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Physical Kinetics of Loop Quantum Gravity and Blackhole Dynamics: Kinetic Theory of Quantum Spacetime, Blackhole Phase Transition Theory and Blackhole Fission.

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ABSTRACT

In the following chapter, a sincere endeavor is made to build a physically as well as in most later aspects a mathematically simple but rigorous physical kinetics of spacetime and of blackholes. Starting with a 3-volume quantization result of the now standard Ashtekar-Lewandowski Quantum Riemannian Geometry, and based on the work of the author on time as a vortex, a 4-volume spacetime quantum, a rapidly fluctuating one is developed and the foundations seem to look shaky in the very beginning, but start to get stronger and stronger as one starts to enter the end of the section on the physical kinetics of blackholes. Thus, experimental tests and observational predictions have been made whenever seem required or appropriate for justification, examples from laboratory table-top physics provided. Once the framework of kinetic theory has been developed, the author has entered into the realm of blackhole phase transitions nucleating from backgroung spacetime as well as other blackhole phase transitions. The equations of phase transitions have been rigorously analyzed and physical interpretations and physical predictions provided. Also certain the Bardeen-Carter-Hawking standard zeroeth law of blackhole dynamics been deduced in the context of equilibrium phase transitions in blackholes. The possibility of splitting of the Kerr-Newman blackhole akin to nuclear fission is obtained. An interesting work is the conception and extensin of the stretched horizon which was constructed by Ashoke Sen in the context of unphysical extremal blackholes in string theory -to that of isolated horizons in the context of arbitrary blackholes as proposed by Rovelli . Quantum gravitational dispersion as well as diffraction of light and gravitational waves by discrete nature of quantum spacetime geometry has been predicted in phenomenology. The paper predicts the gravi-electric Meissner effect in the wake of the Galilean superconductivity in the form of locally Lorentzian spacetimes as a critical behavior in the context of a second order phase transition. The property of the blackholes to undergo fission is demonstrated in the equations of phase transitions. This is used to explain the astrophysical phenomenon of Quasars. An iso-Higgs multiplet is qualitatively predicted as basic constituents of the blackhole. A liquid droplet model is suggested to explain the newly predicted phenomenon of blackhole fission in this paper.The chapter as a whole builds the foundations of the subject of the title of the paper.

Indexing terms/Keywords

Physical kinetics; loop quantum gravity; blackholes phase transitions unblackholes; blackhole fission; canonical gravity Higgs boson.

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1. INTRODUCTION

In [1], a Maxwellian thermodynamic potential treatment of the standard blackhole thermodynamics was considered in considerable detail; the key assumption being that the blackhole dynamic quantities have continuous first order derivatives. In the following we show, based on the stability of Minkowskian topology against the backdrop of general relativity (GR) established by the theory of Christodoulou and Klainermann [2], the onset of a blackhole formation in the frame work of the most simple theory of thermodynamic phase transitions. The physical kinetic theory of spacetime and blackholes (Quantum General Relativity (QGR)) is exhaustively developed apriori. The most general Bardeen –Carter-Hawking [3](BCH) internal energy corresponding to the Kerr-Newman blackhole is considered and calculations made therein. The existence of the background spacetime as a conductor of gravitational flux tubes is established in the physical kinetic theory. This is true in view of GR. The locally Lorentzian spacetime is then argued to be a superconductor wherein gravitational flux tubes are expelled and a blackhole "nucleates" which is true in view of the strong principle of equivalence. The physical kinetic theory equations as well as the phase transitional equations are given physical interpretations and the structure of these equations are analyzed and their physical consequences predicted and further analyzed at appropriate places in the paper.

