EXTENDED EINSTEIN FIELD EQUATIONS FOR COMPLEX SPACETIME

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Abstract. Goal of physics is to arrive at new theory still rooted in old theory. From Newtonian physics to Einstein and most probably to quantum gravity and then to unified field theory that is most accepted view on how physics theories should progress. But what if this assumption is not true? What if from Newton to Einstein and then to Extended Einstein? What if final step does not take into account quantum physics? This seems absurd at first but I will explore this possibility. First question that arises is that basics or fundamental physics should stay at basic level same, basic physics is classical physics and then from it Relativity emerges as result of Maxwell equations. Then a new physic is born, quantum physics that changes the view of classical physics into probability theory with no way to say what will happen exactly. This approach was most successful theory of twenty century and to this day proves itself with amazing accuracy. On the other side of physics there is another successful theory that is general relativity, that proves itself with any experiment. But both theories are incomplete, quantum physics lacks gravity, relativity breaks down at singularities that emerge from it in crucial of universe evolution moment that is the moment of big bang itself. Most physics community effort goes into trying to quantize gravity one way or another, or in general unify quantum physics with gravity and extensions of standard model. But there should be equal amount of tries to do the opposite, try to make quantum physics consistent with gravity first. By that I mean that quantum should be relativized same way theory of relativity needs to be quantized. My approach will be even another one, I will assume that only step forward is to extend relativity into more general theory without need to quantize it at all. And that its generalization will be good enough to explain quantum effects. This may seem absurd at first but as I will show it gives pretty good results and in general is a good but very complicated model of spacetime curvature. Field a physical field should be threat as field a continuous one with no gaps with empty parts of that field. Same should apply to matter field, matter should be treat as one field that is continuous in all space and that is goal of this work.

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Contents

1. Basic definitions

1.1. **Description of the inertial system.** According to Newton's laws of motion, motion with constant velocity or lack of it gives an inertial frame of reference. This definition can be simplified even more that it is a system in which there are no forces associated with the motion of this system. Such a system does not feel the forces associated with its movement. The key question is whether an observer under the influence of a gravitational field can be treated as an inertial observer? According to the equivalence principle, the gravitational field cannot be locally distinguished from the acceleration, on the other hand, omitting the tidal forces, one can look at the inertial system as the system of any falling observer in the gravitational field. This observer locally has no weight, no force acts on him. There are two possibilities, either the observer is in uniform motion or the observer is at rest. The first possibility can be ruled out for obvious reasons only the second possibility remains, the observer in the gravitational field is motionless. This means that every observer in the gravitational field that is not subjected to any kind of apparent force related to e.g. standing on the surface of the gravitational field source or any other force is treated as an inertial system. And according to this observer's perspective, this gravitational field needs to be described. This means that any non-inertial observer cannot see the true cause of motion because there are forces in his system, so they exclude him from being an inertial system. The description of the laws of physics and thus motion must always be seen from the perspective of an inertial observer as only he perceives the true cause of motion, which also applies to the gravitational field. An inertial frame of reference is defined as one which, under the influence of a physical field, remains completely motionless from its own perspective, where this motionlessness is only locally defined. This locality makes us ignore the tidal forces that will naturally accompany the gravitational field, and thus the physical field that is the source of motion. However, the definition of the physical field itself, i.e. the gravitational field, the field that causes motion, is more delicate. It results from the definition of the inertial system itself, physical fields are a field from the perspective of which no inertial observer can be described as an inertial observer, so he must be in motion relative to this field. This means that the field itself cannot give us the whole picture of how motion physically occurs. Only the perspective of a field that is the source of motion and an inertial observer that is able to detect true non-relative motion as a combination gives us a description of physical reality. Any motion that is relative depends on the system in which it is measured, the physical field or simply the gravitational field cannot be dependent on the system in which it is measured, it must be a source of motion for every inertial observer.

