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Research Paper

Hilbert space generalized and Forces

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ABSTRACT
There are several 4-dimensional spaces for spactime as real or complex Hilbert space H^4 , C^4 which have the same sublattice structure of Boolean blocks 2^4 . The SU(3) extension of SU(2) allows more octonian 4-dimensional subspaces, one for gravity and Higgs mass and a second for duteron, nucleons with inner dynamics and atomic kernels. The standard models symmetries are extended. Moebius transformations MT are added for gravity and the six cross ratios complex MT invariants are used presenting six (anti)quarks color charges as an own energy system. The newly introduced three color charge whirls as rgb-gravitons guide discrete dynamics for integration and differentiation of functions is following by using the Heisenberg uncertainties for the 6-dimensional color charge space as complex C^3 extension of spacetime. Projections, stereographic and orthogonal maps are due to rgb-gravitons. This is a new way for unifying the four basic forces of physics.

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I. INTRODUCTION

In physics a real 4-dimensional vector space H^4 is used for describing physical systems. The 4-vectors have a complex extension which is useful for functional calculations and wave descriptions of systems with the complex exponential function exp(iφ). The polar angle is substituted for electromagnetic (also for matter waves) as functions f by scaled time and one variable for its world line expansion in exp(i(ωt+xk)). The two real scalars are considered as parameters, not as additional (space-like) dimensions. In catastrophe theory the parametric approach guides their choice of functions which use higher dimensional Taylor polynomials, not only quadrics like the Hilbert space metrics. For flows with stream lines and equipotential lines descriptions, the potential functions have one or two variables and two to four parameters for the basic seven catastrophes described. The extension is from one function (for which as theory of critical points for manifolds the Morse lemma is used) to families of (potential) functions f_s with several parametric diffeomorphisms for s which partly are structural stable when a single Morse f is degenerate. The streamlines of one function are bended (stretched or squeezed for instance) by applying diffeomorphsisms to the local manifold space. A manifold is locally like a H^4 but can have alternatively higher or lower real or complex dimensions.

Forces of basic interactions use symmetries like U(1) with a universal covering e: $R \rightarrow S^1$ or SU(2), SU(3) for which fiber bundles replace the catastrophes families. Their parameters give dimensions, different from those of H^4. There are projection maps like the Hopf fiber bundle map or e involved. The parameters are replaced by the generators of the symmetry: For the electromagnetic EMI force U(1) it is a Kaluza-Klein rolled projective circle S^1 with a stereographic map to a linear real line as tangent space to S^1. The circle as energy carrier is obtained by orthogonal hitting two frequencies in prportion 1:1. The SU(2) weak WI force uses three Pauli matrices for a 3-dimensional subspace as unit sphere S^3 of H^4. The space coordinates are excluding time, for instance as spin vectors s = (sx,sy,sz). Hopf maps H^4 down to R^3 using the Pauli matrices, not parameters. SU(3) acts similar, using the eight GellMann 3x3-matrix extensions of the three Pauli matrices. The strong interaction SI dimension is for 8 gluons since three matrices are linearly dependent and generate only a plane. The dimension 8 accurs also for C^4 when complex not real coordinates are used, but the sublattice L structure of R^4 and C^4 remains 4 for Boolean blocks 2^4 of commuting operators. The Euclidean metric <u,u> of real 4-vectors is replaced by a complex Hermitean metric <w,w>, using for the complex scalars their quadric zc(z) with c(z) the conjugate of z.

There is a third fiber bundle for a geometrical factor S^5 of the SU(3) topology as twisted fiber bundle $S^3 x S^5$. It maps S^5 as space down to a complex projective space CP^2 with fiber S^1 . This is an inner spacetime for nucleons and atomic kernels with a bounding Riemannian sphere S^2. In H^4 it is observable in projection as bubbles, satisfying the Pauli exclusion principle. The standard model of physics unifies the three EMI, SI, WI forces and sets gravity GR apart as an incompatible seperate Einstein metrics theory. This problem is solved by unsing the S^5 bundles projection CP^2 having an inner dynamics.

The new fiber bundle has an *rgb*-graviton added to gluons as superposition of three (not 2,4 or 6 as for gluons) color charge whirls, They belong to the cross ratios for the S^2 Moebius transformations with three reference points as paramters $0,1,\infty$ in S^2 and one complex variable z. The cross ratios space is not a C^4 but a C^3, similar to the reduction of R^4 coordinates to the R^3 space coordinates. It extends spacetime as C^2 by a projective plane C to C^3 where a fourth real or complex projective coordinate can be added to obtain C^4. With these fiber bundles, maps, symmetries the four basic forces are unified. Some more tools are described later on.

