

LOOP QUANTUM KALUZA–KLEIN GRAVITY AS THE STANDARD MODEL

Nolan Aljaddou

UNIVERSITY OF NEBRASKA OMAHA
OMAHA, NEBRASKA, UNITED STATES

Abstract. Physics is unified, and sufficient; reaching this determination is a matter of premise as much as conclusions, as this work demonstrates with the optimal Kaluza–Klein model (confirming the three particle families as technical Kaluza–Klein excitations within the energy limit).

Keywords: *Kaluza–Klein theory, metric, dimension, root, zeroth, fixed, spin*

1. Macroscopic forces—electromagnetism, gravity (scaled geometry)

Following the unification of the foundations of mathematics and metric mathematical physics, encompassing theoretical unification of principle is necessary to establish for advanced theoretical physics based upon the same precepts, and exists in complete recognition of the thorough function of metric foundations.

Kaluza–Klein theory, with the *Planck-limit* 5th (*zeroth*) “*spinor*” dimension (encapsulating the trace continuum motion effect of a zero-dimensional point-particle in a linear circle, manifested as such quantum “*spin*” value), has been demonstrated thoroughly to unite general relativistic gravitation with the force of electromagnetism [1]; a fundamental and necessary incorporation of the explicit root zeroth dimension, which has mutually cancelling positive and negative action as quantum up and down spin.

2. The 5 metric dimensions

$$m = \mathbf{R}^4 = S(t) \quad (1)$$

[mass]

$$S = \mathbf{R}^3 = (x, y, z) \quad (2)$$

[space]

$$E = \mathbf{R}^2 = h\nu \quad (3)$$

[energy]

$$t = \mathbf{R}^1 \quad (4)$$

[time]

$$s = \mathbf{R}^0 = s(\alpha, \beta) \quad (5)$$

[spin]

Upon proper dimensional integration, the macroscopic forces of gravity and electromagnetism are then accounted for geometrically, sufficiently in these terms. And hence the origin of discrete quanta of energy as the minimum spin excitation of the root relative physical zeroth dimension, deriving the spin quantity minimum, $\frac{\hbar}{2}$, as the ultimate metric bound in the uncertainty principle relation.

3. The energy-space principle

Physical space, in relation to energy, is a *potential combinatorial space*, measured by the partition function as the sum of all combinatorial, probabilistic *entropy*,

$$S = \frac{U}{T} + k_B \log \sum_i e^{-\frac{E_i}{k_B T}}, \quad (6)$$

the basic relational quantum uncertainty principle being properly formulated at the root as one of entropy,

$$\sigma_x \sigma_p \geq \frac{\hbar}{2} \exp \left(H_x + H_p - \log \left(\frac{eh}{2x_0 p_0} \right) \right) \geq \frac{\hbar}{2}, \quad (7)$$

determining a quantum particle's trajectory to be the sum over all given combinatorial microstates—translating directly into the path integral, as extension to particulate dimensional combination over time, by means of Wick transformation of the time variable in the quantum field partition function,

$$Z[\beta, J] = \int D\Phi e^{-S_{E,\beta}[\Phi] + \int_\beta d^d x_E J \Phi} \Big|_{\Phi(x,0)=\Phi(x,\beta)}, \quad (8)$$

leading directly to the derivation of the correlational path integral:

$$\langle x | U(T, 0) | x' \rangle = \int D[x(t)] e^{\frac{iS[x(t)]}{\hbar}}. \quad (9)$$

Space begins with the microscopic, minimalistic zeroth dimension; the positive and negative (or combined zero) quantum spin evolution—modeled by complex two-dimensional Hilbert space—as time, for tangential 1-form particle components, having a particle's subsequent location then determined by the exact difference between collective entropic energy and particular, relative negentropy of the system—the deciding combinatorial factors for spatial

time evolution. Additionally, the *time-translation* of spin-dimensional superposition behavior over space generates quantum waves from its cycloid, root periodic function contextually, with entropic/negentropic probabilistic integration—with the fixed zeroth dimension's initial constancy of boson energy propagation as space, prior to Higgs field influence. Thus is derived the foundational formalism of the quantum theory.

4. Microscopic forces—weak, strong (uncertainty principle range)

The weak force is electromagnetism acting on the scale of the uncertainty principle, materializing through greater potential energy bosons in an energy-conserving charge, anti-charge, and uncharged group (W and Z bosons):

$$V(r) = -g^2 \frac{e^{-\frac{mr}{\hbar c}}}{r}. \quad (10)$$

The strong force's quark confinement bonding is a further property of material zero-point (*spin*) energy bonding, determining a non-vanishing mutually interactive precise strong force charge:

$$V(r) = -g^2 \frac{e^{-\frac{r}{\lambda}}}{r}, \quad (11)$$

the uncertainty principle maintaining a minimum–maximum commutual interaction of transitivity symmetry orientation, as $SU(3)$ components [threefold “*color*”], the gluon configuration of which necessarily coincides with maximal complex-manifold eightfold *octonion algebra*:

$$(i\hbar\gamma^\mu D_\mu - mc)\psi = 0. \quad (12)$$

5. Limits

The special macroscopic limit is the Newtonian classical,

$$\lim(\hbar \rightarrow 0), \quad (13)$$

with matter as global sum cluster; the general macroscopic limit is reached as matter exceeds Newtonian gravity to achieve Einsteinian gravity as globular sum clustering (*electrogravitational distribution equilibrium*):

$$\lim(\varphi \rightarrow g_{\mu\nu}). \quad (14)$$

Example: $\nabla^2 \Phi = \frac{1}{2} \kappa \rho c^4 = 4\pi G \rho \Rightarrow \kappa = \frac{8\pi G}{c^4} \Rightarrow R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$

The quantum path integral reflects that a point-particle is an infinitesimal differential spatiotemporal limit, and extends stationary action to all arbitrary limits; deriving respectively the classical and radial general relativistic limits, as calibrations of each other.