1.2. **Observer Definition.** Observer definition. The observer is understood as a frame of reference capable of measuring time (clock) and distance (ruler). The units of measurement must always be chosen to express distance in time or space. This means that if I measure distance in meters and seconds I have to express both units in meters or seconds, which is achieved by multiplying time by the speed of light (meters) or dividing distance by the speed of light (seconds). This is a fairly basic assumption in the Theory of Relativity. What is crucial for extending the field equations is the exact physical definition of the phenomenon for a given observer. A physical phenomenon is simply such a phenomenon that meets the previous assumption, the observer is completely at rest relative to the event, which means that it is defined as an inertial frame of reference. The previous definition, of course, only makes sense in the case of flat space-time, so it is not a general case. To go to the general case, it is necessary to define an observer in a gravitational field as still an observer motionless relative to an event in which a gravitational field is present. Before discussing free fall from the perspective of an inertial observer, one key point needs to be addressed. Space-time in the mathematical description must adhere to the principle ac- cording to which the observer remains inertial to the event, this means that locally, as in the Theory of Relativity, the observer locally measures flat space- time, which is not true globally. The whole point of this paper is to show that there are other field equations that reproduce this principle but with an additional condition. This condition is that the gravitational field is fully de- pendent on the existence of a field of matter and/or energy at every point in space-time. In the absence of matter at any point in space-time, these equations become equations for flat space-time, which means that literally the source of deviations from flat space-time must be the presence of matter at the point where this space-time deviates from it, otherwise we get flat Minkowski space. There is an additional principle that is central to this whole model and its assumptions, the equivalence of gravity and the field of matter. Which I will discuss in more detail later in the section on the non-zero momentum energy tensor requirement.

1.3. **Light Clock.** In the Theory of Relativity, time is measured using a theoretical light clock that measures the time between successive reflections of a light ray. Such a hypothetical clock has quite important implications for how distance and the passage of time are defined. Since the speed of light is constant in a vacuum for any observer, it is a contentious but important question as to what the speed of light really remains constant. Let's consider three possible scenarios:

1. Relative to some field - a medium once called ether.
2. Relative to an inertial observer.
3. It's just a constant relative to nothing.

Thanks to the light clock, you can answer the question. If there is a field with respect to which light always has a constant speed - that field is an event, the inertial observer perceives that for each event the speed of light is constant, so this does not contradict the second point of this assumption. This also explains why the speed of light is the speed of causality in a simple way, events propagate at the speed of light and any observer who is not moving at the speed of light and therefore not an event stays still relative to the event which makes the speed of light remain constant and the information moves exactly at the speed of light (only in the sense of a physical event). Now a thought experiment using a light clock that can rule out the third option is as follows, I have two observers A and B both of whom use a light clock to measure time, but you don't know which is moving and which is not. These observers at some point in time t meet and compare their clocks, always the clock of the moving observer will have fewer ticks. It is impossible to define whether the observer A was in motion or the observer B was in motion, because without the top-down assumption that this particular observer is in motion and the other one, it is not possible to perform an experiment using light signals that will distinguish which one is truly in motion. However, what makes it possible to distinguish which is in motion is the indication of the first clock relative to the second, if the observer A was in motion, his light clock has a smaller clock indication. This means that both the clock and the observer A were physically in motion relative to an event that lasted a certain amount of time. The difference is that the light in the clock seems to tick normally for observer A and slower for observer B, but observer B will say the same about observer A. This means that since A's clock is in true motion, observer B is right and observer A's perspective is wrong. A's clock is ticking slower objectively because fewer events occur physically for this observer - and since the speed of light is constant relative to events as their number decreases relative to observer B for whom more events occur, it will find that fewer events occur for observer A which is a physical fact. So this paradox clearly shows that the speed of light is constant only and exclusively with respect to the event.

2. Expanding Einstein

2.1. **EFE- Einstein field equations.** Einstein field equations are basics theory of gravitation. They relate spacetime curvature with matter-energy content of universe. But problem with field equations is that they break at edge of a black hole, where all geodesic end. This geodesic incompleteness is a crucial problem that breaks down whole model in ultimate sense. Model works perfect till there is a singularity of a black hole or begin of universe. Another problem with that theory that is not a real problem but seems there could be something wrong is dark matter, as long as dark energy can be thought just as cosmological constant, problem with dark matter is that i could be new type of particle or something is missing in gravity theory.