C^3 by cross ratios space-like generated

The complex cross ratios are the invariants under Moebius trnsformations where the complex plane is closed by a stereographic point ∞ to a 2-dimensional Riemannian sphere S^2. The reference points for the six cross ratios $(z,0;1,\infty)$ are permuted. If $(1;0,\infty)$ is used, the identiy id 2x2-matrix presents as Moebius transformation and cross ratio z; the other permuations are for $(1;\infty,0)$ with 1/z (inversion), for $(0;1,\infty)$ (1-z) for time (translations in time), $(0;\infty,1)$ 1/(1-z) frequency as inverse time interval (kinetic energy), $(\infty;0,1)$ for an angle φ z/(z-1) and a counterclockwise mpo rotation α by 120 degrees, α^2 (a clockwise cw rotation by -120 degree) belongs to its inverse (z-1)/z $(\infty;1,0)$.

Using the three Heisenberg uncertainties HU, the coordinates (r,φ,t) of a complex plane with time t added bifurcate into complex planes (r,m), (φ,L), (t,f). Subsitute in spherical coordinates L by θ, the

HU are position-momentum, angle-angular momentum, time-energy. The six color charges are the energy for them; written as this sequence (r,g,b) red, green, blue is for (r,φ,f) and the pairing of these color charges u is with their conjugate c(u).

The energies associated with them are two potentials (electrical r with radius EM(pot), gravity/mass c(r) with m E(pot)) POT, magnetic energy E(magn) c(b) (with time t), b kinetic energy E(kin) f and heat (with φ) g E(heat), rotational energy E(rot) as L with $c(\varphi)$. If octonians eight dimensions are used and its coordinates are listed as numbers then the pairing is 15 for EM(pot), E(pot), 46 for (t,f) (a WI rotor) and 23 (a SI rotor) for (φ,L). The C^3 coordinates can be interpreted as linear octonian coordinates. In this notation, the SU(2) quaternionic weak WI and EM spacetime coordinates are doubled.

Another extension from the Pauli 2x2-matrices to the SI strong SU(3) GellMann 3x3-matrices is for projections where in the matrices are added a row and column with coordinates 0. Using the C^3 coordinates in complex form (z_1, z_2, z_3) 341256, the first rows of the extended three 4-dimensional spaces are $(z_1\ z_2\ 0)$,$(z_1\ 0\ z_3)$,$(0\ z_2\ z_3)$. The first space 3412 is projected down to the WI/EM spacetime R^4 (as real Hilbert space), the second one 3456 is for the CP^2 inner spacetime of nucleons and atomic kernels and the third one 1256 is for gravtiy with mass, in Euclidean coordinates (x,y,m,f). The 3412 first H^4 coordinates are $z_1 = z + ict$. There is no confusion with this z for the third space coordinate with z = x + iy as complex number!

Cross ratios generate this way three independent 4-dimensional spaces where H^4 is only one, CP^2 is obtained from the SU(3) geometry fiber bundle [2] and the space for gravity/mass has to be described.

Stereographic and central projections

It is observed that the cross ratios are invariant under these projections for four points (figure 2).

The *rgb*-gravitons 126 are acting as projections through their space 1256. In a central projection, the map is traced back through its rays. For two rays, the vertical z-axis of space is drawn, as horizontal

base line u is drawn a line where the z-axis meets for a system Q (a sun), beside it is the intersection of the stereographic map from a point z = r down and marked as P‘. This point is a projection of P (a planet). P is lifted to a point with normed coordinates (u=1,r=Rs). An unsymmetrical distance measure is for |QP| = r and |PQ| = (r-Rs) where Rs is the Schwarzschild radius of Q. The vector

(1,Rs,1) is transformed for this by the scaled 3x3-matrix with first row (0 -r 1), second row (0 0 0) and third row (-r 0 0). The raytracing gives the vector ((-r + Rs), 0, -r). If this is projective interpreted in a space [(-r + Rs), w, -r], it can be normed to the Schwarzschild factor

[(r - Rs)/r, 0, 1] with an angle $\sin^2\beta = Rs/r$. The angular speed $\omega = d\varphi/dt$ is written as differences with $f = 1/\Delta t$ and f is stretched by $1/\cos\beta$. For the metrical measures dr, dt of radius and time in the Minkowski metric for spacetime this means that the Schwarzschild metric is general relativistic

rescaled to $ds^2 = dr^2/\cos^2\beta - c^2dt^2\cos^2\beta$. The area of the differentials is kept invariant $dr'dt' = dr\cdot dt$. The differential form is the same as for length and time in the Minkowski case $l't' = l\cdot t$. The

Minkowski watch shows the metrical rescalings of energy units in figure 1. For it $\cos\beta$ is replaced by special relativistic speed v with $\sin\varphi = v/c$.

