B-mode Octonionic Inflation of E8 Physics

Frank Dodd (Tony) Smith, Jr. - 2014

viXra

BICEP2 in arXiv 1403.3985 said:
"... Inflation predicts ... a primordial background of ... gravitational waves ...[that]... would have imprinted a unique signature upon the CMB. **Gravitational waves induce local quadrupole anisotropies** in the radiation field within the last-scattering surface, **inducing polarization** in the scattered light ... **This polarization pattern will include a "curl" or ... inflationary gravitational wave (IGW) B-mode ... component** at degree angular scales that cannot be generated primordially by density perturbations. The amplitude of this signal depends upon **the tensor-to-scalar ratio ... r = 0.20 +0.07 -0.05** ... which itself is a function of the energy scale of inflation. ...".

In E8 Physics, Inflation is due to Non-Unitarity of Octonion Quantum Processes that occur in 8-dim SpaceTime before freezing out of a preferred Quaternionic Frame ends Inflation and begins Ordinary Evolution in (4+4)-dim M4 x CP2 Kaluza-Klein. The unit sphere in the Euclidean version of 8-dim SpaceTime (see viXra 1311.0088 for Schwinger's "unitary trick" to allow use of Euclidean SpaceTime) is the 7-sphere S7.

Curl-type B-modes (tensor) are Octonionic Quantum Processes on the surface of SpaceTime S7 which is a **7-dim NonAssociative Moufang Loop Malcev Algebra**.
(for Malcev Algebras see Appendix I) (image below from Sky and Telescope)

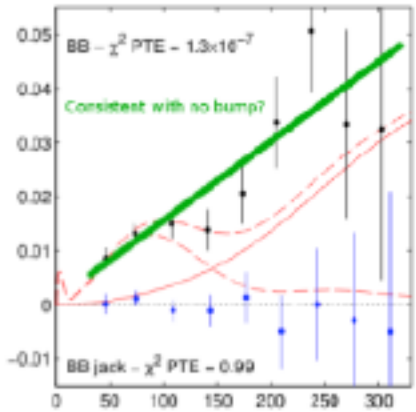
B-modes look like   Spirals on the Surface of S7

Divergence-type E modes (scalar and tensor) are Octonionic Quantum Processes from SpaceTime S7
plus a spinor-type S7 representing Dirac Fermions living in SpaceTime
plus a 14-dim G2 Octonionic Derivation Algebra connecting the two S7 spheres
all of which is a **28-dim D4 Lie Algebra Spin(8)**.
(image below from Sky and Telescope)
E-modes look like Fermion Pair Creation either

off (scalar)  or on (tensor)  the Surface of S7

Therefore: **for E8 Physics Octonionic Inflation the ratio r = 7 / 28 = 0.25**

Phil Bull in his Lumps'n' Bumps blog (17 March 2014) said:
"... the blue points in the plot ... are the nulll tests for the BB power spectrum ... You'd naively expect about a third of the points to have their errorbars not overlapping with zero ...



... you can convince yourself that a straight line would fit the points quite well (green line; my addition). ...".

Here is an outline of how Octonionic Inflation works in E8 Physics:

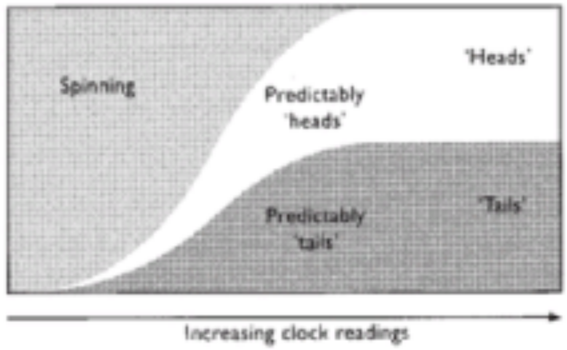
Stephen L. Adler in his book Quaternionic Quantum Mechanics and Quantum Fields (1995) said at pages 50-52, 561:
"... If the multiplication is associative, as in the complex and quaternionic cases, we can remove parentheses in ... Schroedinger equation dynamics ... to conclude that ... the inner product < f(t) I g(t) > ... is invariant ... this proof fails in the octonionic case, and hence one cannot follow the standard procedure to get a unitary dynamics. ...[so there is a]... **failure of unitarity in octonionic quantum mechanics** ...".