2. PHYSICAL KINETICS OF SPACETIME

It is the volume that contains space, but from ontological point of view, it is the space in which we consider volume since we, as external observers, exist in space. The concept of volume in gravitation and spacetime is thus different from the concept of volume in matter where the observer is extrinsic to the portion under investigation. Thus space is more fundamental than volume wherein volume is just a physical concept whereas space or spacetime is a real physical entity. So Avogadro's law needs to be recast into a new form to incorporate spacetime in the light of the Ashtekar-Lewandowski quantum Riemannian geometry, and that too carefully without any contradictions or paradoxes. We attempt to do so as follows:

Equal number of "molecules- n" of spacetime yield or span equal volumes under identical physical thermodynamic and gravitational conditions anywhere in the universe.

Thus,

$$V_{(4)} \propto n \qquad (1)$$

or

$$\frac{V_{(4)}}{n} = constant \qquad (2)$$

For loop quantum gravity, $V_{(4)} = \lambda_{Pl}^4$, $n \neq 1$ necessarily since more than volume can be squeezed together and quantum uncertainty fluctuations allows for creation of more 3-volume quanta. Now $V_{(3)} = V = \lambda_{Pl}^3$, $n = 1$ and $V = 10^{-99} cm^3$. We consider an atom of space as a 3-volume quantum

– a volume of the order of magnitude $\approx 10^{-99} cm^3$. We postulate the existence of a molecule of geometry as a 4-volume quantum i.e., a quantum 3-volume with a quantum vortex (see [4] and also see references therein) bound to it. The magnitude of the size of this quantum 4-volume is of the order of $\approx 10^{-132} cm^4$. If such a molecule exists then,

(1) It is dynamical and always fluctuating in "shape" since it is subject to quantum uncertainties.

(2) It is always evolving for evolving for evolving physical conditions.

Now, we have deduced [1], that

$C_{\Omega,\phi} - C_{J,Q}$ = some terms implying the existence of a universal constant for a gas of "molecules" of spacetime and not matter.

Here we consider a unique discontinuity of a epistemological thread which we will continue later when the proper material is sufficiently discussed.

The implication that $\frac{V_{(4)}}{n} \approx 10^{-132} cm^4$ implies that for unit volume of spacetime n is very large. Thus, spacetime is tightly packed and hence we perceive a continuum.

3. KINETIC THEORY OF BLACKHOLES

The final result in [1] which we restate here:

$$C_{\Omega,\phi} - C_{J,Q} = \kappa \left[\left(\frac{\partial J}{\partial \kappa}\right)_{\Omega,\phi} \left(\frac{\partial \Omega}{\partial \kappa}\right)_{J,Q} + \left(\frac{\partial Q}{\partial \kappa}\right)_{\Omega,\phi} \left(\frac{\partial \phi}{\partial \kappa}\right)_{J,Q} \right]. \qquad (3)$$

implies that a rotating blackhole is the best way to reveal a discrete molecular configuration of spacetime – a non -zero difference of the **TWO** specific heats established mathematically and physically in [1]. The existence of a specific heat itself signifies the existence of molecules. The theory of specific heat extended to non-blackhole astrophysical as well as quantum objects with the help of the "Unruh potentials" (an extension of the blackhole dynamic potentials in [1] to Unruh radiation). Thus, a quantum general relativistic object such as a blackhole or even a photon or a neutrino (difficult to detect and so may be ruled out) would suffice to probe this quantal structure of spacetime. All we would require would be a test for the probe to prove the existence of a discrete structure:

