

**TTQG (Topological Theory of Quantum Gravity) Driven New Theory of Color Physics**

Chinmoy Bhattacharya

Austin Paints & Chemical Pvt Ltd, 3 Ambika Mukherjee Road, Belghoria, Kolkata, 700 056, India

**\*Corresponding Author**

C Bhattacharya, Austin Paints & Chemical Pvt Ltd, 3 Ambika Mukherjee Road, Belghoria, Kolkata, 700 056, India.

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**Abstract**

The concept of 'color space' in the conventional theories of 'color physics' is a concept of 3D color space. The magnitude of any color in the said theories is measured by mathematical integration of the tristimulus values of Red (X), Green (Y) and Blue (B) colors of light wave.

However, the conventional theories of color physics are not able to predict the underlying cause of the existence of the 7 numbers of colors of the VIBGYOR or the Newton's color wheel. Also the said theories cannot explain i) dimension of the light wave color and the object color, ii) the mechanism of evolution of the VIBGYOR colors from a typical 'black body' and iii) the 'spectral power distribution (SPD)' of Sun's energy spectrum.

In this research article through the 'TOPOLOGICAL THEORY OF QUANTUM GRAVITY (TTQG)', principally by considering the topologies and dimensions of mass (object), time, space expansion, space inversion, EM-wave, entropy, etc and others, all the above said mysteries have been revealed and presented here for the first time in the history of physics.

**Introduction**

The entire world scientific community is well acquainted with the classical laws of physics, the thermo dynamical laws, the Planck hypothesis, the relativity theories, the theories of color physics, etc. and so on for many years but the main essence of the said theories have not reached to many people, and as a result of that, as on today even, some 'grey' areas are still left in the above said theories primarily due to the fact that the physical variables like 'time', 'mass', 'acceleration', 'gravitation', etc. had been left-out in their 'abstract' forms in the said theories. The principal underlying reason behind the same, is the lack of the whereabouts of pictorial or geometrical representations of the above said physical variables. The recently discovered TTQG [98-102], has however, revealed the geometrical shapes of most of the principal physical variables of the universe and could become able to explain the many cosmic mysteries of the universe, the geometrical profile of the chemical reactions[99] and the equilibrium constants of the chemical reactions[100], the black body radiation phenomena[98], the cosmos 'graviton

cycle', the cold nuclear fusion phenomena, the dimensionality of the universe [98-102], the dark energy/dark matter[101] and many others[98-102].

In this research article, a new theory of 'color physics' has been developed and presented based on the newly discovered TTQG topologies and dimensions (Figure 1 below) of the physical variable of the universe. The integral expression of color (of the conventional theories of color physics) in the form tristimulus values of Red, Green and Blue color have been utilized to evaluate the true topology and dimensions of the color space of the universe. Two new parameters have been introduced, viz, 'Color hybrid function of light' (CHFL) and, 'Color hybrid function of object' (CHFO) based on the basic concepts of TTQG to reveal the underlying physics and topology of the phenomenon of 'black body radiation' and 'Newton's color wheel' and 'grey universe'. Before this proposition, the said phenomena could not be distinctly explained by the conventional or standard model of physics.

### GEOMETRICAL SHAPES OF THE GRAVITONS OF TQG

Graviton Type	Geometrical Shape	Dimension
(1) Entropy/Distance		10 <sup>10</sup>
(2) Temperature/Force		20 <sup>10</sup>
(3) Time		Inverse 20 <sup>10</sup>
(4) Volume/Energy		30 <sup>10</sup>
(5) Mass		Inverse 30 <sup>10</sup>
(6) EM-Wave (Energy x Entropy) (Force x Area)		40 <sup>10</sup>
(7) Atom (Energy x Entropy x Time)		20 <sup>10</sup>



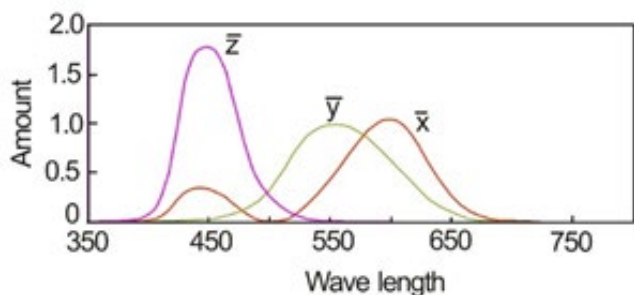
**Figure 1:** Geometrical shapes of the different ‘push- forward’ and ‘pull-back’ gravitons of the ‘Topological Theory of Quantum Gravity’ (TTQG).

#### 1. Color Physics and Gravitons

Color is evolved as a result of interaction among the object, source of light and the observer [89-94]. Once the dimensionalities of the said three variables are properly identified, the dimension of color can be obtained.

