Schwinger - Hua - Wyler

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In their book "Climbing the Mountain: The Scientific Biography of Julian Schwinger"
Jagdish Mehra and Kimball Milton said:

"... Schwinger ... always felt that the mathematics should emerge from the physics, not the other way around ...

[Julian Schwinger said in conversations and interviews with Jagdish Mehra, in Bel Air, California, March 1988]:

"... in 1966 ... Schwinger ... realized that he could base the whole machinery of particle physics on the abstraction of particle-creation and annihilation acts.
One can define a free action, say for a photon, in terms of propagation of virtual photons between photon sources, conserved in order to remove the scalar degree of freedom.
But a virtual photon can in turn act as a pair of electron-positron sources, through a \`primitive interaction' between electrons and photons, essentially embodied in the conserved Dirac current.
So this multiparticle exchange gives rise to quantum corrections to the photon propagator, to vacuum polarization, and so on.
All this without any reference to renormalization or \`high-energy speculations'. ...
The problem with conventional field theory is that it makes an implicit hypothesis that the physics is known down to zero distance ...
Source theory was ... that the physical quantities that you are interested in were not the fields but the correlations between fields
and ... that the correlations between fields are really Green's functions
... which ... take into account not only how the particles behave
but how they are created.
The sources are the way of cataloging the various Green's functions.
The final point at which the theory asks to be compared with experiment ... involves just pure numbers, Green's functions and sources, not operator fields. ...
The whole point was to develop the space-time structure of a Green's function in general so it will be applicable both to stable particles and unstable particles.
...
Green's functions [were] universally recognized as carrying the information of physical interest ... one had differential equations for these Green's functions and then came the necessity of picking out of the vast infinity of solutions the physical ones of interest ...
This was enforced by appropriate boundary conditions, that the wave propagate outwards, that is, the idea of causality ... if you rotated the time axis into a complex space, then the boundary conditions ... would select just the physically acceptable states of the Green's function ... all representations of physical interest can be obtained from the ... Euclidean group ... attached [to]... the Lorentz group ... (the "unitary trick" of Weyl) ... a correspondence between the quantum theory of fields with its underlying Lorentz space, and a mathematical image in a Euclidean space ...".

The Schwinger Sources are finite regions in a Complex Domain spacetime corresponding to Green's functions of particle creation / annihilation.

What Complex Domains have Symmetries of Particle Physics ?

E8 8-dim Octonionic Spacetime (effective at high Planck-scale energies)
is by Triality isomorphic with the natural representation space of fundamental First-Generation Fermion Particles (and AntiParticles)
so
Fermion Particles (and AntiParticles) are represented by Schwinger Sources with Bounded Complex Domain structure of a Cartan domain.

David B. Lowdenslager in Annals of Mathematics 67 (1958) 467-484 said: "... For an irreducible Cartan domain ... there is only one linearly independent Riemannian metric ... the Bergman metric ... corresponding to ... Δ ... the Laplace-Beltrami operator ... solutions of ... Δ f = 0 ... are determined by their values ... on the ... Bergman-Shilov ... boundary B ... Let D be a classical Cartan domain, Δ an invariant Laplacian, and K a Poisson kernel for D. Then K as a function of D satisfies ΔK = 0 , for all b in B ...".

Steven G. Krantz in his book "Geometric Analysis of the Bergman Kernel and Metric" said:

"... the Bergman kernel ... K ... for Ω is related to the Green's function ... θ ... for the boundary value problem

$$\begin{aligned} \frac{\partial}{\partial \bar{z}_j} \triangle \beta &= 0 \qquad \text{on } \Omega, \quad j = 1, \ldots, k \\ \sum_{j-1}^{k} \frac{\partial \beta}{\partial \bar{z}_j} \cdot \overline{\alpha}_j &= 0 \qquad \text{on } \partial\Omega. \end{aligned}$$

... in this way

$$K_\Omega(z,t) = \triangle_z \theta(z,t) \, .$$

...".

Armand Wyler, in his 1972 IAS Princeton preprint "The Complex Light Cone Symmetric Space of the Conformal Group", said: "... the bounded realization Dn of SO(n,2) / SO(n)xSO(2) ... allows to define ... the Bergman metric, the invariant differential operators and their elementary solutions (Green functions) ...[and]... the Shilov boundary Qn ...[as]... the quotient space C(Mn) / P(Mn) of the conformal group by the Poincare group ... and give ... eigenvalues of Casimir operators in the Lie algebra of C(Mn) ...".
In Wyler's approach, the elementary solutions of the invariant differential operators in the Bounded Complex Schwinger Source Domains are Schwinger Green's functions.