(1) A slab of glass or a body of water act as a medium of refractive index, $\mu > 1$ and bend light. So does curved spacetime i.e., gravity. A prism consists of a medium again of refractive index, $\mu > 1$ and due to the amorphous molecular discreteness, disperses light. Similarly, spacetime over large distance scales should in principle disperse light and around **quantum** gravitational objects such as blackholes should diffract t light around the static limit as is possible in the case of a Kerr or a Kerr-Newman blackhole. For other static solutions, the static limit coincides with the event horizon of the blackhole. The diffraction arises due to the difference the refractive indices of the ergosphere of the blackhole and the spacetime surrounding it, in other words due to the gravitational gradient. Now the diffraction pattern can be seen only on a screen so this will be difficult to detect directly using a telescope. However, gravitational waves should by the same argument diffract around the ergosphere of a blackhole. Even in the case of static solutions, if passing sufficiently distant so as not to get trapped by the intense gravity there, both light as well as gravitational waves can diffract. Now, the gravitational waves cause the objects in their path to move relative to each other so thereby flexing the shape of the original configuration. Thus a diffracting gravitational wave will distort the orbits of the rotating astrophysical objects around the blackhole. In the case of dispersion, light of different wavelengths should travel with different velocities. As just demonstrated, due to the tightly packed structure of spacetime, the velocity difference will be minute.

(2) When a quantum blackhole traverses through spacetime, it encounters this abovementioned discreteness and hence the process of travel is rather a resisted or viscous one. Thus some work is done by the blackhole and energy is lost thus making the blackhole shrink further and further until it loses all its energy. This is for a blackhole travelling in time.

Now, a point to note: when a blackhole traverses through spacetime, if classically a blackhole singularity exists, then what is the mechanism for the dynamics of the blackhole singularity, i.e., how does it move from one point to another?

Following conventions in [1], we define enthalpy for a generic gas of spacetime molecules,

$$H_{ST} = U_{ST} - \Omega J - \phi Q \tag{4}$$

and then ad hoc we propose a Clapeyron-Mendelev analog for our quantal spacetime gas:

$$\Omega J + \phi Q = \Gamma T_{UH} \tag{5}$$

where T_{UH} is the Unruh-Hawking temperature arising from the spacetime gas, i.e., from the average kinetic energy of the spacetime molecules. Their continuous perpetual jiggling (thermodynamic fluctuations) in addition to the quantum fluctuations lead to the Wheeler's *quantum spacetime foam* with a temperature and the equation indicates a possibility of formation of quantum blackholes and their immediate radiation; this is possible if the blackhole is some kind of a phase of quantum spacetime which will be justified mathematically in this paper (and was so done in [4] as well). Now, without any recourse to such non-verifiable events, we have to justify the left hand side of eq (5) since quantum spacetime in all frameworks is more or less except for the virtual particle-antiparticle pairs. If one notes the spin network or the relevant spin foam formulation, the appearance of J is justified and the temporal vorticity [4] associated with quantum space is justification enough for the appearance of Ω; the electric potential is due to the electric flux labeled to the spin network edges or links. As for charge, this equation could lead to the very fundamental definition of an electric charge – a property of quantum foam arising due to the physical interaction between vortex-time and electric potential at the bare fundamental level. Occam's razor suggests the creation of quantum blackholes as a more physically simple and viable event in the quantum foam. Thus, we have another prediction: within the Planck scale and within planck' time infinitely many blackholes are created which explode. Let us elucidate on this:

e.g.: a blackhole (infinitely many could be created but we consider a single trivial process just to make it clear) is created in the foam, its mass is $M = 4m_0$ and it emits a particle and an antiparticle and explodes with energy $E = 2m_0$ with ($c = 1$). In absence of quantum gravity, in the quantum field theory (QFT) formalism the perpetual creation and annihilation of the particle-antiparticle pairs is even today deemed ridiculous as it was then when QFT was first conceived. The explosion of this quantum blackhole be felt by atoms and nuclei and should show as a shift in their spectral lines. In the absence of a real finite-time span blackhole, the spacetime should still have a specific heat difference and is in essence the quantum gravitational version of the Mayer's specific heat equation. We derive it as follows.