#### 2. Dimensionality of Color in Regard to Light-Object Interaction

The source of light is providing light waves/EM waves. So source of light is 4-dimensional. The Baryonic matters on which the light wave falls is 2-dimensional. Regarding the dimensionality of the observers, it is to be noted that the human eye receptor cells perceive color in the form of color matching functions  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$  as shown in figure.2 below



**Figure 2:** Graphical presentation of color matching functions  $\bar{x}$ ,  $\bar{y}$ , and  $\bar{z}$

So these are EM waves too. The dimension of color would be obtained by multiplying the dimensionalities of the above said three numbers of variables, as shown below:

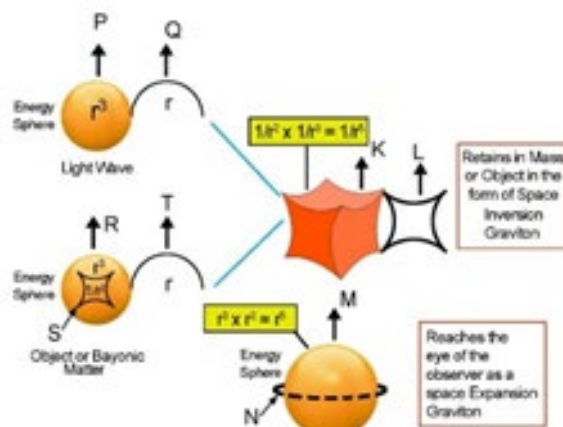
DIMENSION OF SOURCE :  $r^4$  (EM-WAVE)  
 DIMENSION OF OBJECT :  $r^2$  (BARYONIC MATTER)  
 DIMENSION OF OBSERVER :  $r^4$  (COLOUR MATCHING FUNCTION)

So the dimension of color is found as  $r^4 \times r^2 \times r^4 = r^{10}$

The above said 10-dimensionality of color would be valid, as long as one considers, color as a composite of object (mass) and light (EM-wave).

The theory of quantum gravity depicts the color separately in object and light wave. When the color is considered in an object, it is indeed 5-dimensional, and when the color is being viewed as light wave, it is also 5-dimensional.

This phenomenon is being schematically represented in figure 3.



**Figure 3:** Evolution of colour from Object-EMI wave intreraction

In figure.3. it is clearly shown that when light wave falls on an object, the energy graviton of light wave inverses to form mass graviton (P → K) and that is being retained in the object. The mass graviton of the object reverses to form energy graviton (R → M). The entropy graviton of light (R) wave and the entropy graviton (T) of the object or mass get hybridized with each other to form force graviton (N). The time graviton of object (S) and the mass graviton (K) hybridizes to each other and this inverse five (5) dimensionality, is being retained in the object as ‘object color’.

On the contrary, the energy graviton (M) and the force graviton (N) hybridizes to form the space expansion graviton and which

reaches the eye of an observers as a sudden thrust, or stimuli and in the optic nerves of the eye, a perception of color is developed. Color is energy dispersion, when viewed as light wave and color is energy inversion, when color is being viewed as an object.

In energy dispersion form it is 5-dimensional and in mass form it is 5-dimensional too, but is inverse 5- dimensional.

### 3. Dimensionality of Color as Evolved from the Basic Definition of Color in Color Physics as an Integration of Energy Field

The color has been defined in basic color physics as a hybrid of the following parameters.

- i) Relative reflectance,  $R(\lambda)$ , of the object at full range of wave lengths ( $\lambda$ ) of visible light.
- ii) Energies,  $E(\lambda)$ , of the source of light in the selected range of the wave length of visible light.
- iii) Color matching functions  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$  shown in Figure 2

The integral expression of color [95] in the form of tri-stimulus value of Red (X), Green (Y) and Blue (Z), are

$$X = k \int E(\lambda)R(\lambda)\bar{x}(\lambda)d(\lambda) \quad (1.1)$$

$$Y = k \int E(\lambda)R(\lambda)\bar{y}(\lambda)d(\lambda) \quad (1.2)$$

$$Z = k \int E(\lambda)R(\lambda)z(\lambda)d(\lambda) \quad (1.3)$$

Here k is the normalization constant. If dimensional analysis is being done of the Eqn

(1.1) above, we get:

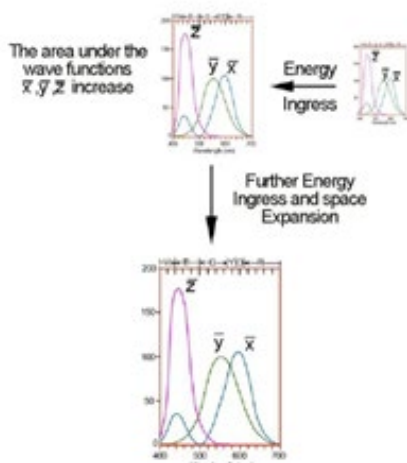
k = normalization constant = dimensionless

$E(\lambda)$  = energy =  $r^3$

$R(\lambda)$  = percent reflectance = dimensionless

$\bar{x}(\lambda)$  = wave length =  $r$

As a matter of fact, the product of,  $E(\lambda)R(\lambda)$ , is being introduced in the color matching functions  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$  respectively as shown in Fig.4 below.



**Figure 4:** Coloe and Space expansion

As the Energy in the form of  $E(\lambda)R(\lambda)$  enters in the area /volume under the curves  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$ , the said volumes increase and the color matching functions take enlarged shape as shown in figure 4.