EFE can be written as ten equations where key is Einstein tensor [1][2][3][4] that is derived from Banachi identity. This makes conservation of energy possible and energy momentum tensor zero covariant derivative, equation can be written:

$$G_{ab} = \kappa T_{ab} \tag{2.1}$$

$$R_{ab} - \frac{1}{2} R g_{ab} = \kappa T_{ab} \tag{2.2}$$

Where both parts of equation give zero covariant derivative that can be written, whee I will use covariant derivative with index up so it's multiply by metric tensor:

$$g^{bk} \nabla_k = \nabla^b \tag{2.3}$$

$$\nabla^b G_{ab} = \nabla^b \kappa T_{ab} = 0 \tag{2.4}$$

$$\nabla^b \left(R_{ab} - \frac{1}{2} R g_{ab} \right) = \kappa \nabla^b T_{ab} = 0 \tag{2.5}$$

Vacuum solutions are arrived at when energy momentum tensor [5] is equal to zero so when there is no matter present that is equal for vanishing of Einstein tensor to be equal to zero $G_{ab} = 0$. But it does not mean that spacetime is flat when Einstein tensor vanishes. So it means that matter field is not a continuous field and this will be key hint for extending that equation.

Where i did use normal letters for spacetime indexes, not Greek ones as it is written most of the time. But still convention I will be using here is that Latin letters have indexes ranging from zero to three. So they both represent space and time coordinates.

2.2. **EEFE- Extended Einstein field equations.** Now why does matter field should not vanish in any point? It seems absurd but its only way to arrive at extension of Einstein field equations. And it has one big advantage it can explain in principle dark matter. Matter will extend as a field in whole space, that could explain why there is missing matter in the universe, it's stored in field itself.

But where to start? That is key question, let first write EFE but expand all elements to curvature tensor:

$$R^c_{bcd} - \frac{1}{2} R^c_{ncm} g^{nm} g_{bd} = \kappa T_{bd} \tag{2.6}$$

Where I did use bd index as base one. Now we can see a reaping pattern here, there is curvature tensor then it's contractions. Only thing that does not follow this rule is energy momentum tensor that does not have any contractions. What if this symmetry of contraction is preserve so let me rewrite this equation:

$$R^c_{bcd} - \frac{1}{2} R^c_{ncm} g^{nm} g_{bd} = \kappa T^c_{bcd} \tag{2.7}$$

Now there is a clear pattern, in truth we are acting on four rank tensors in whole equation. On one side of equation there is curvature tensor and it's contractions that are a bit complex on left side there is some unknown tensor that reduces to energy momentum tensor by contraction. So EFE are not a final word as it can be seen we can calculate curvature tensor directly by using one metric tensor that will contraction cancel one contraction, and this will lead to:

$$g^{kc} R^c_{bcd} - \frac{1}{2} g^{kc} R^c_{ncm} g^{nm} g_{bd} = \kappa g^{kc} T^c_{bcd} \tag{2.8}$$

$$R^c_{bkd} - \frac{1}{2} R^c_{nkm} g^{nm} g_{bd} = \kappa T^c_{bkd} \tag{2.9}$$

$$R^c_{bkd} - \frac{1}{2} R^c_{k} g_{bd} = \kappa T^c_{bkd} \tag{2.10}$$

$$g_{pc} R^c_{bkd} - \frac{1}{2} g_{pc} R^c_{k} g_{bd} = g_{pc} \kappa T^c_{bkd} \tag{2.11}$$

$$R_{pbkd} - \frac{1}{2} R_{pk} g_{bd} = \kappa T_{pbkd} \tag{2.12}$$

EEFE can be written in two forms as seen here mixed and fully covariant, I will use fully covariant one for all calculations presented here but they are both equal from fact it's a tensor equation.