Consider a sample quantal spacetime of internal energy, U_{ST} and let the enthalpy of the foam be H_{ST}. By eqs (4) and (5) the two are related for "empty" spacetime by

$$H_{ST} = U_{ST} - \Gamma T_{UH} \tag{6}$$

$$\frac{\partial H_{ST}}{\partial T_{UH}} - \frac{\partial U_{ST}}{\partial T_{UH}} = -\Gamma \tag{7}$$

The next step delivers Hawking's assertion of the negativity of specific heat provided quantum foam is constantly churning out quantum blackholes which also explode. So, define:

$$C_{\Omega,\phi} = \frac{\partial H_{ST}}{\partial T_{UH}} \tag{8-a}$$

$$C_{J,Q} = \frac{\partial U_{ST}}{\partial T_{UH}} \tag{8-b}$$

Insert these values in eq (7) and we get

$$C_{\Omega,\phi} - C_{J,Q} = -\Gamma\,. \tag{9}$$

The Unruh-Hawking temperature T_{UH} is given by

$$T_{UH} = \frac{a\hbar}{2\pi k_B c}\,. \tag{10}$$

This is the unique epistemological thread that we had left incomplete earlier. More is to add in the following.

4. NUCLEATION OF A BLACKHOLE: BASIC THEORY AND CALCULATIONS

We have a background spacetime [4] with a global Riemannian curvature. This we call the normal component of the two-fluid model (refer to the above discussion of kinetic theory of spacetime). We therefore proceed to derive, the phase transition that leads to a black hole nucleating in a background spacetime — a second order phase transition in spacetime where the spacetime itself is a result of a first order phase transition occurring at the (sub) Planckian scale.

In our $SU(2)$ causality gauge theory [5], we are concerned with the generators of rotations, and the dynamical observable here is the intrinsic spin angular momentum of the black hole, which makes its appearance here in the change in the internal energy of the black hole, as

$$dU = \frac{\kappa c^2}{8\pi G} dA + \Omega dJ + \phi dQ\,. \tag{11}$$

We therefore by thermodynamical arguments and the intrinsic angular momentum J being an extensive parameter choose it as the order parameter and build the gravitational Gibbs' function as

$$\mathcal{G} = U - \frac{\kappa c^2}{8\pi G} A - \Omega J - \phi Q, \tag{12}$$

so that,

$$d\mathcal{G} = -A d\kappa\, \frac{c^2}{8\pi G} - J d\Omega - Q d\phi. \tag{13}$$

$$\left(\frac{\partial \mathcal{G}}{\partial \kappa}\right)_{\Omega,\phi} = -\frac{c^2}{8\pi G} A, \tag{14-a}$$

$$\left(\frac{\partial \mathcal{G}}{\partial \Omega}\right)_{\kappa,Q} = -J, \tag{14-b}$$

$$\left(\frac{\partial \mathcal{G}}{\partial \phi}\right)_{\kappa,\Omega} = -Q. \tag{14-c}$$

$$\left(\frac{\partial \phi_c}{\partial \kappa}\right)_{\Omega} = \frac{\left(\frac{\partial \mathcal{G}_n}{\partial \kappa}\right)_{\Omega,\phi} - \left(\frac{\partial \mathcal{G}_s}{\partial \kappa}\right)_{\Omega,\phi}}{\left(\frac{\partial \mathcal{G}_n}{\partial \phi}\right)_{\Omega,\kappa} - \left(\frac{\partial \mathcal{G}_s}{\partial \phi}\right)_{\Omega,\kappa}} \tag{15}$$

where the subscripts "n" and "s" stand for the normal and the superconducting components of the two component fluid that we are considering. We therefore have,

$$\left(\frac{\partial \phi_c}{\partial \kappa}\right)_{\Omega} = -\frac{c^2}{8\pi G}\,\frac{A_n - A_s}{Q_n - Q_s}. \tag{16}$$

Similarly,

$$\left(\frac{\partial \phi_c}{\partial \Omega}\right)_{\kappa} = -\,\frac{J_n - J_s}{Q_n - Q_s}. \tag{17}$$

Or therefore,

$$\left(\frac{\partial\kappa}{\partial\Omega}\right)_{\phi_c} = \frac{8\pi G}{c^2}\frac{J_n - J_i}{A_n - A_i}. \quad (18)$$