The value of X of color corresponds to the expanded volume/ space of the color matching function  $\bar{x}$ , after integration. The value of Y and Z corresponds to the volumes of the color matching functions  $\bar{y}$  and  $\bar{z}$  respectively, after integration. So development of color is basically a space expansion phenomenon.

The dimension of color matching function  $\bar{x}$ , in Eq.(1.1) has been considered to be equal to r, i.e., the dimension of entropy or distance. The  $E(\lambda)R(\lambda)$  represents some amount of energy, and this energy has to move to a certain distance to distribute itself under the curves  $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$  (in Figure 2) and so, the  $\bar{x}(\lambda)$ ,  $\bar{y}(\lambda)$  and  $\bar{z}(\lambda)$  in Eqs.(1.2) to (1.3) represents the distance/entropy of travel of the energy. So the dimension of the color matching functions are entropic (r) ones.

So the dimensionality of the Eqn.(1.2) turns out to be  $\int r^3 .r.dr = \int r^4 dr = r^5/5 + I$  (Constant of integration) (1.4)

So the dimensionality of color turns out to be 5, in light waves and in the matter, it will be just inverse 5- dimensional.

The color of an object, what the brain perceives, is related to the ratios of relative volumes of the color matching functions ( $\bar{x}$ ,  $\bar{y}$  and  $\bar{z}$ ) respectively, after being expanded as shown in Figure 4

If, for example after expansion of the color matching functions, the value of X, Y and Z are; (in any arbitrary chosen scale)

X = 70 – RED

Y = 20 – GREEN

X = 10 – BLUE

Then the color will be prominently redder, since the ratio of X, Y and Z is 7:2:1 and X predominates to a large extent.

So in this said case, space enhancement of  $\bar{x}$ , is the highest among the three color matching functions. Color as light wave, in its white form, can also be viewed as a hybrid of the following 5 numbers of gravitons.

Entropy (r)

Force ( $r^2$ )

1<sup>st</sup> degree energy ( $r^3$ )

EM-wave ( $r^4$ )

Space expansion ( $r^5$ )

So white color stationary graviton

$$= (r \times r^2 \times r^3 \times r^4 \times r^5)^{1/5} = r^3 \quad (1.5)$$

So this white color stationary graviton, when gets a push forward in the form of dimensionality of  $r^2$ , it turns into white color EM wave graviton or space expansion graviton

$$r^3 \times r^2 = r^5 \quad (1.6)$$

Black color graviton exists in the mass only and it is a hybrid of the following gravitons:

Order ( $r^{-1}$ )

Time ( $r^{-2}$ )

1<sup>st</sup> degree mass ( $r^{-3}$ )

Anti EM- Wave ( $r^{-4}$ )

Space inversion ( $r^{-5}$ )

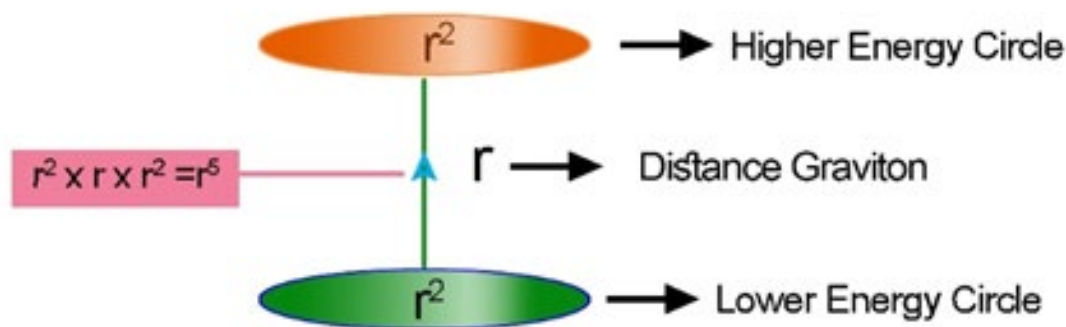
So the stationary Black color graviton in the form of mass, is =  $(r^{-1} \times r^{-2} \times r^{-3} \times r^{-4} \times r^{-5})^{1/5} = r^{-3}$ .

Now when this gets a further inversion or pull-back in the form of  $r^2$  it turns to Black color

$$r^3 \times r^2 = r^5$$

So the white and Black colors graviton does exist in equilibrium, with each other and the effect of blending of White Color and Black color, makes the universe Grey.

The dimensionality of color can also be viewed as the hybrid of absorption and scattering of light.



**Figure 5:** Evolution of color from transition of electrons from lower to high energy level

The path length being the entropic one, one can obtain the dimension of scattering/scattering co-efficient, from equation (1.7) as Scattering co-efficient (s) =  $r^3/(1/r^3) \times (1/r) = r^5$  (1.8)

Now absorption co-efficient of light is by definition “amount of light absorbed per unit mass per unit path-length”. So the dimension would be the same as that for scattering co-efficient in equation (1.8). But the absorbed light, when being absorbed, attains the form of mass, and the dimension reaches to inverse 5-dimension.

Color of light

= Volume x Push Forward

= energy x temperature

$$(1.9)$$

Color of object

= Mass x Pull-back

= Mass x time

$$(1.10)$$

Color of light is an energy and temperature hybrid or space expansion or is an expanding phenomenon. Color of object is a space inversion phenomena or mass-time hybrid. So when t is very high, color is Black, the darkest, that is what a ‘Black-Body’ or a ‘Black-Hole’ is. When t decays or the attractive forces are reduced, the object becomes colorful.