3. Properties of EEFE

3.1. **Conservation.** I can easy prove that indeed this new tensor has covariant derivative equal to zero on both side of equation [6], it's pretty simple task from fact how this tensor is derived. I will write EFE and i know that it's covariant derivative is zero so I can just multiply both side of equation by same metric tensor that will give me, where I use fact that covariant derivative of metric tensor is equal to zero so I threat it as a constant:

$$\nabla^d \left(R^c_{bcd} - \frac{1}{2} R^c_{ncm} g^{nm} g_{bd} \right) = \kappa \nabla^d T^c_{bcd} = 0 \tag{3.1}$$

$$\nabla^d g^{kc} \left(R^c_{bcd} - \frac{1}{2} R^c_{ncm} g^{nm} g_{bd} \right) = \kappa \nabla^d g^{kc} T^c_{bcd} = 0 \tag{3.2}$$

$$\nabla^d \left(R^c_{bkd} - \frac{1}{2} R^c_{nkm} g^{nm} g_{bd} \right) = \kappa \nabla^d T^c_{bkd} = 0 \tag{3.3}$$

Now contraction of those equation will naturally lead to EFE that is obvious fact from previous equations, but will write it:

$$g^{kp} R_{pbkd} - \frac{1}{2} g^{kp} R_{pk} g_{bd} = \kappa g^{kp} T_{pbkd} \tag{3.4}$$

$$R_{bd} - \frac{1}{2} R g_{bd} = \kappa T_{bd} \tag{3.5}$$

3.2. **Non vanishing energy momentum tensor and dimensions.** This new extended Einstein tensor has one key property, when matter field vanishes it gives a flat spacetime. I can prove it by writing that tensor and setting it zero:

$$R_{pbkd} - \frac{1}{2} R_{pk} g_{bd} = 0 \tag{3.6}$$

Now set indexes so Riemann tensor vanishes:

$$R_{pkkk} - \frac{1}{2} R_{pk} g_{kk} = 0 \tag{3.7}$$

$$-\frac{1}{2} R_{pk} g_{kk} = 0 \tag{3.8}$$

$$R_{pk} = 0 \tag{3.9}$$

Now plug it into equation gives that Riemann tensor is always zero:

$$R_{pbkd} = 0 \tag{3.10}$$

It means that energy momentum extended tensor has to not vanish at every point of space to not give flat spacetime. Finally last property is that there is only equal amount of unknowns in four dimensional spacetime. This can be easy seen from fact that Ricci tensor with metric tensor has total twenty components that are independent. And Riemann tensor gives twenty independent components in four dimensional spacetime. And to prove it's only case I can take number of independent Riemann components and set it equal to two times second order symmetric tensor components that gives:

$$\frac{n^2 \left(n^2 - 1\right)}{12} = n \left(n + 1\right) \tag{3.11}$$

$$\frac{n^4 - n^2}{12} = n^2 + n \tag{3.12}$$

$$\frac{n^3 - n}{12} = 1 + n \tag{3.13}$$

$$\frac{n^3 - n}{12} - n - 1 = 0 \tag{3.14}$$

Solution to this equation [7] is $4, -1, -3$ so from fact that number of dimensions is always a positive number there is only four left.

3.3. **Quantum like effects.** Real question is can this model explain quantum effects? First I do write two possible way of writing spacetime interval that means distance in complex spacetime, then I will combine then into one single real interval:

$$ds^2 = g_{ab} dz^a dz^b \tag{3.15}$$

$$d\overline{s}^2 = \overline{g}_{ab} d\overline{z}^a d\overline{z}^b \tag{3.16}$$

$$d\overline{s}^2 ds^2 = g_{ab}\overline{g}_{ab} dz^a dz^b d\overline{z}^a d\overline{z}^b = ds^4 \tag{3.17}$$

Now what is left is to define metric tensor and in general a complex field:

$$g_{ab} = \frac{\partial \chi^i}{\partial z^a}\frac{\partial \chi^j}{\partial z^b}\eta_{ij} \tag{3.18}$$

$$\overline{g}_{ab} = \frac{\partial \overline{\chi}^i}{\partial \overline{z}^a}\frac{\partial \overline{\chi}^j}{\partial \overline{z}^b}\eta_{ij} \tag{3.19}$$

$$\chi^k = a^k(\mathbf{x})\, e_k + i b^k(\mathbf{x})\, e_k \tag{3.20}$$

$$\overline{\chi}^k = a^k(\mathbf{x})\, e_k - i b^k(\mathbf{x})\, e_k \tag{3.21}$$

$$\chi^k \left(\chi^k\right)^\dagger = \chi^k \overline{\chi}_k = a^k(\mathbf{x})\, a_k(\mathbf{x}) + b^k(\mathbf{x})\, b_k(\mathbf{x}) \tag{3.22}$$