In E8 Physics, our present 4-dimensional physical spacetime freezes out from a high-energy 8-dimensional octonionic spacetime due to selection of a preferred quaternionic subspacetime. Our spacetime remains octonionic 8-dimensional throughout inflation, so the **NonAssociativity and Non-Unitarity of octonions accounts for particle creation without the need for tapping the energy of a conventional inflaton field**.

In E8 Physics the 7 Dirac Fermion-types correspond to the7 Imaginary Octonions plus the 8th Fermion (neutrino) corresponding to the real number 1.

The initial Octonionic Big Bang produced particle-antiparticle pairs of the 8 Fermions living in the initial Cl(16) E8 Local Lagrangian Region (see viXra 1403.0178).

David Deutsch in his 1997 book "The Fabric of Reality" said (pages 276-283):
"… there is no fundamental demarcation between snapshots of other times and snapshots of other universes ... Other times are just special cases of other universes ... Suppose ... we toss a coin ... Each point in the diagram represents one snapshot



... in the multiverse there are far too many snapshots for clock readings alone to locate a snapshot relative to the others. To do that, we need to consider the intricate detail of which snapshots determine which others. …
in some regions of the multiverse, and in some places in space,
the snapshots of some physical objects do fall, for a period, into chains,
each of whose members determines all the others to a good approximation …".

Anthony Bonner in his 2007 book "The Art and Logic of Ramon Llull" said:
"… Giordano Bruno wrote five commentaries on Llull, four of them on the Art -
more attention than he gave to any other thinker ...
Giordano Bruno ... saw .... Llull's ... Art ... as a way to explore the connections among his infinity of worlds …".
If you look at Llull's Art (especially his Quaternary Phase) you see that it is equivalent to E8 Physics (see viXra 1403.0178) with
the Clifford Algebra Cl(16) containing E8 giving the Local Lagrangian of a Region
that is equivalent to a " snapshot" of the Deutsch "multiverse" and that the completion of the union of all tensor products of all Cl(16) E8 Local Lagrangian Regions
then emergently self-assemble into a structure = Deustsch multiverse
and form a generalized hyperfinite II1 von Neumann factor AQFT
(Algebraic Quantum Field Theory).

In each successive Unfolding of Octonionic Inflation each of the 8 Fermion Pairs
by correspondence between Imaginary Octonions and E8 Integral Domain Lattices
(see Appendix II)
undergoes a Creation Process whereby there is created
a new Cl(16) E8 Local Lagrangian Region with 8+8 = 16 New Fermions.

Each Unfolding contains a number of Creation Processes each of which has duration of the Planck Time Tplanck and none of which are simultaneous,
so that the total duration of N Unfoldings is 2^N Tplanck.

Paola Zizzi in gr-qc/0007006 said: "... during inflation,
the universe can be described as a superposed state of quantum ... [qubits].
the self-reduction of the superposed quantum state is ... reached at the end of inflation ...[at]... the decoherence time ... [Tdecoh = 10^9 Tplanck = 10^(-34) sec] ...
and corresponds to a superposed state of ... [10^19 = 2^64 qubits]. ...".

Why decoherence at 64 Unfoldings = 2^64 qubits ?

2^64 qubits corresponds to the Clifford algebra Cl(64) = Cl(8x8).
By the periodicity-8 theorem of Real Clifford algebras, Cl(64) is the smallest Real Clifford algebra for which we can reflexively identify each component Cl(8) with a vector in the Cl(8) vector space. This reflexive identification/reduction causes our universe to decohere at N = 2^64 = 10^19
which is roughly the number of Quantum Consciousness Tubulins in the Human Brain.

At the end of 64 Unfoldings, Non-Unitary Octonionic Inflation ended having produced about 16^64 = (2^4)^64 = 2^256 = 10^77 Fermions.