That is why heating a Black Body, it changes its own color and as well go on emitting different color light-waves. Color can be viewed also as an electronic transition from a lower energy circle to a higher energy circle, as shown above in Figure 5.

Color can be viewed also as an electronic transition, from a lower energy circle to a higher energy circle belongs to a large energy sphere (as will be explained shortly).

Scattering coefficient of light [95] is the amount of light (volume of light) scattered, per unit mass per unit path length. So the dimension of scattering turns out to be

$$(volume/mass) \times 1/(Path-length) \quad (1.7)$$

In accordance with Figure 5. The dimensionality of color turns out to be =  $r^2 \times r \times r^2 = r^5$ . (1.11)

So this is basically related to the transition of electrons from one orbital of lower energy to an another orbital of higher energy and the color of ‘transition metal salts’ are being explained in the ‘Crystal Field Theory’ in regard to this.

Color can also be viewed as a function of concentration of charges in solution, as the pH scale is. pH is a measure of hydrogen ion concentration in solution. So it is basically “Amount of charge per unit mass of solution”.

So the index of color is = charge/mass =  $r^2/(1/r^3) = r^5$ . (1.12)

Color graviton of light

= electric current x entropy

= EM wave graviton x entropy

$$(1.13)$$

Color graviton of object

= (Time graviton)<sup>2</sup> x order graviton

$$(1.14)$$

#### 4. Evolution of Newton’s Color Wheel from QG Theory of Color

The 5-dimensionality of color in light wave can also be viewed as hybrid of entropy, force, energy... as already mentioned. As a matter of fact, from the proper dimensional analysis of the above said hybrids, one can evaluate the electro-magnetic spectrum starting from IR to the formation of VIBGYOR as depicted by Sir Isaac Newton. The hybrid of entropy ( $\pi r$ ), force ( $\pi r^2$ ), energy ( $\pi r^3$ ), EM-wave ( $\pi^2 r^4$ ) and acceleration ( $\pi^2 r^5$ ) can be written as (color hybrid function in the light wave) CHFL

$$\begin{aligned}
\text{CHFL} &= (\pi r \times \pi r^2 \times \pi r^3 \times \pi r^4 \times \pi r^5)^{1/5} \\
&= (r \times \pi r^2 \times \pi r^3 \times \pi r^4 \times \pi r^5)^{1/5} \\
&= \{r \times (\pi r^2)^7\}^{1/5} \\
&= \{r^{1/5} \times (\pi r^2)^7\}
\end{aligned}
\tag{1.15}$$

Now if we put,  $r^{1/5} = R$ , the above mathematical relation turns into

$$\text{CHFL} = \{R \times (\pi R^2)^7\} \tag{1.16}$$

So a CHFL basically is a hybrid of a distance graviton and seven numbers of circles.

The hybrid of order ( $1/\pi r$ ), Time ( $1/\pi r^2$ ), mass ( $1/\pi r^3$ ), anti-magnetic field ( $1/\pi^2 r^4$ ) and space-inversion graviton ( $1/\pi^2 r^5$ ) can be written as (color hybrid function in object, CHFO)

$$\begin{aligned}
\text{CHFO} &= \frac{1}{\pi r} \times \frac{1}{\pi r^2} \times \frac{1}{\pi r^3} \times \frac{1}{\pi^2 r^4} \times \frac{1}{\pi^2 r^5} \\
&= \left\{ \frac{1}{r} \times \left( \frac{1}{\pi r^2} \right)^7 \right\}^{1/5}, = \left\{ \frac{1}{r^5} \times \left( \frac{1}{\pi r^2} \right)^7 \right\}
\end{aligned}
\tag{1.17}$$

If we put,  $(1/r^{1/5}) = 1/R'$ , then the Eqn.(1.17) becomes

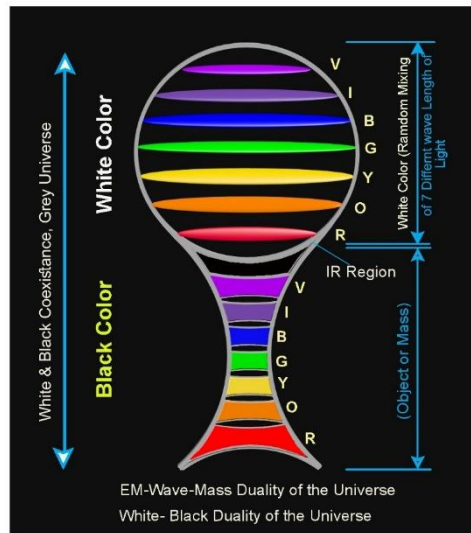
$$\text{CHFO} = \frac{1}{R'} \times \left( \frac{1}{\pi R'^2} \right)^7 \tag{1.18}$$

So the hybrid of CHFL and CHFO can be written as (Eqns.1.16) and (1.17)

$$\text{CHFL} \times \text{CHFO} = R \times (\pi R^2)^7 \times \frac{1}{R'} \times \left( \frac{1}{\pi R'^2} \right)^7 \tag{1.19}$$

### 5. 'Mass-EM Wave Duality', 'Object Color - EM Wave Color Duality'

From equation (1.19), one can draw the picture of color of light, and color of object, in equilibrium with each other. This has been done and shown in figure 6.



