E8 AQFT and Sarfatti-Bohm Free Will

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E8 Physics AQFT is constructed from an E8 Physics Lagrangian (viXra 1508.0157)
by embedding E8 into the Real Clifford Algebra Cl(16) = Cl(8)xCl(8)
and taking the completion of the union of all tensor products of copies of Cl(16)
which forms a generalized hyperfinite II1 von Neumann factor algebra AQFT
(Algebraic Quantum Field Theory) that by Periodicity retains underlying E8 symmetry.

The World-Line of a Particle in E8 Physics is a String connecting the Cl(16) copies
that make up points / events in the History of the Particle.

Interaction among those History World-Line Strings by String Theory
produces a Force / Potential that is similar to Gravity
but
the Local Lagrangian of E8 Physics in each copy of Cl(16) in the AQFT
already contains Gravity (as well as the Standard Model).
The purpose of this paper is to describe

the Physical Interpretation of the E8 AQFT String Gravity-like Force / Potential

as the Sarfatti-Bohm Quantum Potential with Back-Reaction that permits Free Will
and is the fundamental Force of Quantum Consciousness that is described as Gravity
by Penrose and Hameroff (Physics of Life Reviews 11 (March 2014) 39-78).

The Quantum Potential of this paper is a Bohm internal energy of a quantum system
whose total force does not fall off with distance since it depends on the form of
the quantum state rather than its magnitude.

The form is described in terms of Cl(16) which is related (see viXra 1512.0300)
to the Tensor Product Quantum Reed-Muller code [[256 , 0 , 24]] x [[256 , 0 , 24]]
and which contains not only 248-dim E8 but a total of 65,536 elements.

E8 AQFT in the Bohm picture would have a Bohm Quantum Potential that would guide

(analogous to Gravity Curvature of Spacetime guiding particles within 4-dim Spacetime)

particles and their forces within Spacetime (including CP2 Internal Symmetry Space) that are represented in 248-dim E8 as these 128+64+28+28 = 248-dim structures:

Fermion Particle Types by 8+8 = 16-dim OP2 Octonion Projective Plane
If you count each of the 8 E8 Spacetime components of each type separately,
then by E8 / D8 = 64+64 = 128-dim (OxO)P2 Octo-Octonionic Projective Plane

Spacetime by 4+4 = 8-dim Octonions
If you see both position and momentum, then by 8x8 = 64-dim D8 / D4 x D4 = Gr(8,16)

Conformal Gravity gauge bosons + Standard Model ghosts = 16+12 = 28-dim D4

Standard Model gauge bosons + Gravity ghosts = 12+16 = 28-dim D4

So,

**the Bohm Quantum Potential of E8 AQFT acts
as curvature of E8 in terms of those structures.**

Jack Sarfatti has noticed that General Relativistic Gravity not only
has an action by Curvature of Spacetime that guides particles
but also
has a back-reaction of particles by their mass distribution on Curvature of Spacetime
so he has generalized the Bohm Quantum Potential to form

**the Sarfatti-Bohm Quantum Potential that also acts as back-reaction
of particle / force distribution to modify curvature of E8 structures**.

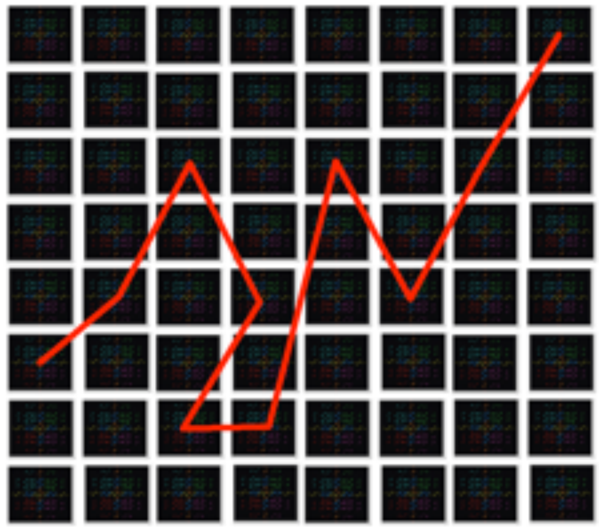
In terms of Quantum Creation and Annihilation Operators, E8 AQFT is described by the maximal contraction of E8 which is a realistic generalized Heisenberg Algebra

h92 x A7 = 5-graded 28 + 64 + ((SL(8,R)+1) + 64 + 28
(see viXra 1507.0069 and 1405.0030)

but from the Heisenberg Algebra Operator point of view the Geometric Structure analogy with General Relativity is not so clear so this paper will use a Lie Algebra / Symmetric Space view of E8 AQFT Geometric Structure.