5. PHYSICAL KINETICS OF THE BLACKHOLE PHASE TRANSITIONS

A phase transition is signified by latent heat or in other words, zero change in the Gibbs free energy. Consider now eq (13); here the Gibbs free energy is constant and hence the change in this energy is supposed to be zero at the time of the phase transition. This renders $\kappa, \Omega\ and\ \phi$ to be simultaneously constant at transition temperature which happens to be the surface gravity of the blackhole. As the surface gravity, κ, happens to be constant, we happen to arrive systematically at the zeroeth law of blackhole dynamics for our equilibrium phase transition. At transition the angular velocity and electric potential also somehow remain constant. The ergosphere is a kind of a domain wall that transits to a pinched off one during the Penrose process or the Blandford-Znacjek extraction of the rotational or electromagnetic energy of the blackhole respectively. The new phase here could be any of the two static configurations viz., Reissner-Nørdstrom or Schwarzschild blackhole. Apart from this, in the Kerr or Kerr-Newman case as well as the Reissner-Nørdstrom or Schwarzschild case, there is a domain wall at the horizon yielding thereby a stretched horizon concept developed by Ashoke Sen in his derivation of an expression for blackhole entropy from pure string theory considerations [7]. It is worthwhile to note that just as in the case of the extremal blackholes analyzed by Susskind et al. and by Sen in [7], the entropy of the blackhole is not exactly $\frac{1}{4}\boldsymbol{A}$.

Our pure physical kinetic consideration of spacetime and blackholes has brought us to a loop quantum gravitational extension, to arbitrary blackholes, of a pure string theoretic object which is otherwise applicable only to extremal blackholes which are physically unrealistic. At this stretched isolated horizon, the blackhole state and the quantum spacetime state are in equilibrium. In other words, as many blackhole "constituents" (say strings) escape to spacetime phase as spacetime quanta enter to form the blackhole phase. Our earlier contention that a blackhole is a phase of quantal spacetime is thus physically (i.e., by physics epistemological argumentative basis) justified. Let us proceed to derive the entropy area relationship for a blackhole.

5.1 The entropy area relationship at the stretched isolated horizon

Consider a d=2 surface, S, immersed in a spacelike hyper surface, Σ_t. The Bekenstein – Hawking entropy is given by the relationship,

$$S_{BH} = k_B \ln N(A) \quad \text{(A)}$$

where, $N(A)$ is the number of states that the geometry of a surface with area A can assume. We are familiar with the stansard s – knot derivation of the loop quantum gravity . For now, suffice it to say that the d=2 surface, as a stretched isolated horizon allows for an ε – operator to be called the smear operator. It is given by

$$\hat{\varepsilon}_j := \frac{4\pi\gamma}{2\ln 2}\sum_k \sqrt{j_k(j_k+1)} \quad \text{(B)}$$

Now, the original number of states become for d=2 and for the lowest state $j_k = \frac{1}{2}$, $N(A) = 2^{\varepsilon_0 \frac{A}{A_0}}$ where the area state given by the operator:

$$\hat{A}_j := 8\pi G\hbar\gamma \sum_k \sqrt{j_k(j_k+1)} \quad \text{(C)}$$

becomes $A_0 = A_{\frac{1}{2}} = 4\pi G\hbar\gamma\sqrt{3}$. The eq (B) becomes $\varepsilon_0 = \frac{\gamma\pi\sqrt{3}}{\ln 2}$. This may at first glance look like a cheap trick, but, we get upon inducting the values in the expression for $N(A)$ and setting $G = \hbar = k_B = 1$.