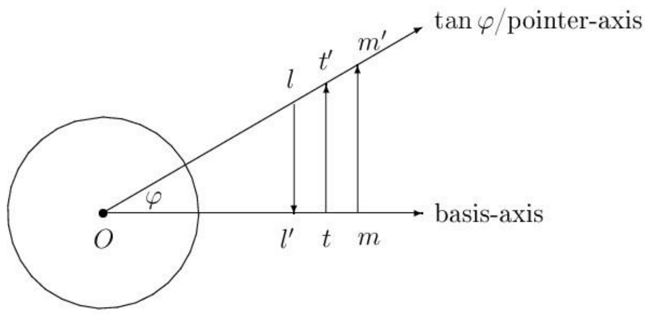

Figure 1 Mink watch, length is squeezed, time dilated and mass increased

For the Schwarzschild metrical case, frequency is increased. This gives also the other two effects explained by general relativity: for the electromagnetic EMI interactions waves the functional description in physics has to be rescaled in long distances where in this case the EMI frequency in $\lambda f = c$, λ wave length, is getting redshift by a gravitational lossed squeezed frequency. For the double lensing the effect is opposite, frequency is transformed $hf = mc^2$ from the large gravity mass m potential of a star where EMI pases by; in a mirror reflection the EMI wave brakes its world line on which it travels with the increased frequency. It is observed that the Eintein energy-momentum tensor is need for computing Rs. Physics assumes that all mass carrying systems in the universe have an own Rs. It is added to them by a mass setting Higgs field after a big bang. The big bang reverses radii at Rs: inside a black hole quarks for instance have a radius r‘<Rs and after the black holes decay they have in the universe radius r with $r'r = Rs^2$. In addition, the two cosmic speeds are generated for the system: the first cosmic speed v_1^2/c^2 is the positive gravitational potantial. The second cosmic speed is $v_2^2/c^2 = Rs/r$. In nucleons uud proton, ddu neutron one of the doubles uu or dd cannot escape because of the nucleons mass rescaling. Its speed v satisfies $v_1 \leq v < v_2$. They can be in the nucleons wave package because they have different color charges as quantum numbers.

The stereographic projection is used in several dimensions. For the U(1) case as projective line it means that the Kaluza-Klein rolled projective coordinate is mapped to the linear, last octonian coordinate e_7 for EMI. Light is observed linear as its cosine wave expansion, the imaginary exponential part of its function is not observed. This holds also for oscillations.

There are longitudinal and transversal wave expansions observed. In the 3- and 5-dimensional cases, the circle S^1 is a fiber of two fiber bundles. The SU(2) Hopf fiber bundle maps R^4 and its unit sphere S^3 with the Pauli matrices down to space R^3 and its Riemannian unit sphere S^2. The SU(3) topological units sphere factor S^5 is mapped down to 3456 CP^2, a space for the strong SI rotor 356 in nucleons and deuteron.

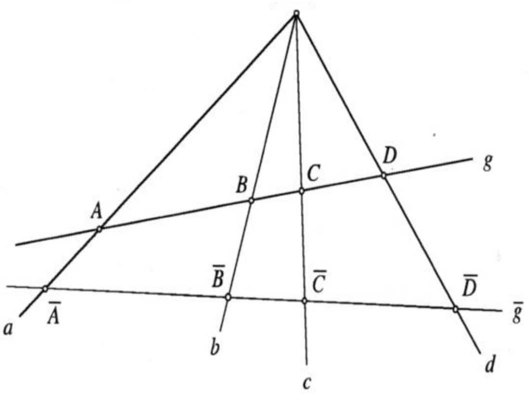

Figure 2 invariance of the cross ratio under central projections from one transversal to the other transversal line

Differentiation and Integration

For the dynamical setting, differentiation and integration of functions f(u) is needed. The differentials du for coordinates in the tangent spaces of manifolds replacing R^4 or C^4 as local structure of curved spaces are associated with new octonian coordinates, 5 mass/momentum is
df(x)/dx with dx for the space metric (also dy, dz, dr). For u = z = x+ iy the complex differential dz (on the 7th octonian coordinate) is also for (residual) contour integrations $\int f(z)dz$.