**Figure 6:** Diagrammatic presentation of Grey Universe

In figure 6,  $(1/\pi R')$  represents the IR region,  $(\pi R)$  represents the border line between visible region of electromagnetic spectrum and the invisible or the high energy electromagnetic wave region.

The seven different colors i.e., violet (V), Indigo (I), Blue (B), Green(G), Yellow (Y), Orange (O) and Red (R) that is the VIB-GYOR, are spread over the space in the form of circles  $(\pi R^2)^7$  with increasing magnitude of energy, as shown in figure 6. The R value in equation (1.19) is an average value of R to be derived

from the averaging the individual R value of the seven different color circles, as shown in figure.6 (to be covered in a separate article to be published).

The colors of the object are being trapped as inverse circles,  $(1/\pi R^2)^7$ , in the increasing order of attractive forces from Red to Orange to Green to Blue to Indigo to Violet. In visible light wave region, Red color belongs to the lowest energy and Violet, the highest energy.



On the contrary, in an object Red color is in the least cohesive form of color and Violet is the most cohesive form of color. The random mixing of seven different color circles of the upper part of the figure 6, leads to the formation of white color light. In the object part the cohesive inverse circles, on an average, do emit only very low energy EM-wave, i.e., the invisible IR waves. So the object looks black or is called a Black Body.

The Black-Body remains in equilibrium, with the white color of light waves and as a result of this, blending of Black and White color; the universe is a grey universe.

The figure 6, represents also the “EM-WAVE-MASS DUALITY” or typical “BLACK-BODY RADIATION” to give rise to different colors of the object and light wave as well.

$$\begin{aligned}
 \text{SPD} &= \frac{(\text{POWER})}{(\text{AREA})} \times \frac{1}{(\text{WAVE LENGTH})} \\
 &= \frac{\text{ENERGY}}{\text{TIME}} \times \frac{1}{\text{AREA}} \times \frac{1}{\text{WAVE LENGTH}}
 \end{aligned}
 \tag{1.2}$$

Now the dimensionalities of the different variables in equation (1.2) above as

$$\text{Energy} = r^3$$

$$\text{Time} = 1/r^2$$

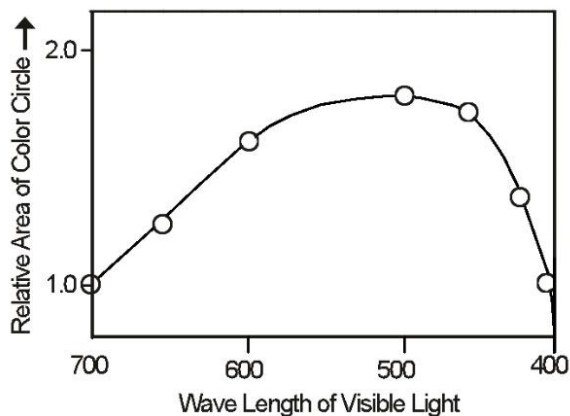
$$\text{Area} = r^2$$

$$\text{Wave length} = \text{distance} = r$$

So the final form of SPD is,

$$= \frac{r^3 \times r^2}{r^2 \times r} = r^2
 \tag{1.21}$$

So SPD, in fact represents the areas of the seven different circles as shown in figure 6, If we plot the relative areas of the seven different circles, starting from Red (R) to Violet (V), (taking the area of Red = 1), against the wave length visible light, we get a curve as that shown in figure 7.



**Figure7:** Representation of SPD against Wave Length of Visible Light.

From figure 7, it is clearly found that the SPD increases from R → O → Y → G and peaks at Green wave length and then diminishes monotonically up to the wave length of Violet light. This SPD wave length pattern of the curve in figure 7, exactly matches, to the visible spectrum of a solar radiation and which also peaks at Green wave length of visible light. This also explains the Black Body Radiation curves too.

### References

1. Lenard-Jones, J.E. (1924) “On the determination of molecular fields”, Proc. R. Soc. Lond. A, 1924 RSPA.106.463J. der: 10.1098/rspa.1924.0082

The color phenomena as a blend of object color and light wave color can be considered, as a whole of 10-dimensionality. So the super-entropic gravitons/singularity gravitons formation ( $1/r^{10}$ ) is also sourced from light wave-matter interaction as well. The origin of the singularity roots from

- i) LIGHT WAVE-OBJECTS INTERACTION
- ii) OVER LAPPING OF INVERSE ACCELERATION FIELDS

Now, the energy distribution of visible EM region (or sunlight) or the spectral power distribution of the various wave-length of light will be looked into.

‘Spectral Power Distribution’ (SPD), by definition [89], is power per unit area per unit wave-length of an illumination.