$$S = \frac{1}{4}A. \quad \text{(D)}$$

Thus, the ringing modes of oscillation of a blackhole are censored within the stretched isolated horizon. The ε – operator may take a different value for different dimensions, e.g., for d=3 the $ln2$ in the denominator of eq (B) will become $ln3$. In fact, the constants there will change. In general, we can allow a fractal or Hausdorff dimension, d, and rewrite

$$\hat{\varepsilon}_j := \frac{k\gamma}{\ln d}\sum_k \sqrt{j_k(j_k+1)}\ . \quad \text{(E)}$$

Similarly, we will allow the number states $N(A)$ to take the base d as a Hausdorff dimension instead of whole number dimensions. Thus, $N(A) = d^{\varepsilon_0 \frac{A}{A_0}}$. The arising of a fractal dimension in the physics of the blackhole horizon signifies the existence of what one might call in non-linear dynamics and chaos theory terminology, a fractal blackhole or even better – an unblackhole. A blackhole is a fractional part of this unblackhole.

6. AN ALTERNATE SET OF EQUATIONS AND CONDITIONS FOR BLACKHOLE NUCLEATION FROM BCH LAW OF THERMODYNAMICS

From eqs. (13) to (15) again we have:

$$\left(\frac{\partial \Omega_c}{\partial \kappa}\right)_\phi = \frac{\left(\frac{\partial \zeta_n}{\partial \kappa}\right)_{\Omega,\phi} - \left(\frac{\partial \zeta_s}{\partial \kappa}\right)_{\Omega,\phi}}{\left(\frac{\partial \zeta_n}{\partial \Omega}\right)_{\kappa,\phi} - \left(\frac{\partial \zeta_s}{\partial \phi}\right)_{\kappa,\phi}} \quad (19)$$

where the subscripts "n" and "s" stand for the normal and the superconducting components of the two component fluid that we are considering. We therefore have,

$$\left(\frac{\partial \Omega_c}{\partial \kappa}\right)_\phi = \frac{c^2}{8\pi G}\,\frac{A_n - A_s}{J_n - J_s}. \quad (20)$$

Similarly,

$$\left(\frac{\partial \Omega_c}{\partial \phi}\right)_\kappa = \frac{Q_n - Q_s}{J_n - J_s}. \quad (21)$$

Or therefore,

$$\left(\frac{\partial \kappa}{\partial \phi}\right)_{\Omega_c} = \frac{8\pi G}{c^2}\,\frac{Q_n - Q_s}{A_n - A_s}. \quad (22)$$

7. ANALYSIS OF THE EQUATIONS OF PHASE TRANSITION

In eq (22) charge Q is the order parameter. Thus we can see that both, the angular momentum J as well as the charge Q are equally fit for a given energymomentum configuration to yield a system nucleating from critical behavior obeying eq (1), i.e., the four laws of blackhole dynamics. If one considers the work of Unruh et. al. [6] and argues along his lines, one gets nucleation of energy momentum bags and the generalized equations

$$\left(\frac{\partial a}{\partial \Omega}\right)_{\phi_c} = \frac{8\pi G}{c^2}\,\frac{J_n - J_s}{A_n - A_s}, \quad (23)$$

and

$$\left(\frac{\partial a}{\partial \phi}\right)_{\Omega_c} = \frac{8\pi G}{c^2}\,\frac{Q_n - Q_s}{A_n - A_s}. \quad (24)$$

Now, it is apparently clear from the eqs (18) and (22) (or alternately from eqs (13) and (14)) that for critical angular velocity Ω_c, the angular momentum J as well as the charge Q are connected and the same goes for the critical electric potential ϕ_c.

