Model.

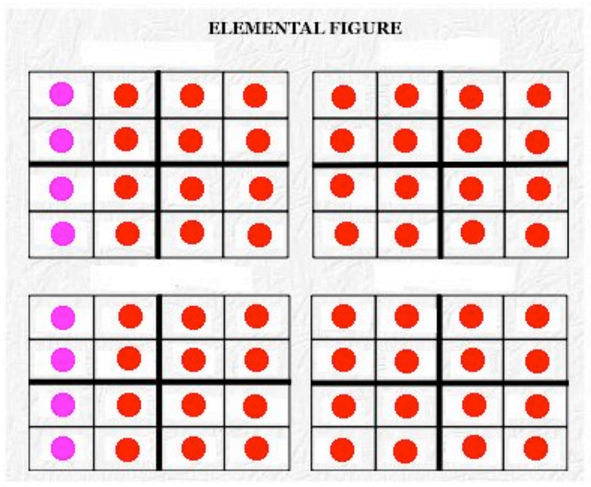
Adding in 64 blue lines (blue 8-HyperCube points without white dots) gives 120 lines that represent the Spin(16) BiVector Lie Algebra of the Clifford Algebra Cl(16) = Cl(8) x Cl(8):

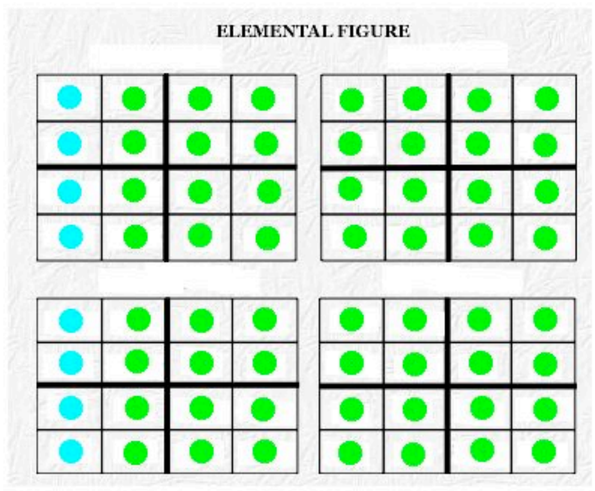
The 64 blue lines, and the 64 pure blue 8-HyperCube points, represent 8-dimensional Kaluza-Klein Vector SpaceTime and can be shown as a 64-element Elemental Figure.

By Triality Automorphisms, the 8+56 = 64-element magenta and red 8-HyperCube points that represent 8 Fermion Particles can also be shown as a 64-element Elemental Figure and the 8+56 = 64-element cyan and green 8-HyperCube points that represent 8 Fermion AntiParticles can also be shown as a 64-element Elemental Figure.

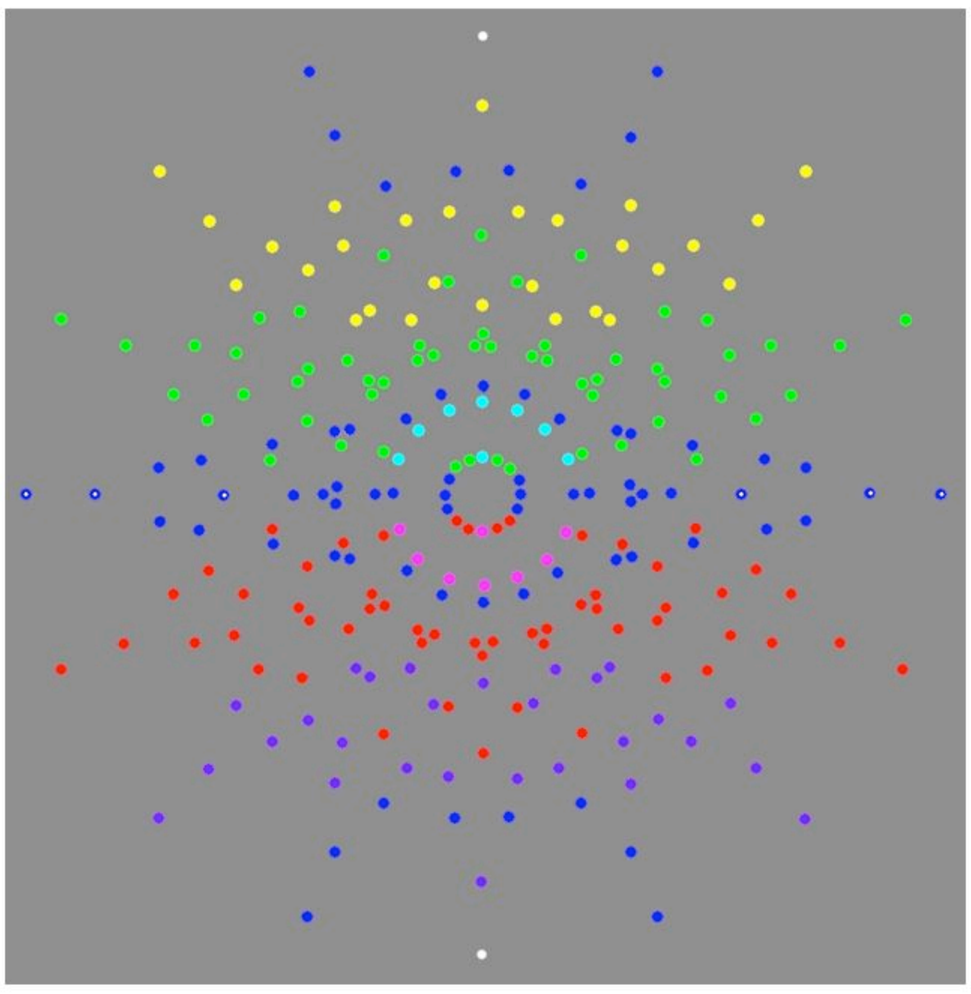
The 64 red-magenta Fermion Particle elements plus the 64 green-cyan Fermion AntiParticle elements form the 128 elements of one Half-Spinor representation of Spin(16).