(The two approaches are analogous to two views of Gravitation described by Steven Weinberg
in his book “Gravitation and Cosmology” (Wiley 1972) as
“... the theory of elementary particles ...”
and
“... the ... Riemannian geometry ...geometrical approach ...”.)

In terms of **E8 structure whose curvature by action and back-reaction guides and in turn is influenced by E8 particle / force distribution**
consider the World-Lines of Particles moving in the E8 structure
such as the red line in this 64-element subset of Deutsch Many-World Snapshots



Andrew Gray (quant-ph/9712037) described Quantum Interactions of World-Lines:
"... probabilites are ... assigned to entire fine-grained histories ...
base[d] ... on the Feynman path integral formulation ...
The formulation is fully relativistic and applicable to multi-particle systems.
It ... makes the same experimental predictions as quantum field theory …".

David Tong (String Theory University of Cambridge Part III Mathematical Tripos 2009)
said: "... if the dimension of spacetime is **D = 26 ... bosonic string** ...
the critical dimension ... our theory contains a bunch of massless particles ...
massless particles are interesting because they give rise to long range forces ...
The states transform in the 24 x 24 representation of SO(24) ...
the symmetric traceless representation of SO(24) is ... a massless spin 2 particle ...".
Joseph Polchinski ("String Theory" vol. 1 (Cambridge 1998)) said:
"... **Closed plus open unoriented bosonic string** ... have ...
the tachyon ...
and ... a [24x24 trace term] scalar ... dilaton ...
and ... **a symmetric ... 24x24 ... tracelesss tensor ... spin-2 graviton** ...".

Closed string tachyons localized at orbifolds of fermions produce virtual particles / antiparticles for Schwinger Sources (viXra 1311.0088, 1507.0173, 1508.0157).

Dilatons are Goldstone bosons of spontaneously broken scale invariance that (analogous to Higgs) go from mediating a long-range scalar gravity-type force to the nonlocality of the Bohm-Sarfatti Quantum Potential.

The symmetric traceless spin 2 particle = Bohmion = Carrier of the Bohm Force of the Bohm Quantum Potential.

“... Bohm’s Quantum Potential can be viewed as an internal energy of a quantum system ...” according to Dennis, de Gosson, and Hiley (arXiv 1412.5133) and Peter R. Holland says in "The Quantum Theory of Motion" (Cambridge 1993): "... the **total force ... from the quantum potential ... does not ... fall off with distance** ... because ... the quantum potential ... depends on the form of ...[the quantum state]... rather than ... its ... magnitude ...".

There is redundancy in the E8 description of Quantum States:

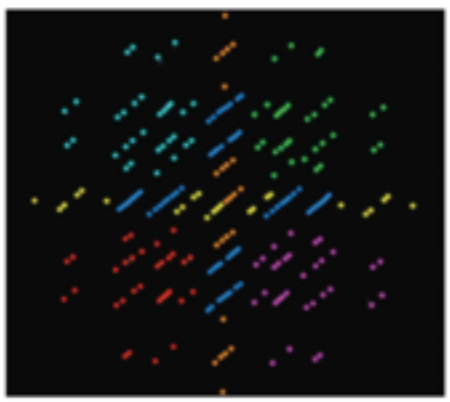
Fermion components carry Spacetime information
so E8 / D8 = 8x8 + 8x8 -> 8 + 8

Spacetime position and momentum are redundant
so D8 / D4 x D4 = 8x8 -> 8

Gauge Bosons correspond to Emission / Absorption Fermion Pairs
so D4 x D4 = 28 + 28 -> 0

How to reduce redundancy to get efficient Geometric Structure ?