2. “The relationship between Lenard Jones (12-6)... Morse Potential” Naturforsch 58a, 615-617 (2003).
3. Zhang, L. (2013). The Van der Waals force and gravitation force in matter. Lei Zhang arXiv: 1303.3579, arXiv:1303,3599VI
4. An alternative model of particle physics in a 10-dimension (pseudo) Euclidian space-time. Richard Bonneville..09 arXiv:0912.5354.
5. Menon, K. K., & Qureshi, T. (2018). Wave-particle duality in asymmetric beam interference. Physical Review A, 98(2), 022130.
6. Zaslavskii, O. B. (2006). Ultimate gravitational mass de-

- fect. *General Relativity and Gravitation*, 38(5), 945-951.
7. Modified Planck units, YU.L.Bolotin, V.V.Yanoksky arXiv:1701.01022 [Physic.gen-ph].
  8. HUAY, TAUL.G.Maxwell's equation, Hooken, N.J.Willey ISBN, 0470542764.
  9. Jackson J.D. (1999) *Classical Electrodynamics* (3rd ed.) New York, Wiley.
  10. Fundamental Physical Constant from NIST Physics.nist.gov.
  11. Halliday and Resnick. (1974). "6 Power" *Fundamental of Physics*, Chapter 13 3, pp 13-2, 3. *The Feynman Lecture on Physics Vol.1*, 1963.
  12. Loudon, R. (2000). *The quantum theory of light*. OUP Oxford.
  13. Duffin, W.J. (1990). *Electricity and Magnetism*, 4th ed., McGraw Hill.
  14. Serway, R. A., Jewett, J. W., Wilson, K., & Rowlands, W. (2016). *Physics for Global Scientists and Engineers, Volume 2 (Vol. 2)*. Cengage AU.
  15. "The NIST reference on fundamental physical constants". Physics. nist. Gov, Retrieved 2011-11-08.
  16. Rybicki, G. B., & Lightman, A. P. (1991). *Radiative processes in astrophysics*. John Wiley & Sons.
  17. McQuarrie, Donald A., Simon, John D. (1979). *Physical Chemistry: a molecular approach (rev/ed.)* Sausalito, Califo: Univ. Science Books.
  18. Browne, M. (2013). *Schaum's Outline of Physics for Engineering and Science*. McGraw-Hill Education.
  19. *Radiative Processes in Astrophysics*, Rylicki and Lightman, pp.20-28.
  20. Purcell, Edward. M, David J. (2013). *Electricity and Magnetism* (3rd ed.) New York, Cambridge University Press. pp14-20.
  21. J.Maxwell. *Treatise on Electricity and Magnetism*, 2, 236-237.
  22. "The Nobel Prize in Physics 1921" Nobel Foundation Retrieved 2013-03-16.
  23. M.G.Arore & M.Singh (1994) *Nuclear Chemistry Anmol Publications* p.202 ISBN, 81-261-1763-X.
  24. Goldston, R.J., Rutherford P.H. (1995). *Introduction to Plasma Physics*. Taylor & Francis, p.1-2.
  25. Sharma 'Atomic and Nuclear Physics'. Pearson Education India. p.478 ISBN 978-81-317-1924-4; 'Detecting Cosmic rays from a galaxy far, far away' *Science Daily* 21 September 2017, retrieved 26 December 2017
  26. X-rays NASA Archived from the original on November 22, 2012, retrieved November 7, 2012; Gamma rays NASA, Archived from original on 2012-05-02; Verdenne G.Attetia, J-L (2009) *Gamma-ray Bursts. The brightest explosions in the Universe*, Springer.
  27. Schrodinger, E. (1926), "An undulatory theory of the mechanics of atoms and molecules" *Phys. Rev.* 28(6), 1049-1070.
  28. Griffiths, D. J., & Schroeter, D. F. (2018). *Introduction to quantum mechanics*. Cambridge university press.
  29. Atkins, P. W. (1977). *Molecular quantum mechanics parts I and II: An introduction to quantum chemistry*.
  30. Atkins, P. W. (1974). *Quanta: A handbook of concepts* (No. 21). Clarendon Press.
  31. Einstein Albert. (1916). *The foundation of the General Theory of Relativity* *Annalen der Physik*, 354 (97), 769.
  32. Gron, Oybind; Hernik, Sigbojorn. (2007). *Einstein General Theory of Relativity: with modern application is cosmology*; Springer Science and Business Media, p.180.
  33. Lehmkuhl, D. (2019). *General relativity as a hybrid theory: The genesis of Einstein's work on the problem of motion. Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics*, 67, 176-190.
  34. Hess, P. O. (2016). *The black hole merger event GW150914 within a modified theory of general relativity*. *Monthly Notices of the Royal Astronomical Society*, 462(3), 3026-3030.
  35. Chrimes, A. A., Levan, A. J., Stanway, E. R., Lyman, J. D., Fruchter, A. S., Jakobsson, P., ... & Wiersema, K. (2019). *Chandra and Hubble Space Telescope observations of dark gamma-ray bursts and their host galaxies*. *Monthly Notices of the Royal Astronomical Society*, 486(3), 3105-3117.
  36. Bergh, S. V. D. (2011). *The curious case of Lemaître's equation No. 24*. arXiv preprint arXiv:1106.1195.
  37. Nussbaumer, H., & Bieri, L. (2011). *Who discovered the expanding universe?*. arXiv preprint arXiv:1107.2281.
  38. Way, M. J. (2013). *Dismantling Hubble's Legacy?*. arXiv preprint arXiv:1301.7294.
  39. World, Robert, M. (1984). *General Relativity* University of Chicago, Press, ISBN-970-0-226-87033-5.
  40. Wald, R. M. (1999). *Gravitational collapse and cosmic censorship*. In *Black holes, gravitational radiation and the universe* (pp. 69-86). Springer, Dordrecht.
  41. Overbye, Dennis. (2015). "Black Hole Hunters" NASA.
  42. Montgomery, C., Orchiston, W., & Whittingham, I. (2009). *Michell, Laplace and the origin of the black hole concept*. *Journal of Astronomical History and Heritage*, 12, 90-96.
  43. Abbott, B. P., Abbott, R., Abbott, T. D., Abernathy, M. R., Acernese, F., Ackley, K., ... & Cavalieri, R. (2016). *Observation of gravitational waves from a binary black hole merger*. *Physical review letters*, 116(6), 061102.
  44. Telescope, E. H. (2019). *First M87 Event Horizon Telescope Results*. *Astrophys. J*, 875, L1.
  45. Shapiro, S. L., & Teukolsky, S. A. (2008). *Black holes, white dwarfs, and neutron stars: The physics of compact objects*. John Wiley & Sons.
  46. *Introduction to Black Holes* Retrieved 26 September 2017.
  47. *SPACE TIME WALTZ – Jagjit Singh*, Publication an Information Directorate, Wiley Eastern Ltd., 1st ed. ISBN:81-7236-105-x.
  48. Penrose, R. (2002). "Golden Oldie": *gravitational collapse: the role of general relativity*. *General Relativity and Gravitation*, 34(7), 1141-1165.
  49. Rose, C. (2013). *A Conversation with Dr. Stephen Hawking and Lucy Hawking*. charlirose.com.
  50. Patnaik, S. (Ed.). (2017). *Recent Developments in Intelligent Nature-inspired Computing*.
  51. Giddings, S. B., & Thomas, S. (2002). *High energy colliders as black hole factories: The end of short distance physics*. *Physical Review D*, 65(5), 056010.
  52. Belgiorno, F., Cacciatori, S. L., Clerici, M., Gorini, V., Ortenzi, G., Rizzi, L., ... & Faccio, D. (2010). *Hawking radiation from ultrashort laser pulse filaments*. *Physical review*