The End of Inflation time was at about 10^(-34) sec = 2^64 Tplanck

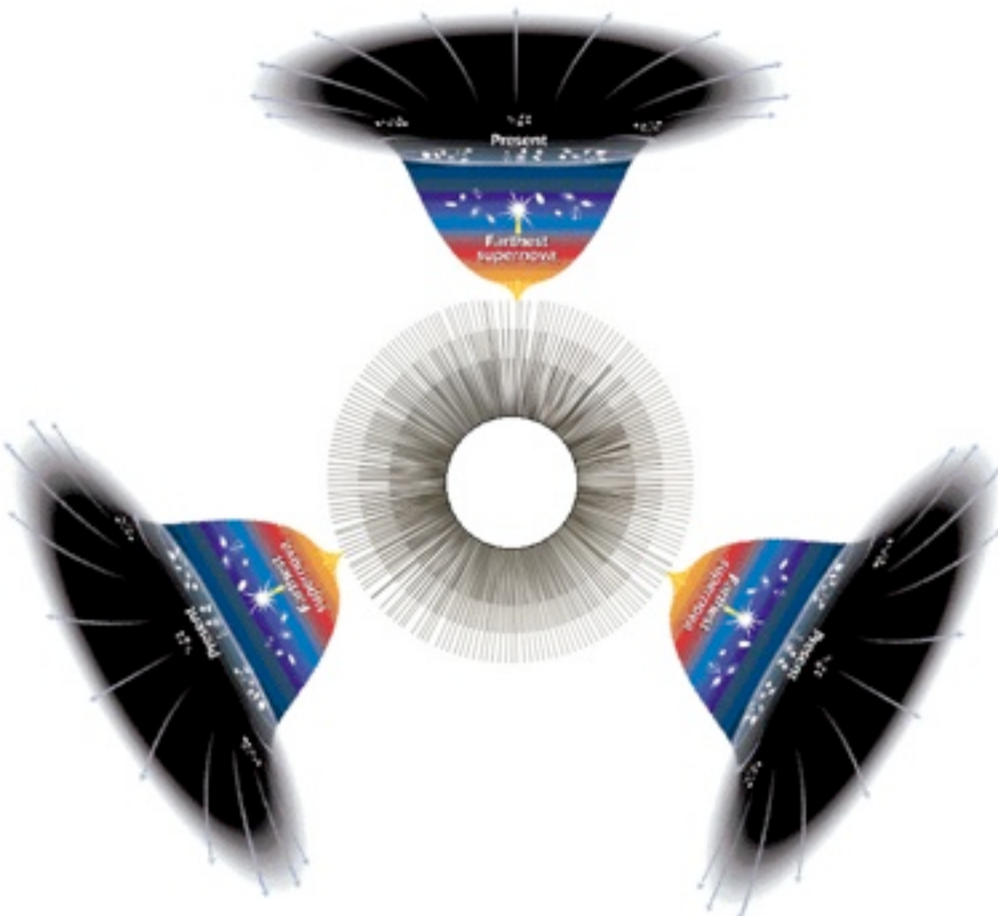
and

the size of our Universe was then about 10^(-24) cm
which is **about the size of a Fermion Schwinger Source Kerr-Newman Cloud**.
(see viXra 1311.0088)

End of Inflation and Low Initial Entropy in Our Universe:

Roger Penrose in his book The Emperor's New Mind (Oxford 1989, pages 316-317) said:
"... in our universe ... Entropy ... increases ... Something forced the entropy to be low in the past. ... the low-entropy states in the past are a puzzle. ...".
The key to solving Penrose's Puzzle is given by Paola Zizzi in gr-qc/0007006:
"... during inflation, the universe can be described as a superposed state of quantum ... [qubits].
The self-reduction of the superposed quantum state is ... reached at the end of inflation ...[at]... the decoherence time
... [Tdecoh = 10^9 Tplanck = 10(-34) sec] ...
and
corresponds to a superposed state of ... [10^19 = 2^64 qubits]. ...
... This is also the number of superposed tubulins-qubits in our brain ... leading to a conscious event. ...".

The Zizzi Inflation phase of our universe ends with decoherence "collapse" of the 2^64 Superposition Inflated Universe into Many Worlds of the Many-Worlds Quantum Theory, only one of which Worlds is our World.



In this image
the central white circle is the Inflation Era in which everything is in Superposition;
the boundary of the central circle marks the decoherence/collapse at the End of Inflation; and
each line radiating from the central circle corrresponds to one decohered/collapsed Universe World (of course, there are many more lines than actually shown), only three of which are explicitly indicated in the image, and only one of which is Our Universe World.
Since our World is only a tiny fraction of all the Worlds, it carries only a tiny fraction of the entropy of the 2^64 Superposition Inflated Universe, thus solving Penrose's Puzzle.