6. Proper unification

The $\frac{\hbar}{2}$ metric limit of the uncertainty principle relation determines the Planck length, L_P , to be the minimum unit limit of spatial action; hence, spacetime as is measured reduces to the minimum Planck length as fundamental unit of all structure, directly equated with the minimum dimensional spin excitation eigenvalue, $\frac{\hbar}{2}$, and thus is properly derived in the theory of *loop quantum gravity*, as such SU(2) “spin networks” (modeling the minimum *zeroth* dimension action at all points), which generate a sufficiently smooth macroscopic spacetime as path integral calibrated “*spin foam*”. Loop quantum gravity successfully unites *spin* with *space* as background-independent principle (reducing categorically to root *zeroth* dimensionality collectively), accounting successfully for phenomena as black holes and the big bang.

Unification of force formula, however, must take the form of a piecewise function, contingent on relative uncertainty principle positional gradients of $\hbar$. Unified loop quantum gravity equates to the reductive principle that particles are indistinct from spacetime fundamentally, as with the particular *virtual “graviton”*; loop quantum gravity does not necessitate a particular graviton parameter, as it is subsumed into the quantized geometry of spacetime, and by transitivity, no other associated particles can be elements beyond such unified spacetime structure (even the *photon* in the thus unified electrogravitational Kaluza–Klein relativity). This extends to all particles via the Higgs field, thereby reconciling wave-particle duality definitively, with matter and energy as sum *ripple effect* dynamics of intrinsic minimalistic relative spin potentials, calculated by quantized area and volumes of the zeroth-dimensional spin “loops” of the networks.

Example: $A = 8\pi\hbar G \gamma \sum_i \sqrt{j_i(j_i + 1)}$

7. Integration

Quantum Kaluza–Klein theory is sufficient to account for all natural phenomena when its fifth spin dimension is properly comprehended, and the uncertainty principle is factored into the microscopic forces. The one actual force is zero-point (spin fluctuation) coupling, or the strong force, with a coincident uncertainty principle weak “isospin” interaction (evident in the chiral anomaly), implying an incident “strong isospin” property, the complementary strongly-interacting quark particles defining 0 strong isospin leptons by sheer

complementarity and exclusivity of interaction, as positive and negative combined 0 value; the other forces being geometric effects of its cumulative macroscopic organization, demonstrably. The Higgs particle is of zero spin due to neutrality in its conversion of all spins from massless to massive particles.

8. Fundamental derivations

There are 5 fundamental root principles deriving the force properties of the standard model of particle physics, and they are addressed here.

8.1. Fundamental range (uncertainty principle) [minimum spin excitation]

$$\Delta t \Delta E \geq \frac{\hbar}{2} \quad (15)$$

8.2. Root force (spin coupling) [strong nuclear interaction]

$$V(r) = -g^2 \frac{e^{-\frac{r}{\lambda}}}{r} \quad (16)$$

8.3. Symmetry-breaking (microscopic limit) [weak nuclear interaction]

$$V(r) = -g^2 \frac{e^{-\frac{mr}{\hbar c}}}{r} \quad (17)$$

8.4. Special action (path integral) [inertia]

$$\langle x|U(T, 0)|x'\rangle = \int D[x(t)] e^{\frac{iS[x(t)]}{\hbar}} \quad (18)$$

8.5. General action (Kaluza–Klein relativity, with implicit zeroth dimension) [electrogravitation]

$$\tilde{R}_{\mu\nu} - \frac{1}{2}\tilde{R}\tilde{g}_{\mu\nu} + \Lambda\tilde{g}_{\mu\nu} = \frac{8\pi G}{c^4}\tilde{T}_{\mu\nu} \quad (19)$$

Once these properties are properly recognized, they are naturally integrated into the standard model Lagrangian:

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + i\bar{\psi}\not{D}\psi + h.c. + \psi_i y_{ij} \psi_j \varphi + h.c. + |D_\mu \varphi|^2 - V(\varphi). \quad (20)$$

9. Conclusions

Proper unitary root metrics must be taken into account to provide a full, unified framework to causally encompass all of theoretical physics, and it exists in modified Kaluza–Klein quantum relativity, with the correct application and incorporation of loop quantum gravity, demonstrated irrefutably herein.

REFERENCES

- [1] Wesson, Paul S., Five-Dimensional Physics: Classical and Quantum Consequences of Kaluza–Klein Cosmology, World Scientific Publishing Company, 2006.