Look at the 240 Root Vectors of the E8 Root Vector Polytope.



Each E8 Root Vector has

1 Root Vector Itself - North Pole

56 Nearest Neighbors

126 Next-Nearest Neighbors - Equator

56 Next-Next-Nearest Neighbors

1 Antipodal Opposite - South Pole

The 126 Equator Next-Nearest Neighbors are the Root Vectors of 133-dim E7.

The 1 North Pole and 1 South Pole are the Root Vectors of 3-dim SU(2).

The 56 Nearest Neighbors and 56 Next-Next-Nearest Neighbors represent the 112-dim symmetric space

E8 / E7 x SU(2) = Set of (QxO)P2 in (OxO)P2 = E8 / D8

where Q = Quaternions, O = Octonions, and P2 = Projective Plane

E7 is the Automorphism Group of the 112-dimensional Brown Algebra Br3(O)
so identify Br3(O) as the algebra corresponding to 112-dim E8 / E7 x SU(2).

Br3(O) is a Complexification of the 56-dimensional Freudenthal Algebra Fr3(O).
Automorphism Group of Fr3(O) is E6 of 54-dim E7 / E6 x U(1) = (CxO)P2 in (QxO)P2

Fr3(O) is a Complexification of the 27-dim Jordan Algebra J3(O).
Automorphism Group of J3(O) is F4 of 26-dim E6 / F4 = OP2 in (CxO)P2

The Traceless Part of J3(O) is 26-dim J3(O)o = Space of Bosonic String Theory =

a	S+	$V_{M4}xV_{CP2}$
S+*	-a-b	S-
$V_{M4}xV_{CP2}$*	S-*	b

where a and b are Real Numbers and V_{M4} and V_{CP2} are Quaternions
and S+ and S- are Octonions and * denotes Octonion conjugation

so

J3(O)o is a 26-dim space describing Fermion Particles and Spacetime in which Strings correspond to World-Lines of Particles moving in Spacetime and String Interactions describe Sarfatti-Bohm Quantum Theory

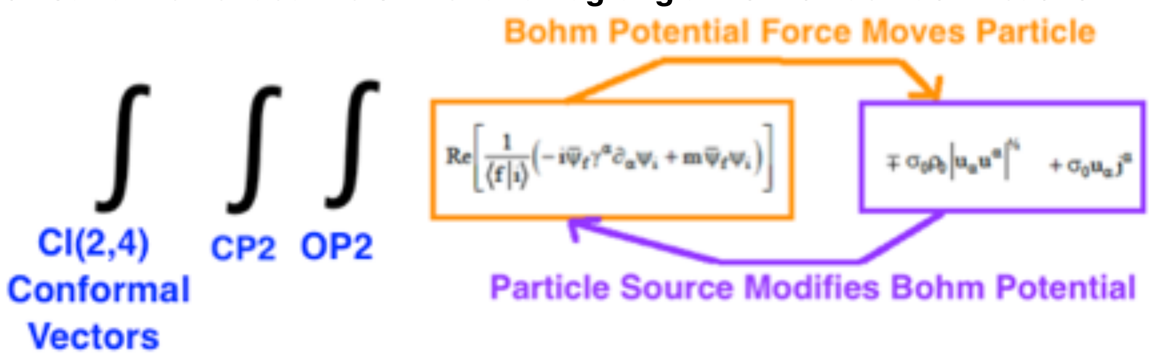
(viXra 1210.0072, 1308.0064)