Appendix I (3 pages): **Malcev Algebras**

Jaak Lohmus, Eugene Paal, and Leo Sorgsepp in their book Nonassociative Algebras in Physics (Hadronic Press 1994), said:
"... Moufang loops and Mal'tsev [another transliteration for "Malcev"] algebras ... are ... natural (minimal) generalizations of Lie groups and Lie algebras, respectively. Because of the uniqueness of octonions ... octonionic Moufang loop and the corresponding simple (non-Lie) Mat'tsev algebra are of exceptional importance
...
A Moufang loop is a set G with a binary operation (multiplication) ... so that ...
1) in the equation g h = k, the knowledge of any two of g,h,k [in] G specifies the third one uniquely;
2) there is a distinguished unit or identity element e of G with the property e g = g e = g, [for all] g [in] G;
3) the Moufang identity holds: (g h)(k g) = g((h k)g), [for all] g,h,k [in] G.
A set with such a binary operation that only axioms 1/ and 2) are satisfied is called a loop. ... roughly speaking, loops are the "nonassociative groups". ... The most remarkable property of Moufang loops is their diassociativity: the subloop generated by any two elements in a Moufang loop is associative (group). Hence, for any g,h in a Moufang loop G ... (h g)g = h g^2 , g(g h) = g^2 h , (g h)g = g(h g) ... thanks to [which]... the Moufang identity can be written ... (g h)(k g) = g(h k) g.
... one can define the notion of the inverse element of g [in] G. The unique solution of the equation g x = e (x g = e) is called the right (left) inverse element of g [in] G and denoted as g-1R (g-1L). From ... diassociativity ... g-1R = g-1L = g-1 , g-1(g h) = (h g)g-1 = h , (g-1)-1 = g , (g h)-1 = h-1 g-1 ; [for all] g,h [in] G.
... The Moufang loop G is said to be analytic if G is a real analytic manifold so that both the Moufang lop operation G x G --> G : (g,h) --> g h and the inversion map G --> G : g --> g-1 are analytic ... denote the dimension of G by r ... introduce the antisymmetric quantities
c^i_jk := a^i_jk - a^i_kj ... i,j,k = 1, ... , r ,
called the structure constants of G.
...
The tangent algebra *G* of G ...[with]... product
[X,Y]^i := c^i_jk X^j Y^k = -[Y,X]^i ; i,j,k = 1, 2, ... , r .
...[with the]... Mal'tsev identity ...
[[X,Y],[Z,X]] + [[[X,Y],Z],X] + [[[Y,Z],X],X] + [[[Z,X],X],Y] = 0
... is ... the ... Mal'tsev algebra. ... the Jacobi identity ...[may fail] in *G*
...
... every Lie algebra is a Mal'tsev algebra
...
In a Mal'tsev algebra *G* the Yamaguti triple product ... may be defined as ...
[x,y,z] := [x,[y,z]] - [y,[x,z]] + [[x,y],z]
...
K. Yamaguti proved ... the possibility of embedding a Mal'tsev algebra into a Lie algebra ...

every Mal'tsev algebra can be realized as a subspace of some Lie algebra so that the Mal'tsev operation is a projection of the Lie algebra operation to this subspace.
....
Every Mal'tsev algebra is also a ... Lie triple system ...
Lie triple systems ... serve as tangent algebras for symmetric spaces ...".

S7 Moufang Loop

E. K. Loginov in his paper hep-th/0109206 Analytic Loops and Gauge Fields said:
"... simple nonassociative Moufang loops ...[are]... analytically isomorphic to one of the spaces S7, S3 x R4, or S7 x R7
...
... Suppose A is a complex (real) Cayley-Dickson algebra, M is its commutator Malcev algebra, and L(A) is the enveloping Lie algebra of regular representation of A.

It is obvious that the algebra L(A) is generated by the operators Rx and Lx, where x [is in] A. We select in L(A) the subspaces R(A), L(A), S(A), P(A) and D(A) generated by the operators

Rx,
Lx,
Sx = Rx + 2Lx,
Px = Lx +2Rx and
Dx,y = [Tx, Ty]+T[x,y],

where Tx = Rx -Lx, accordingly. ...

[Rx, Sy] = R[x,y] ...[and]... [Lx, Py] = L[y,x].