- letters, 105(20), 203901.
53. Grossman, Lisa. (2010). Ultrafast laser pulse makes Desktop Black-Hole glow.
  54. Kumar, K. P., Kiranagi, B. S., & Bagewadi, C. S. (2012). Hawking Radiation-A Augmentation Attrition Model. *Advances in Natural Science*, 5(2), 14-33.
  55. For an alternative derivation and more detailed discussion of awking radition Hawking radiation as a form of unruh radiation. See de Witt, BrayH Hawking radiation as a form of unruh radiation. See de Wilt, Bryce. (1980). "Quantum gravity: the new synthesis" in Hawking S; Isreal.W (eds). *General relativity; An Einstein centenary* p.696.
  56. Jacob D Bekenstein. (2008). "Bekenstein Bound" *Scholrapedia*, 3(10), 7374.
  57. Hawking, S. W., & Ellis, G. F. R. (1973). *The large scale structure of space-time* (Vol. 1). Cambridge university press.
  58. Misner, C. W., Thorne, K. S., & Wheeler, J. A. (1973). *Gravitation* WH Freeman and Co. San Francisco, 660.
  59. Peacock, J. A. (1999). *Cosmological physics*. Cambridge university press.
  60. Brill, D. (2012). Black Hole Horizons and How They Begin. *Astronomical Review*, 7(1), 25-35.
  61. Chen, Y., Shu, J., Xue, X., Yuan, Q., & Zhao, Y. (2020). Probing axions with event horizon telescope polarimetric measurements. *Physical Review Letters*, 124(6), 061102.
  62. Giddings, S. B. (2019). Searching for quantum black hole structure with the Event Horizon Telescope. *Universe*, 5(9), 201.
  63. Kutner, M. L. (2003). *Astronomy: A physical perspective*. Cambridge University Press.
  64. Schwarzschild, K. (1916). *Über das Gravitationsfeld eines Massenpunktes nach der Einstein'schen Theorie*. Berlin. *Sitzungsberichte*, 18.
  65. Wald Robert. (1984). *General Relativity*. The University of Chicago Press. 152-153.
  66. Schaffer, S. (1979). John Michell and black holes. *Journal for the History of Astronomy*, 10, 42.
  67. Valev, Dimitar. (2008). Consequence from conservation of total density of the universe during the expansion. *arXiv*.1008.0533.
  68. McConnell, N. J., Ma, C. P., Gebhardt, K., Wright, S. A., Murphy, J. D., Lauer, T. R., ... & Richstone, D. O. (2011). Two ten-billion-solar-mass black holes at the centres of giant elliptical galaxies. *Nature*, 480(7376), 215-218.
  69. Sanders, R. H. (2014). *Revealing the Heart of the Galaxy*. Cambridge University Press.
  70. Carol, Seam M. (2004). *Space-time and Geometry* Addison Wesley. ISBN 978-0-8053-8732-2.
  71. R.Penrose. (1965). Gravitational collapse and space-time singularities. *Phys. Rev. Lett.* 14.
  72. Kerr, R. P. (1963). Gravitational field of a spinning mass as an example of algebraically special metrics. *Physical review letters*, 11(5), 237.
  73. Newman, E. T., & Janis, A. I. (1965). Note on the Kerr spinning-particle metric. *Journal of Mathematical Physics*, 6(6), 915-917.
  74. Black Holes/Science Mission Directorate NASA retrieved 17th March 2018.
  75. "IAU members vote to recommend renaming Hubble law as Hubble-Lemaitre law Int. astronomical Union. 29 October 2018.
  76. Joann's Haranas and Joannis Gkigkitzis. *Int. Scholarly Research Notices*, Volume 2014, Article ID 718251 "The Mass Graviton and its relation to the number of information according to Holographic principle".
  77. From the Flat Space S-matrix to the wave function of the universe. Paolo Benninease *arXiv*:1811.08864.
  78. Modestino, G. (2016). Explanation of the Special Theory of Relativity by Analytical Geometry and Reformulation of the Inverse-Square-Law. *arXiv preprint arXiv:1609.06208*.