The proper interpretation to these equations is as follows. Gravity is encoded into the very fabric of spacetime. The angular velocity going critical and hence yielding a Kerr type blackhole is natural for an observer stationary. The frame of reference in which the energy momentum configuration is stationary is actually a non-inertial frame. This is equivalent to gravity. Hence, it is possible for a trapped surface to form. The expulsion of all pervading gravitational flux tubes from the body of the spacetime into the energymomentum bags thus corresponds to the nucleation of a blackhole by the BCH law given by eq (11). On the other hand, a rather small region of spacetime that is endowed with Minkowskian topology embeds in the large scale curved structure. This may be viewed as critical imbedding of Minkowskian spacetime as it results from the critical behavior of intensive blackhole thermodynamic parameters viz., the angular velocity Ω_c and the electric potential ϕ_c. Thus, when an energymomentum configuration is rotated i.e., a rotation is applied in this Minkowskian topology, equivalently gravity takes over due to the non-inertial nature of the rotating frames and the flatness characteristic of the Minkowskian topology tends to disappear and does so completely for a critical value of angular velocity, Ω_c. The same goes for the electric potential.

Eqs (18) and (22) are identical with the Clausius-Clapeyron equation. For a locally Lorentzian space-time geometry , these equations further show the spacetime geometry to transit to a nonabelian superconducting state so that all the "electric" flux tubes (arising from the electric potential)_ to get pushed into the "bags" of large energy momentum such as black holes resulting into locally Lorentzian flatness. The eqs (23) and (24) are the essence of both, the weak and the strong principle of equivalence. The principle of equivalence is thus a gravi-electric Meissner effect. This superconducting phase is characterized by the existence of locally Lorentzian space-time domains wherein there exist gravitational/

Galilean supercurrents characterized by rectilinear geodesics or inertial frames. It is worthwhile to note that the electric potential can also yield non-inertial frames for only the consideration of this without the angular velocity will yield the famous Reissner-Nørdstrom blackhole. So, incidentally we have proved that apart from angular velocity, an electric potential for certain critical strength can dismantle the geodesic flatness. But for neutral mass distributions, both, $\Omega\ and\ \phi$ are required. Since, $J\ and\ Q$ are connected in the general case, Ω plays a crucial role. The Minkowskian topological stability demonstrated by Christodoulou and Klainermann is subject to the order parameters $J\ and\ Q$ and via these the effects of $\Omega\ and\ \phi$. These conditions lead to the formation of blackhole spacetimes.

8. ANALYSIS OF THE EXTREMAL LIMIT OF THE PHASE TRANSITION EQUATIONS

If the angular velocity Ω extends beyond the critical angular velocity Ω_c and tends to a very large value i.e., $\Omega \gg \Omega_c$ or for collapse conditions of the eq(18) tends to infinitely large value i.e., $\Omega \to \infty$ the blackhole will deform and ultimately undo into two parts. This is exactly akin to the Bohr-Wheeler liquid droplet model of the nucleus. Thermodynamically for this to happen, the angular momentum and the electric charge should tend to extremely small values separately, i.e., $J \to 0\ and\ Q \to 0$ or the two should stay constant while the above condition for angular velocity holds. The last condition for the charge corresponds either in combination with the angular momentum as in the case of Kerr- Newman solutions or singularly as in the case of the Reissner-Nørdstrom solutions of the Einstein Field Equations. When the charge Q of the blackhole becomes too high for a nucleated Kerr-Newman blackhole, any kind of perturbation caused including that due to high angular velocity can deform the blackhole enough to cause it to fly apart into two or more parts due to electrostatic repulsion. This is a fine example of blackhole fission. The phase transition equations collapse for this phenomenon. We provide an explanation for the phenomenon of Quasars: When a blackhole splits by the above mechanism, the binding gravitational energy and electromagnetic energy is ejected as jets in two opposite directions in accordance with the linear and angular momentum conservation principles as well as the conservation of charge if there is any on the parent blackhole. This is a more plausible explanation than the conventional one. At least the phenomenon does occur.