Roderick Sutherland (arXiv 1509.02442) gave a Lagrangian for the Bohm Potential saying: “... This paper focuses on interpretations of QM in which the underlying reality is taken to consist of particles have definite trajectories at all times ... An example ... is the Bohm model ... This paper ... provid[es]... a Lagrangian ...[for]... the unfolding events ...
... **describing more than one particle while maintaining a relativistic description requires the introduction of final boundary conditions as well as initial, thereby entailing retrocausality** ...
In addition ... the Lagrangian approach pursued here to describe particle trajectories also entails the natural inclusion of an accompanying field to influence the particle’s motion away from classical mechanics and reproduce the correct quantum predictions. In so doing, it is ... providing a physical explanation for why quantum phenomena exist at all ... **the particle is seen to be the source of a field which alters the particle’s trajectory via self-interaction** ...
The Dirac case ... each particle in an entangled many-particle state will be described by an individual Lagrangian density ... of the form:

$$\mathfrak{L} = \mathrm{Re}\left[\frac{1}{\langle f|i\rangle}\left(-i\bar{\Psi}_f\gamma^\alpha\partial_\alpha\Psi_i + m\bar{\Psi}_f\Psi_i\right)\right] \mp \sigma_0\rho_0\left|u_\alpha u^\alpha\right|^{1/2} + \sigma_0 u_\alpha j^\alpha$$

... the ...[first]... term ...[is]... the ... Lagrangian densities for the PSI field alone ...
... sigma_o is the rest density distribution of the particle through space ... j is the current density ...
... rho_o and u are the rest density and 4-velocity of the probability flow ...”.

Jack Sarfatti extended the Sutherland Lagrangian to include Back-Reaction



where a, b and V_{M4} form Cl(2,4) vectors and V_{CP2} forms CP2
and S+ and S- form OP2 so that
26D = 16D orbifolded fermions + 10D and 10D = 6D Conformal Space + 4D CP2 ISS
(ISS = Internal Symmetry Space and 6D Conformal contains 4D M4 of Kaluza-Klein M4xCP2)

saying (linkedin.com Pulse 13 January 2016): “... the reason entanglement cannot be used as a direct messaging channel between subsystems of an entangled complex quantum system, is the lack of direct back-reaction of the classical particles and classical local gauge fields on their shared entangled Bohmian quantum information pilot wave ... Roderick. I. Sutherland ... **using Lagrangian field theory, shows how to make the original 1952 Bohm pilot-wave theory completely relativistic, and how to avoid the need for configuration space for many-particle entanglement**.

The trick is that final boundary conditions on the action
as well as initial boundary conditions influence what happens in the present.
The general theory is "post-quantum" ... and it is non-statistical ...
There is complete two-way action-reaction between quantum pilot waves
and the classical particles and classical local gauge fields ...
orthodox statistical quantum theory, with no-signaling ...[is derived]... in two steps,

first arbitrarily set the back-reaction (of particles and classical gauge field on their pilot waves) to zero. This is analogous to setting the curvature equal to zero in general relativity, or more precisely in setting G to zero.

Second, integrate out the final boundary information, thereby adding the statistical Born rule to the mix. ...
the mathematical condition for zero post-quantum back-reaction of particles and classical fields (aka "beables" J.S. Bell's term) is exactly de Broglie's guidance constraint. That is, in the simplest case, the classical particle velocity is proportional to the gradient of the phase of the quantum pilot wave. It is for this reason, that the independent existence of the classical beables can be ignored in most quantum calculations.
However, orthodox quantum theory assumes that the quantum system is thermodynamically closed between strong von Neumann projection measurements that obey the Born probability rule.
The new post-quantum theory in the equations of Sutherland, prior to taking the limit of orthodox quantum theory, should apply to pumped open dissipative structures. Living matter is the prime example. This is a clue that should not be ignored. ...".

Jack Sarfatti (email 31 January 2016) said: "... Sabine [Hossenfelder]'s argument ...
"... two types of fundamental laws ... appear in contemporary theories.

One type is deterministic, which means that the past entirely predicts the future. There is no free will in such a fundamental law because there is no freedom.

The other type of law we know appears in quantum mechanics and has an indeterministic component which is random. This randomness cannot be influenced by anything, and in particular it cannot be influenced by you, whatever you think "you" are. There is no free will in such a fundamental law because there is no "will" - there is just some randomness sprinkled over the determinism.

In neither case do you have free will in any meaningful way."

... However ...[**There is a Third Way**]...
post-quantum theory with action-reaction between quantum information pilot wave and its be-able is compatible with free will. ...".