  79. Corichi, A., Díaz-Polo, J., & Fernández-Borja, E. (2007, May). Loop quantum gravity and Planck-size black hole entropy. In *Journal of Physics: Conference Series* (Vol. 68, No. 1, p. 012031). IOP Publishing.
  80. Bojowald, M. (2007, June). Singularities and quantum gravity. In *AIP Conference Proceedings* (Vol. 910, No. 1, pp. 294-333). American Institute of Physics.
  81. Ashtekar, A. (2007). An introduction to loop quantum gravity through cosmology. *arXiv preprint gr-qc/0702030*.
  82. Gamma-ray Burst UV/optical afterglow polarimetry as a probe of quantum gravity.
  83. Martin Bojowald. Quantum gravity and cosmological observations. *AIP Conf. Proc.*
  84. Hansson, J. (2006). Newtonian quantum gravity. *arXiv preprint gr-qc/0612025*.
  85. Ward, B. F. L. (2008). Resummed quantum gravity. *International Journal of Modern Physics D*, 17(03n04), 627-633.
  86. Wang, C. H. T. (2006). New 'phase' of quantum gravity. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 364(1849), 3375-3388.
  87. Demir, D. A., & Tanyıldızı, Ş. H. (2006). Higher curvature quantum gravity and large extra dimensions. *Physics Letters B*, 633(2-3), 368-374.
  88. Kiefer, C. (2006). Quantum gravity: general introduction and recent developments. *Annalen der Physik*, 15(1-2), 129-148.
  89. Temple C.Patton. "Pigment Handbook, Color Theory; Characterization and Physical Relationships", 3, 229-288.
  90. Z.W.Wick, F.N.Zones, S.Peter pappas, D.A.Wicks. (2007). *Organic Coatings: Science and Technology*" 3rd ed. Wiley Interscience, 383-416.
  91. Young, T. (1802). II. The Bakerian Lecture. On the theory of light and colours. *Philosophical transactions of the Royal Society of London*, (92), 12-48.
  92. Wright, William David. (1928). "A re-determination of trichromic coefficients of the spectral colors" *Transaction of the Optical Society*, 33(3), 73-134.
  93. CIE. (2017). Free Documents for Download. Archived from the original.
  94. Smith, thomas; Guild, John. (1931-32). "The CIE Colorimetric standards and their use" *Transactions of the Optical Society*, 33(3), 73-104:141-164.
  95. CIE. (1932). *Commission internationale de Eclairage Proceedings*. Cambridge: Cambridge University Press.
  96. H.Dinmelmeier, C.D.Olt, Hans-Thomas Jarpa A.Marek, E.Mueller. (2007). "Generic Gravitational Wave Signals from the Collapse of Rotating Stellar Cores", *Phys. Rev.*



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Lett. 98:251101.

97. Sloan, D., & Ferreira, P. G. (2017). Cosmology of an infinite dimensional universe. *Physical Review D*, 96(4), 043527.
98. Bhattacharya, C. (2020). Cosmology and unified quantum gravity theory of the universe. *Adv Theo Comp Phy*, 3(3).
99. Bhattacharya, C. 'Novel Quantum Gravity Approach to Evaluate the Dimensionalities and the Geometrical Profiles of the Chemical Reactions', 11(4).
100. Bhattacharya, C. (2020). Novel Quantum Gravity Interpretation of Chemical Equilibrium, Free Energy, Dark Energy and Dark Matter of the Universe. *Adv Theo Comp Phy*, 3(3).

101. Bhattacharya, C. (2020). Unified Quantum Gravity Theory Driven Concepts of the Classical Laws of Physics, the Dark Energy, the General Theory of Relativity and the "Zero-Energy Universe". *Adv Theo Comp Phy*, 3(4).
102. Bhattacharya, C. (2021). Novel Quantum Gravity Model of the Physics of Operability of Galvanic Cells and Electrical Power Generation. *Adv Theo Comp Phy*, 4(1).

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