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Review Article

# Spin 2 rgb-graviton Field Quantums Exist

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## Abstract

The inversion from dark matter, dark energy to universes energies is described (section 1). The strong inner nucleon dynamics, the weak Hopf map, the color chares G-compass are briefly described (sections 2,3,4). It is necessary to use different, often projective or 8-dimensional coordinate systems (section 5) explaining spin 2 of rgb-gravitons. An alternative is added.

**Keywords:** Dark Energy; rgb-gravitons

## Section 1 Inversions at a bigbang

Linear xy spacial coordinates are for inversions replaced by polar coordinates r·exp(iφ) coordinates. Lissajous figures of two frequencies hitting make from (x,y)-coordinates the circle with radius $r^2 = x^2 + y^2$. The radius r' inside dark matter is inverted to universes radii r for mass systems in $r'r = Rs^2$, Rs Schwarzschild radius of dark matter. Speed v is taken as a variable and inverted at the Minkowski cone from dark energy speeds v' to universes speeds v in $v'v = c^2$, c speed of light, $v \leq c$. The angle φ as variable is given by $\sin \varphi = v/c$ and $x = r \cdot \cos \varphi$, $iy = ir \cdot \sin \varphi$. Both inversions in the Planck era can be used for the generation of Minkowski ($v \leq c$) and Schwarzschild metric ($Rs < r$) in the universe. As tools are constructed the G-compass and nucleons triangle symmetry $D_3$. Exchanged are the orientation for the reference triple 0,+1,∞ and 0,-1,∞ of complex cross ratios in (z,0;u,∞), u = +1 or u = -1, z complex variable, defining the six color charges of quarks as an independent force (G-compass, section 2) and the inner nucleon dynamics (figures 2,3, section 3).

The todays astronomy postulates dark matter and dark energy because of their observable actions in galaxies. This is repeated here for the Planck era since it allows in its first step to generate the known two metrics quoted above. In a second step it is used for the newly introduced color charge force, their rgb-graviton superpositions and the setting of mass centers for nucleons.

## Section 2 G-compass and color charge force

The Hopf map from the 3-dimensional unit sphere $S^3$ in spacetime $R^4$ to the unit sphere $S^2$ in xyz-space is defined by the three Pauli matrices. The x-coordinate is for the complex dot product, the y-coordinate for the complex cross product and the third spacial z-coordinate has associated a 4x4-matrix in two independent rotational blocks for the tori $S^1xS^1$ in $S^3$ arising for the Heegard decompositions of $S^3$. If to $S^2$ the stereographic map is applied setting z = 0 then the complex plane with coordinates $w = z_2/z_1$, $z_1 \neq 0$, with Moebius transformations MT as symmetry is obtained. The invariant six cross ratios represent the six color charges cc as an independent force from nucleons quarks. This allows their superposition rgb-graviton as a field quantum. The tool G-compass (figure 1) shows a color charge distribution on each segment. If cut along the vectors for the sixth' roots of unity, the segments radii are identified and a cone surface presents the cc similar as magnetic field quantums. G is a rotational 2x2-matrix of order 6 with first row (1 -1) and second row (1 0). If properly scaled it is the dark energy generated Schwarzschild metrics scaling factor (r – Rs)/r in section 1. G provides six valued sets not only for color charges but also for six electrical charges and six masses for the fermionic series of quarks and leptons. Six energies are generated, in octonion coordinates (listed by indices) as 1 electrical charge, 2 heat, 3 rotational energy, 4 magnetic energy (and time), 5 mass, 6 frequence (kinetic energy). The

octonion coordinate 0 is for the newly defined color charge force and 7 for the electromagnetic interaction EMI as force (rolled to a cylindrical Kaluza-Klein U(1) circle).

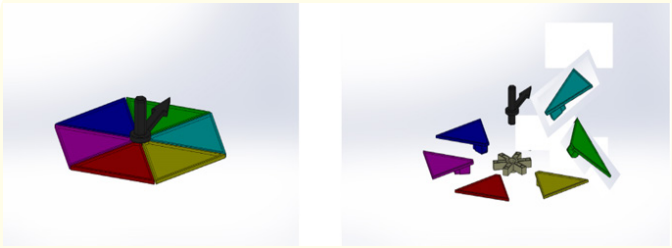

**Figure 1:** G-compass and color charge segments; the needle can only turn discrete in the 6th roots positions.

Color charges are in connection with the finite symmetry group $S_4$ as permutations of the four cross ratio members. Its CPT normal Klein subgroup $Z_2xZ_2$ factors it to $D_3$. Each factor class contains a color charge, a $D_3$ symmetry, an octonion coordinate and an energy. As perspective projections they preserve color charges and proportions. From the polynomial Moebius transformation version rescalings are on 5 (scaled identity matrix), inversion on 1 as 1/z (the conplex variable z is used), translation/momentum and frequency by 1/(1-z), its inverse (1-z) for a time interval as inverse of frequency or magnetism as directed vector flow through an area, (z-1)/z for rotations and its inverse as heat/entropy in a volume.