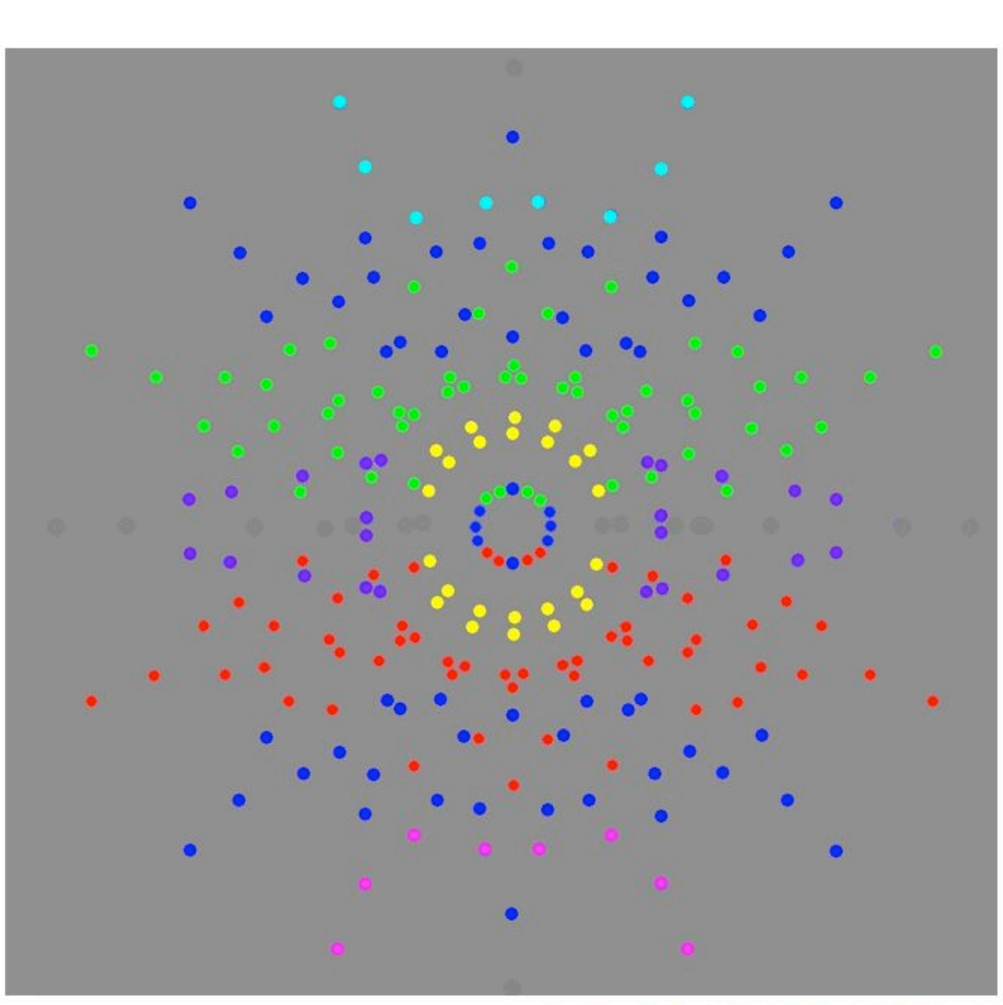




The 120 elements of the Spin(16) BiVector Lie Algebra plus the 128 elements of a Half-Spinor representation of Spin(16), both of which live in the Clifford Algebra Cl(16) = Cl(8) x Cl(8), combine to form the 120+128 = 248-dimensional E8 Lie Algebra:



8-HyperCube = 256 vertices = 1 + 8 + 28 + 56 + (8+48+8+(3+3)) + 56 + 28 + 8 + 1



E8 Lie Algebra = 120+128 = 248 vertices = 8 + 28 + 56 + (28+8+28) + 56 + 28 + 8

E8 Physics

The resulting E8 Physics Model has:

EPR structure similar to that of Joy Christian;

E8 structure modified from that of Garrett Lisi;

Cl(16) = Cl(8)xCl(8) Clifford Algebra structure anticipated by Ramon Llull;

Higgs mechanism produced by formation of M4 x CP2 spacetime as shown by work of Meinhard Mayer;

Standard Model Gauge Groups produced therein as shown by work of N. A. Batakis;

Conformal Gravity produced as in the MacDowell-Mansouri mechanism;

Dark Energy : Dark Matter : Ordinary Matter ratio 75 : 21 : 4 produced by conformal structures similar to those of Irving Ezra Segal;

Force Strength and Particle Mass calculations done using the Work of Hua Luogeng, particularly work on the Geometry of Complex Domains;

T-quark composite Higgs model based on the work of Yamawaki et al, resulting in a 3-state T-quark - Higgs system;

and Algebraic Quantum Field Theory (AQFT) constructed from a Clifford Real-Periodicity-8 hyperfinite II1 von Neumann algebra factor.

E8 Root Vectors = 112+128 = 240 = 8 + 28 + 56 + (24+8+24) + 56 + 28 + 8