Using Schwinger-type Euclidean Spin(10) version of the Spin(8,2) Conformal Group, the Fermion Schwinger Sources correspond to the Symmetric space
the Lie Sphere Spin(10) / Spin(8)xU(1)
which has local symmetry of the Spin(8) gauge group with respect to which the first generation spinor fermions are seen as +half-spinor and -half-spinor spaces,
so the Fermion Schwinger Source Bounded Complex Domain D8 is of type IV8
which has Shilov Boundary Q8 = RP1 x S7 .

The Complex Domain of type IV8 is described by L. K. Hua in his book "Harmonic Analysis of Functions of Several Complex Variables in the Classical Domains" as

(4) The domain $\mathfrak{R}_{IV}$ of n-dimensional $(n>2)$ vectors

$$z=(z_1, z_2, \dots, z_n) \qquad BDI\,(q=2)$$

(z_i are complex numbers) satisfying the conditions[2]

$$|zz'|^2+1-2\bar{z}z'>0, \qquad |zz'|<1.$$

with Characteristic Manifold = Shilov Boundary = RP1 x S7

4°. The characteristic manifold of the domain $\mathfrak{R}_{IV}$ consists of vectors of the form $e^{i\theta}x$, where $0\le\theta\le\pi$, and $x=(x_1, \dots, x_n)$ is a real vector which satisfies the condition $xx'=1$.

$$H(z, \theta, x)=\frac{1}{V(\mathfrak{C}_{IV})\,[(x-e^{-i\theta}z)(x-e^{-i\theta}z)']^{n/2}}, \tag{4.7.11}$$

It is easy to calculate the magnitude of the volume $V(\mathfrak{C}_{IV})$:

$$V(\mathfrak{C}_{IV})=\frac{2\pi^{\frac{n}{2}+1}}{\Gamma\left(\frac{n}{2}\right)}.$$

The Poisson kernel of a type IV Complex Domain is

(4) For $\mathfrak{R}_{IV}$

$$P(z, \xi)=\frac{1}{V(\mathfrak{C}_{IV})}\cdot\frac{(1+|zz'|^2-2\bar{z}z')^{\frac{n}{2}}}{|(z-\xi)(z-\xi)'|^n}, \tag{4.8.9}$$

where $\xi\in\mathfrak{C}_{IV}$.

and the Bergman kernel of a type IV Complex Domain is

Theorem 4.4.1. *The Bergman kernel of the domain* $\mathfrak{R}_{IV}$ *is*

$$\frac{1}{V(\mathfrak{R}_{IV})}(1+|zz'|^2-2\bar{z}\bar{z}')^{-n},$$

where, by (2.5.7),

$$V(\mathfrak{R}_{IV})=\frac{\pi^n}{2^{n-1}\cdot n!}.$$

How big are the Schwinger Sources ?

Schwinger Sources as described above are continuous manifold structures
of Bounded Complex Domains and their Shilov Boundaries
but
E8 Physics at the Planck Scale has spacetime condensing out of Clifford structures
forming a Leech lattice underlying 26-dim String Theory of World-Lines
represents 8 + 8 + 8 = 24-dim of fermion particles and antiparticles and of spacetime.

The automorphism group of a single 26-dim String Theory cell modulo the Leech lattice
is the Monster Group of order about 8 x 10^53.

When a fermion particle/antiparticle appears in E8 spacetime it does not remain a single
Planck-scale entity becauseTachyons create a cloud of particles/antiparticles.
The cloud is one Planck-scale Fundamental Fermion Valence Particle plus an effectively
neutral cloud of particle/antiparticle pairs forming a Kerr-Newman black hole.

That cloud constitutes the Schwinger Source.
Its structure comes from the 24-dim Leech lattice part of the Monster Group which is
2^(1+24) times the double cover of Co1, for a total order of about 10^26.

(Since a Leech lattice is based on copies of an E8 lattice and since there are 7 distinct E8 integral domain
lattices there are 7 (or 8 if you include a non-integral domain E8 lattice)mdistinct Leech lattices.
The physical Leech lattice is a superposition of them, effectively adding a factor of 8 to the order.)