To this belongs the counting of quantized frequency winding numbers f = n, n = 1,2,… a natural number. The circulation time is T = 1/n. Only full windings are stored as energy E = hf. If not possible, energy is emitted or absorbed as observed for electrons in an atoms shell (spectral series and Bohr radii for main quantum numbers). This holds more generally for matter wave packages. Their group speed for momentum p = mv is optical computed by setting their mass m(v) as function from special relativistic speed v. The Schroedinger substitutions occur, where a wave length is substituted by momentum, an angular speed by kinetic speed in $\omega = 2\pi f$, f by energy E = hf. The mass m(v) relativistic cos φ rescaling of nucleons is essential for this differentiation with m_0 as mass at rest and sum of the three quarks mass. Also m(v) gets inner speeds as frequency $hf = mc^2$ transfered mass added to m_0.

Integrations are: ∫fdr, two f as electrical or gravity POT, ∫gdt, two kinetic, rotational speeds, ∫BdA is for integration of magnetic energy from induction, ∫hdV is for entropy, temperature in a volume. It occurs through the dynamics of the SI rotor 356 in 3456. This needs an energy exchange of the nucleon with its environment, described by the hedgehog model [2].

The dynamics has as symmetries the members of the nucleons quark triangle. The *rgb*-graviton has at its spin-like orthogonal base triple the quarks barycentrical mass attached and to the quarks color charge r,g or b a force vector, listed in the above six energies list. The *rgb*-graviton makes during the dynamical integration cycle a pendulum squeezing stretching in the proportion of the three basic spin lengths ½:1:2 forth and back. The six cycle in time is set by the normed general relativistic scaling factor with first row of the coefficient matrix G as (1 -1), second row (1 0). G is of order 6 and repeats the cycle. The single integrations use conic rotations. The fixed r-quark is conic cw clockwise rotating, the g-quark opposite mpo and two sides with common endpoint r or g of the triangle are rotated such that the b-quark is rotating with the triangles cubic D_3 member α^2. After six discrete rotations it has fixed the triangles vertices and three barycentrical coordinates are generated. At their intersection Higgs sets the renormed nucleons mass.

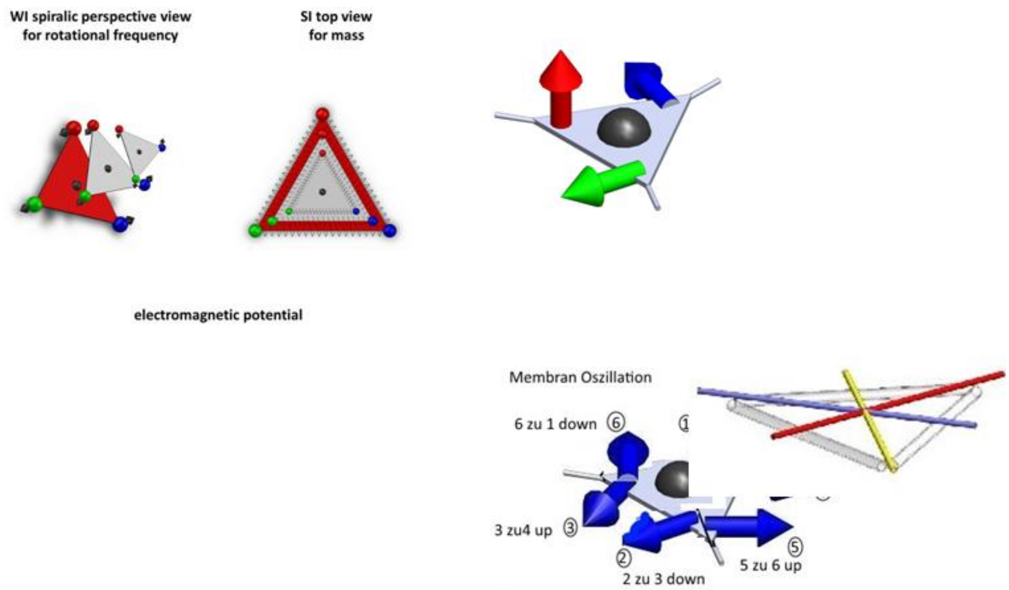

Figure 3 pendulum contraction/expansion of the nucleon triangle for integrations (here EM(pot)), quark triangle with attached force eigenvectors marked as r,g,b; the conic rotation keeps r or g in the state changing positions fixed; six kinetic blue positions; barycentrical coordinates generated