9. CONCLUSIONS

We started off to develop a kinetic theory of spacetime and blackholes using results partly from Loop Quantum Gravity (LQG) and the author's own work on quantum gravitational phase transitions developed within the framework of LQG wherein time was proved mathematically to be a vorticity associated with canonical quantum gravity in particular and quantum dynamics in general. This property of time was associated with the quanta of 3-volume and the theory of physical kinetics was developed. While working with the equations developed in the paper and physically interpreting them, strikingly similar results to those of the BCH Blackhole Dynamics as well as the now standard concept of stretched Horizon of the blackhole given by Ashoke Sen in the context of string theory were deduced in the context of loop quantum gravity to the physically real blackholes and the standard Bekenstein–Hawking entropy area relationship is redelivered with an additional extension of the stretched horizon in the context of the physically unrealistic extremal blackholes to the stretched isolated horizon f stationary as well as arbitrary blackholes. The extremities of the phase transition equations were analyzed, predictions were made in all these contexts . One thing is certain : this is no mix and match or a mere coincidence. LQG and string theory seem to complement each other – the former in t he context of non-perturbative quantum gravity and the latter in the perturbative format context. For LQG, it is difficult if not impossible to derive a rigorous perturbative theory and for string theory, it is the other way around. (Of course, though the 2D Conformal Field Theory (2D-CFT) on which the world sheet dynamics of the quantum string is based is mathematically as rigorous as the formalism of LQG, the string perturbation series which is developed on the world sheet is not at all rigorous.) The most sensational prediction of the present paper is that of the fission of the blackhole under extremal conditions in the analysis of the phase transition equations. Comparison has been drawn therein with the Bohr-Wheeler Liquid Droplet Model of the nucleus. And why shouldn't this be so? After all the strong nuclear force is a vestige of the strong quantum Chromodynamic force and the gauge groups of the quantum chromodynamic and the quantum gravitational interaction forces are both non-abelian plus the structure of QCD and LQG are similar. In fact, it should be possible to split a blackhole by sending some constituent of it, a physically real constituent and that too the right one; just as the neutrons and not the protons cause the nuclear fission. The theory of Higgs bosons is not really complete but has actually just begun. A curious observation is that while all the properties are lost in the simplest example of say, a Schwarzschild blackhole, the mass is still there, conserved. While we all know that the Higgs boson gives mass to the ordinary matter particles, there is no ordinary matter inside the blackhole. Thus, there is definitely a Higgs' cousin – an iso-Higgs multiplet, some even charged and spinning to account for the other types of blackholes viz., the Reissner-Nordstrom, the Kerr and the Kerr-Newman blackholes. The blackhole is constituted by these or a combination of these. When a blackhole admits a certain mass slightly more than its irreducible mass, it wobbles a bit. For extremely heavy blackholes, the absorption of energy-momentum leads to an increase in mass much more than the limited irreducible mass and the wobble is too much. Just as in the case of the Bohr-Wheeler liquid drop model, the blackhole is deformed beyond "repair" by its gravity. The iso-Higgs inside the blackhole thus makes the blackhole unstable. The blackhole then splits like a tweaked liquid droplet. This another process of the Blackhole Fission. Here, the main theme is the proposal of an Iso-Higgs Multiplet.

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Author' biography with Photo

Koustubh Kabe is M.Sc. by Research in Theoretical Physics from Mumbai University. He has published A couple of papers in the fields of Blackhole Dynamics and Loop Quantum Gravity. In particular, he deals with the problem of time in classical and quantum gravity as well as in quantum mechanics. His key paper in addressing this issue is to appear shortly. He has published a book, titled "Blackhole Dynamic Potentials and Condensed Geometry: New Perspectives on Blackhole Dynamics and Modern Canonical Quantum General Relativity", with Lambert Akademik Verlag (LAP). He is currently interested apart from the abovementioned topics, in Geometric Analysis, Theoretical Astrophysics and Physical Cosmology as well as Physical Mathematics and Number Theory. Recently, he has taken interest in unifying String Theory with Loop Quantum Gravity by investigating Perturbative extensions of the latter, since string theory is perturbative in its very basic formulation and making a background independent non-perturbative formulation of string theory is indeed very difficult and gives rise to physical inconsistencies. He is also pursuing research in Algebraic Geometry.