The volume of the Kerr-Newman Cloud is on the order of 10^27 x Planck scale,
so the Kerr-Newman Cloud should contain about 10^27 particle/antiparticle pairs
and its size should be about 10^(27/3) x 1.6 x 10^(-33) cm =
= roughly 10^(-24) cm.

How do the Schwinger Sources fit into the E8 Lagrangian Structure ?

The fundamental high-energy E8 Lagrangian for Octonionic 8-dim SpaceTime is

$$\int_{ST} GRb + StMb + Spf \quad .$$

an integral over SpaceTime ST of a Gravity boson term GRb,
a Standard Model boson term StMb, and a Spinor fermion term Spf.

Consider the Spinor fermion term Spf based on Schwinger Source Fermions.

In the conventional picture, the spinor fermion term is of the form m S S* where m is the fermion mass and S and S* represent the given fermion.
Although the mass m is derived from the Higgs mechanism, the Higgs coupling constants are, in the conventional picture, ad hoc parameters, so that effectively the mass term is, in the conventional picuture, an ad hoc inclusion.

E8 Physics does not put in the mass m in an ad hoc way,
but
constructs the Lagrangian integral such that
the mass m emerges naturally from the geometry of the spinor fermions by setting the spinor fermion mass term as the volume of the Schwinger Source Fermions.

Effectively the integral over the Schwinger Source spacetime region
of its Kerr-Newman cloud of virtual particle/antiparticle pairs plus the valence fermion gives the volume of the Schwinger Source fermion and defines its mass,
which, since it is dressed with the particle/antiparticle pair cloud,
gives quark mass as constituent mass.

Note that in the process of breaking Octonionic 8-dim SpaceTime
down to Quaternionic (4+4)-dim M4 x CP2 Kaluza-Klein
all Fermions are treated similarly so that ratios of their masses remain the same.

What about Gauge Bosons ?

The fundamental high-energy E8 Lagrangian for Octonionic 8-dim SpaceTime is

$$\int_{ST} GRb + StMb + Spf \quad .$$

an integral over SpaceTime ST of a Standard Model boson term StMb,
a Gravity boson term GRb, and a Spinor fermion term Spf.

What are the Schwinger Sources for the gauge boson terms StMb and GRb ?

The GRb bosons live in one of the two D4 Lie SubAlgebras of the E8 Lie Algebra.

The StMb bosons live in the other of the two D4 Lie SubAlgebras of the E8 Lie Algebra.

The process of breaking Octonionic 8-dim SpaceTime
down to Quaternionic (4+4)-dim M4 x CP2 Kaluza-Klein
creates differences in the way gauge bosons "see" M4 Physical SpaceTime.

Joseph Wolf (Journal of Mathematics and Mechanics 14 (1965) 1033) showed that
there are only 4 equivalence classes of 4-dimensional Riemannian Symmetric Spaces
with Quaternionic structures, with the following repesentatives:

S4 = 4-sphere = Spin(5) / Spin(4) where Spin(5) is the Schwinger-Euclidean version of the Anti-DeSitter Group that gives MacDowell-Mansouri Gravity

CP2 = complex projective 2-space = SU(3) / U(2) with the SU(3) of the Color Force

S2 x S2 = SU(2)/U(1) x SU(2)/U(1) with two copies of the SU(2) of the Weak Force

S1 x S1 x S1 x S1 = U(1) x U(1) x U(1) x U(1) = 4 copies of the U(1) of the EM Photon
(1 copy for each of the 4 covariant components of the Photon)

The GRb bosons (Schwinger-Euclidean versions) live in
a Spin(5) subalgebra of the Spin(6) Conformal subalgebra of D4 = Spin(8).
They "see" M4 Physical spacetime as the 4-sphere S4
so that their part of the Physical Lagrangian is

$$\int_{S4} GRb \quad .$$

an integral over SpaceTime S4.
The Schwinger Sources for GRb bosons are the Complex Bounded Domains and Shilov Boundaries for Spin(5) MacDowell-Mansouri Gravity bosons.
However, due to Stabilization of Condensate SpaceTime
by virtual Planck Mass Gravitational Black Holes,
for Gravity, the effective force strength that we see in our experiments
is not just composed of the S4 volume and the Spin(5) Schwinger Source volume,
but is suppressed by the square of the Planck Mass.
The unsuppressed Gravity force strength is the Geometric Part of the force strength.