... the algebra L(A) is decomposed into the direct sums

L(A) = D(A) + S(A) + R(A),
L(A) = D(A) + P(A) + L(A),

of the Lie subalgebras D(A) + S(A), D(A) + P(A) and the vector spaces R(A), L(A) ... In addition, the map x --> Sx from M into S(A) is a linear representation of the algebra M, which transforms the space R(A) into M-module that is isomorphic ... to the regular Malcev M-module. ...

... the direct summands ... are orthogonal with respect to the scalar product tr{XY} on L(A) ...

[From 7-dim S7 to 28-dim Spin(8)]

...Let A be the complex Cayley-Dickson algebra [of Octonions]. Then A supposes the base 1, e1, ..., e7 such that ei ej = -delta_ij + c_ijk ek,

where the structural constants c_ijk are completely antisymmetric and different from 0 only if

c_123 = c_145 = c_167 = c_246 = c_257 = c_374 = c_365 = 1.

It is easy to see that in such base the operators

Rei = e[i0] - (1/2) c_ijk e[jk] ,
Lei = e[i0] + (1/2) c_ijk e[jk] ,

where e[uv] are skew-symmetric matrices 8 x 8 with the elements (euv)ab = delta_ma delta_nb - delta_mb delta_na .
Using the identity

c_ijk c_mnk = delta_im delta_jn - delta_in delta_jm + c_ijmn ,

where the completely antisymmetric tensor c_ijkl is defined by the equality

(ei,ej,ek) = 2 c_ijkl el ,

we have D_ei,ej = 8 e[ij] + 2 c_ijmn e[mn] . ...

... Its enveloping Lie algebra L(A) (in fixed base) consists of real skew-symmetric 8 x 8 matrices. Therefore we can connect every element F = F_mn e[mn] of L(A)
with the 2-form F = F_mn dx^m /\ dx^n . ... the factors of F are such that

epsilon F0i + (1/2) c_ijk F_ jk = 0 ,
if F [is in] S(A) + D(A) ...[or]... P(A) + D(A)

epsilon F0i = c_ijk F_ jk ,
if F [is in] R(A) ...[or]... L(A)

where there is no summing over j,k in [the second equations], c_ijk 6= 0, and

epsilon = 0, if F [is in] D(A),
epsilon = 1, if F [is in] S(A) + D(A), F [is not in] D(A) or F [is in] R(A),
epsilon = -1, if F [is in] P(A) + D(A), F [is not in] D(A) or F [is in] L(A).

For epsilon = -1 these are precisely the (anty-self-dual) equations of Corrigan et al. ...
In addition, R(A) and L(A) are not Lie algebras. Therefore the [second] equations, in contrast to [the first equationa], are not Yang-Mills equations. Nevertheless, there are a solution of the [second] equations, which generalizes the known (anty-)instanton solution of Belavin et al. ...".

Appendix II (1 page):

Correspondence between Imaginary Octonions and E8 Integral Domain Lattices

```
     7-dim S7   EXPANDS TO  Spin(8) Lie Algebra containing S7 and S7 and G2
       / \
        |   corresponds to
       \ /
7 Imaginary Octonions  i j k E I J K
       / \
        |  corresponds to
       \ /
7 independent E8 Integral Domain Lattices
based on the 7 basic Heptavertons / Onarhedra

     Associative   Coassociative  Heptaverton
      Triangle         Square
                                      k J
        I              J---j          |/
i  -->  / \  ---------->  |   | -->    I--i--E
      E---i            K---k         /|
                                    K j

                                      k I
        J              K---k          |/
j  -->  / \  ---------->  |   | -->    J--j--E
      E---j            I---i         /|
                                    K i

                                      i J
        K              I---i          |/
k  -->  / \  ---------->  |   | -->    K--k--E
      E---k            J---j         /|
                                    I j

                                      I k
        j              I---J          |/
E  -->  / \  ---------->  |   | -->    J--E--j
      i---k            K---E         /|
                                    K i

                                      E j
        J              I---j          |/
I  -->  / \  ---------->  |   | -->    J--I--k
      i---K            k---E         /|
                                    K i

                                      E k
        j              J---i          |/
J  -->  / \  ---------->  |   | -->    K--J--i
      I---K            k---E         /|
                                    I i

                                      E i
        J              K---i          |/
K  -->  / \  ---------->  |   | -->    I--K--j
      I---k            j---E         /|
                                    J k
```