Symmetries

The factoring by the Klein CPT normal subgroup of order 4 of the cross ratios 4-tuple symmetry S_4 is used for the SI rotor. The D_3 symmetry is obtained with one member of order 3 and three reflections. The factors contain a color charge, r,g,b,c(r),c(g),c(b), an (octonian) coordinate 1,2,6,5,3,4, an energy EM(pot), E(heat), E(kin), E(rot), E(magn) and as symmetry a member of D_3

id, $\alpha\sigma_1$, α, σ_1 , α^2, $\alpha^2\sigma_1$. They replace Pauli matrices. They are not the generating members of the Riemannian spheres Moebius transformation, but contain some; id 1 is for scalings, σ_1 5 for inversion, $\alpha^2\sigma_1$ 4 for translations, α^2 3 for rotations. Left out are in this list $\alpha\sigma_1$ 2 for heat transfer with accoustic phonons for volume integrations and α 6 which occurs in three forms of frequency as inverse time interval, also counting winding numbers for instance of complex contour integrations or multiples of spin length windings and as angular frequency. Inversion occurs also for universes speed v at the speed of light c as bounding Minkowski double cone surface. It can be closed at projective infinity by a circle to a pinched torus with one singular point P as a surface for dark energy with speeds v‘>c inside with v‘v = c². This is also an umbilic point for the Minkowski double cone of the parabolic umbilic [5].

Catastrophes can guide jumps, spontaneous sudden changes as listed for the SI rotor and other such changes of states where heat for the temperature changes of matter states as gas, fluid, solid, plasma are the best known examples. The catastrophe geometrical shapes and symmetries are much more general than the ones discussed here.

Remarks

The use of fibers is repeated by the Heegard decompositions of S³ where n handles are attached to one another for other than genus 1 (leptons) and genus 2 (quarks) manifolds bounding surfaces.

Applications of catastrophes are for the n roll mill potential flows dynamics. - The parametrical treatment of degenaries in the manifolds is described by catastrophes. If their flows are interpreted as vector fields where vectors trace out the stream lines, field theory is added and has the dimension for the associated catastrohe map. Manifolds with no critical structure use one variable, Morse critical use a signed quadrics metric in diagonal form with one Euclidean part and the second (Euclidean) part signed with -1. Minkowski metric is of this form. The seven basic catastrophes have for the fold one variable and one parameter, similar to exp-functiotns oscillations, for the widely used cusps two variables and two parameters (2,2), in sequence written the swallowtail (2,3), the butterfly (2,4), for the umbilics the pair is (2,3) elliptic, (2,4) parabolic, (2,5) hyperbolic. Fields are then 4-, 5-,6-,7-dimensional, projected down to the 4-dimensional presentation in H^4. The quadrical

metrics parts u² are replaced by the variables powers as u^n and products $u^j u^k$ with n, (j+k)≤6. Higher powers are not considered.

For the dynamical description of energy systems in H^4 the presentation through projections is nececcary. Fiber bundle projections extend points of a base space by a rolled 1-dimensional fiber and use central and orthogonal projections. Field or flow projections have in the parametric extended spaces degenerate critical subspaces or points which also take (by their geometry care) of spontaneous, sudden state changes of systems when energetic instabilities occur. Decays are in this case available with field bosons of short lifetime like those of WI or Higgs. Energy transmissions, emissions use often quasiparticles. The linear 4-vector functions approach with a Euclidean or Hermitian quadric (complex) form is given up, as well as the numerical presentation where parameteres are added to 4-vector dimensions.

For changing quadrical vector measures <u,u> to <uT,u>, Gleason operators T are used with an orthogonal 3-base GF spin-like triple for S² coordinates which can be rescaled for the attached real, complex or quaternionic scalars by a scalar λ with |λ| = 1 for their rotations in S². The GF mostly use quasiparticle presentations while forces use particles and field quantums. For the quanta measures T the Copenhagen interpretation holds: only one real vector is observable in a measurement and the measured system P can change its state after the measurement. The (experiments) output is registered on a second apparatus Q applied to P. Q can be spacetime. The new quadrical metric can be observable, for instance as a curved orbit of P in H^4 instead of its linear world line. Rescalings of energy measures occur, for instance of mass where frequencies, velocities are added or subtracted by Higgs to basic P masses by using mc² = hf for mass increase or defect. Special relativistic rescalings of P, Q energy units are also possible between their two coordinate systems.

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