The Standard Model SU(3) Color Force bosons live in
a SU(3) subalgebra of the SU(4) subalgebra of D4 = Spin(8).
They "see" M4 Physical spacetime as the complex projective plane CP2
so that their part of the Physical Lagrangian is

$$\int_{CP2} (SU(3) \text{ part of StM})b \quad .$$

an integral over SpaceTime CP2.
The Schwinger Sources for SU(3) bosons are the Complex Bounded Domains and Shilov Boundaries for SU(3) Color Force bosons.
The Color Force Strength is given by
the SpaceTime CP2 volume and the SU(3) Schwinger Source volume.
Note that since the Schwinger Source volume is dressed with the particle/antiparticle pair cloud, the calculated force strength is
for the characteristic energy level of the Color Force (about 245 MeV).

The Standard Model SU(2) Weak Force bosons live in
a SU(2) subalgebra of the U(2) local group of CP2 = SU(3) / U(2)
They "see" M4 Physical spacetime as two 2-spheres S2 x S2
so that their part of the Physical Lagrangian is

$$\int_{S2xS2} (SU(2) \text{ part of StM})b \quad .$$

an integral over SpaceTime S2xS2.
The Schwinger Sources for SU(2) bosons are the Complex Bounded Domains and Shilov Boundaries for SU(2) Weak Force bosons.
However, due to the action of the Higgs mechanism,
for the Weak Force, the effective force strength that we see in our experiments
is not just composed of the S2xS2 volume and the SU(2) Schwinger Source volume,
but is suppressed by the square of the Weak Boson masses.
The unsuppressed Weak Force strength is the Geometric Part of the force strength.

The Standard Model U(1) Electromagnetic Force bosons (photons) live in
a U(1) subalgebra of the U(2) local group of CP2 = SU(3) / U(2)
They "see" M4 Physical spacetime as four 1-sphere circles S1xS1xS1xS1 = T4
(T4 = 4-torus) so that their part of the Physical Lagrangian is

$$\int_{T4} (U(1) \text{ part of StM})b \quad .$$

an integral over SpaceTime T4.
The Schwinger Sources for U(1) photons
are the Complex Bounded Domains and Shilov Boundaries for U(1) photons.
The Electromagnetic Force Strength is given by
the SpaceTime T4 volume and the U(1) Schwinger Source volume.

What are the results of Wyler-type calculations for Schwinger Sources ?

The Schwinger Source calculations using the Wyler approach give the following results, details of which can be found at http://vixra.org/abs/1310.0182 and my web sites. Since calculations are for ratios of particle masses and force strengths, the Higgs mass and the Geometric Part of the Gravity force strength are set so that the ratios agree with conventional observation data.

Particle/Force	Tree-Level	Higher-Order
e-neutrino	0	0 for nu_1
mu-neutrino	0	9 x 10^(-3) eV for nu_2
tau-neutrino	0	5.4 x 10^(-2) eV for nu_3
electron	0.5110 MeV	
down quark	312.8 MeV	charged pion = 139 MeV
up quark	312.8 MeV	proton = 938.25 MeV
		neutron - proton = 1.1 MeV
muon	104.8 MeV	106.2 MeV
strange quark	625 MeV	
charm quark	2090 MeV	
tauon	1.88 GeV	
beauty quark	5.63 GeV	
truth quark (low state)	130 GeV	(middle state) 174 GeV
		(high state) 218 GeV
W+	80.326 GeV	
W-	80.326 GeV	
W0	98.379 GeV	Z0 = 91.862 GeV
Mplanck=1.217x10^19 GeV		
Higgs VEV (assumed)	252.5 GeV	
Higgs (low state)	126 GeV	(middle state) 182 GeV
		(high state) 239 GeV
Gravity Gg (assumed)	1	
(Gg)(Mproton^2 / Mplanck^2)		5 x 10^(-39)
EM fine structure	1/137.03608	
Weak Gw	0.2535	
Gw(Mproton^2 / (Mw+^2 + Mw-^2 + Mz0^2))		1.05 x 10^(-5)
Color Force at 0.245 GeV	0.6286	0.106 at 91 GeV