## Section 3 Nucleon inner dynamics

In nucleons the neutral color charge of red-blue-green is observed. As conic field quantums similar to magnetic field quantums they are in superposition for the rgb-graviton. The $D_3$ symmetry of the quark triangle has a presentation for the inner dynamics of the nucleon: the six permutations of r,g,b as states need two revolutions about the circumference of the triangle, counted in physics as spin ½ for the quarks and nucleon. The momentum vector attached to one quark moves with the rotation α of $D_3$ in each step and moves with its initial point on a Moebius strip from up to down or reversely until the first state is obtained again (Figures 2 left, 3). In the model (left figure 2) only one axis is set in a cycle and alternatively turned clockwise with red or coutnerclockwise with green as tip of the cone.

**Figure 2:** Nucleon inner $D_3$ dynamics at left, for LIGO [1] gravitational waves: earthworm at right (spacetime stretching/squeezing, a second graviton frequency quantization); emitted or absorbed are phonons, accousitc vibrating strings in the proportions of the cylindrical amplitudes 2:1:½ (tone with two overtones).

In the $D_3$ symmetry [2], red is setting with the octonion coordinate 1 a radius, with 12 complex polar coordinates $r\cdot\exp(i\varphi)$, exp the exponential function. The angle φ belongs to the coordinate 2 The $D_3$ symmetries for this are the Pauli matrix $\sigma_1$ followed by $\alpha\sigma_1$ which gives the rotation α of order 3 for the momentums initial point on the quark. In octonion coordinates the rgb-graviton is a 126 base vector triple GF (figure 4) for a measuring Gleason operator similar to the spin GF 123. If strong interaction GellMann matrices are used, 126 is replaced by $\lambda_j$, j = 1,2,3, reducing these 3x3-matrices to weak interaction Pauli 2x2-matrices with the third for a spherical angle 3 measured towards the spacial z-axis (mostly for conic rotations).

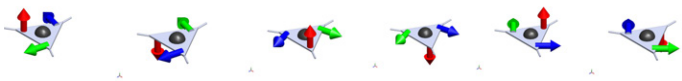

**Figure 3:** Six $D_3$ states, alternative r, g are kept fixed at a vertex and the other two color charges are conic rotated; barycentrical coordinates are generated which determine a barycenter of the nucleon.

In order to present nucleons as a wave package with a new computed momentum for its world line in the universe, it is necessary to use the dark energy inversion as a (Minkowski) relativistic scaling of its mass [4].

## Section 4 Spin 2

Recall: For different interactions and energy presentations are in use the SU(3) GellMann 3x3-matrices of the stong interaction

SI (8 gluons as field quantums). For the weak interaction WI and electromagnetism EM are spacetime coordinates with the quaternion symmetry SU(2), three Pauli matrices for three weak bosons as field quantums. Its extension has the magnetic group of order 8 (+1, -1 signed identity and Pauli matrices).

The finite complex 4-dimensional Hilbert space model can be located on the added GellMann matrices in form of a 3x3-matrix which has as first row ($z_1$ $z_2$ $z_3$), $z_3$ = (m,f) a projective mass m, frequency f plane with the line $mc^2 = hf$. The second row is (0 0 $z_4$), the third row (-c($z_3$) -c($z_4$) 0). Its closed subspace structure is orthomodular and consists of Boolean blocks for sets of commuting projection operators. No modus ponens, deduction theorem holds. For atomic diagrams, 3-cycles (like xyz-space coordinates 123 in octonions) have to be extended by a fourth Boolean atom (1234 adding time) and 4-cycles require an inner astroid with 8 different atoms in 4 blocks. The orthomodular Hilbert space structure is not used in physics or quantum philosophy paradoxies. The above coordinate $z_4$ is in octonions 07, color charges and EMI as forces.

The EMI space 1567 in octonions have a Kaluza-Klein rolled circle U(1) as the universal cover R (real line 7), the space z-coordinate is the same as the time 4 coordinate, a central axis for a circular cylinder. The transversal xy-plane for the circle provides spin 1 one revolution and the EMI frequency (coordinate 6) extending in time on the cylinder as exp helix line with one winding for a photon as field quantum. For wave packages and speed c the length λ (coordinate 1) of the wave satisfies λf = c. Relativistic mass coordinates 5 is added for EMI and color charges 0 coordinate is missing for EMI. This cc 0 acts as input energy after a big bang and EMI 7 has photons as output energy from atoms.

For quantum measured energy units are used octonion coordinates with seven measuring GF base triples of Gleason operators. In the Fano memo are listed 167 for EMI, 123 for space and spin, 145 for EM (electromagnetism), 246 for heat, 257 for mass, 347 for rotational energy (angular momentum), 356 for the inner nucleon $D_3$ dynamics. SI has three more GF 126 for rgb-gravitons, 345 for dual gravitons and 037 for the color charges as independent force (not quark bound).

The mass 5 entangled gravity GR has in octonions 123 from WI, 126 from $D_3$, 0 from color charges, 4 for its cylindrical earthworm wavepackages extension (moving with speed c) in spacetime as spiralic stretching/squeezing coordinates (due to rgb-gravitons and duals), 7 is missing. The earthworm model in the MINT Wigris library shows technical GR details in cylindrical coordinates [3].

Physics has not found graviton spin 2 field quantums. Comparing spin 2 with the quark or nucleons spin1/2, a 180 degree rotation should produce for spin 2 an identical state. This is possible for the nucleons inner dynamics. Blue is kept fixed in its position at -z as local space axis. The rgb-graviton location is on a projective plane where antipods on the equatorial xy-plane are identifyed. Rotating by 180 degrees about the z-axis keeps red at the x-axis and green at the y axis fixed since projective x = -x and y = -y. As a rgb-graviton $P^2$ space observe that in $R^4$ spacetime it has no self-intersections. The lower halfsphere of a bounding $S^2$ for the nucleon is used representing $P^2$.

As fiber bundle the nucleon space arises from the SI geometry part $S^5$ by norming to $CP^2$, a complex projective 2-dimensional space with boundary $S^2$ and fiber $S^1$ [5,6].

An alternative description of the rgb-graviton is using 3-dimensional projective duality: the quark triangle area is replaced by a point O as tip of a nucleon tetrahedron with base the quark triangle. Every side of the triangle is replaced by a color charge vector pointing from O to the quark not on this side. The barycenter B is replaced by the area spanned by the vectors endpoints (identical with quarks locaton). The rgb-graviton rotates about OB in 120 degrees, twice makes 240 degree and three such rotations set the original state. In this GR stretching/squeezing proportions are set in a spiralic clockwise or right hand screw rotation triangle side lengths 2:1:½ for squeezing, reversed by the dual in a spiralic counterclockwise or left hand screw rotation. The earthworm model has a cylindrical wave description for this.

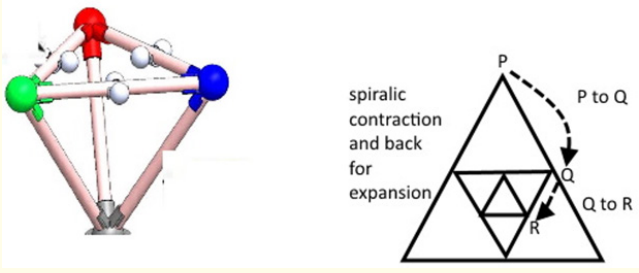


**Figure 4:** Nucleon tetrahedron, spiralic rotation at left (the three quarks persue attracted on a circle one another for squeezing).

In the hedgehog model for projective color charge hemispheres its is assumed that an added energy vector can be changed in up/down direction, moving on a Moebius strip for energy exchanges between the nucleon and its environment. The thresholds which open a color charge valve come from an elliptic umbilic catastrophe as 6 roll mill.

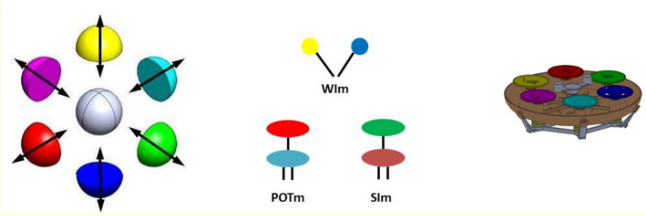


**Figure 5**

Figure 4 hedgehog at left (a 6 roll mill sets thresholds for the vectors turning, the color charge acts as valve and the vector turns on a Moebis strip between its up/down positions), middle part 3 driving motors (6 forces) POT (EM red 1 + GR turquoise 5), SI (heat green 2 + rotational energy magenta 3), WI (magnetic yellow 4 + kinetic energy blue 6), at right 6 roll mill; each motor has a connection to its two parts driven by a rubber band; there are two or three different speeds for the motors.

**Figure 6:** MINT-Wigris mathematical Tools in the MINT Wigris library, Emmy Noether Memorial museum.

## Conclusion

It should be verified that the rgb-gravitons and MINT Wigris models, described in many articles of the author, are sufficient for a quantum gravity GR theory. The known GR properties can be derived for this new presentation. Complex cross ratios are used for color charges as an independent force. The symmetry $D_3$ and the G-matrix are newly introduced for this and inversions relate to inverting radius from dark matter (Schwarzschild metric scaling, spherical coordinates for space), inverting speed from dark energy (Minkowski metric scaling, affine coordinates for spacetime), inverting a frequency/energy interval to a time interval (octonion coordinates for energy systems, measuring Gleason operators for setting their units), as addition inverting the logarthmic function from dark energy to its inverse exponential waves psi-function (Hilbert space metric and projections, Hermitian complex metric). Dimensions for particle retracts from 1 to 3 are projective dual exchanged in a real 5-dimensional projective (Kaluza-Klein) space. More details are found in the references (1-3,5.6). Experimental datas are available as the detected neutral color charge of nucleons, the stretching/squeezing observed by LIGO for gravitational waves; further experiments should be invented. For nucleons this and inversions should be investigated. The projective cross ratios bound view is not used by other authors.

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