Now when i have all fields defined I can move to most used field that is scalar field. Let me state that there is a scalar field that integral is equal to some real number N that will be normalization constant of that field. I will write that scalar field just as ψ, all information about it can be written:

$$\int_{\mathbf{M}^4} \sqrt{\det\left(g_{ab}\overline{g}_{ab}\right)}\psi d^4\mathbf{x} = N \tag{3.23}$$

$$\frac{1}{N}\int_{\mathbf{M}^4} \sqrt{\det\left(g_{ab}\overline{g}_{ab}\right)}\psi d^4\mathbf{x} = 1 \tag{3.24}$$

$$\frac{1}{N}\int_{x^a(\mathbf{x})\in\mathbf{M}^4} \sqrt{\det\left(g_{ab}\overline{g}_{ab}\right)}\psi d^4\mathbf{x} = \varphi\left(x^a(\mathbf{x})\right) \tag{3.25}$$

To construct field equation I need only set Riemann tensor to a complex tensor instead of real one that is just done by changing metric tensors. I will define probability function with field equation:

$$R^\dagger_{abcd} = \overline{R}^{abcd} \tag{3.26}$$

$$R^\dagger_{abcd} R_{abcd} = \psi \tag{3.27}$$

$$R^\dagger_{abcd} R_{abcd} = R^\dagger_{abcd}\left(\kappa T_{abcd} + \frac{1}{2} R_{ac} g_{bd}\right) \tag{3.28}$$

$$\psi = R^\dagger_{abcd}\left(\kappa T_{abcd} + \frac{1}{2} R_{ac} g_{bd}\right) \tag{3.29}$$

$$\frac{1}{N}\int_{x^a(\mathbf{x})\in\mathbf{M}^4} \sqrt{\det\left(g_{ab}\overline{g}_{ab}\right)} R^\dagger_{abcd}\left(\kappa T_{abcd} + \frac{1}{2} R_{ac} g_{bd}\right) d^4\mathbf{x} = \varphi\left(x^a(\mathbf{x})\right) \tag{3.30}$$

4. Predictions

4.1. **Dark Matter.** Dark matter is in this EEFE not a new type of particle but field of matter itself that extends in space. I will do simplest possible approximation of value of this field by using simple integral. First i start off by writing density with function of mass $M(R)$. Then will assume that in units of radius that gives surface of matter r_0 i will get rest mass contained in that radius. And finally write density dived by rest mass that will be close to one over radius to third. From it its straight forward to calculate integral that gives total mass change from surface to infinity [8]:

$$\rho = \frac{M(R)}{\frac{4}{3}\pi R^3} \tag{4.1}$$

$$\int_0^{r_0} \frac{M(R)}{\frac{4}{3}\pi} dr = M_0 \tag{4.2}$$

$$\frac{\rho}{\int_0^{r_0} M(R)\, dr} \approx \frac{1}{R^3} \tag{4.3}$$

$$\int_1^{\infty} \int_0^{\pi} \int_0^{2\pi} \frac{1}{R^3} dr d\theta d\varphi = \pi^2 \tag{4.4}$$

This is simplest calculation for dark matter that is just extend matter field. I assumed spherical coordinate system. In more general case, mass density function decreases proportional to radius cubed. From it I can calculate how much there is dark matter compared to normal matter:

$$\frac{\pi^2 - 1}{\pi^2} \approx 90\% \tag{4.5}$$

This whole dark matter calculation is a approximation but a good enough one.

4.2. **Universe expansion.** Good test of this theory is predicting the cosmological constant. From previous subsection approximation of amount of dark matter is equal to π^2 now I will use perfect fluid model but with pressure calculation that will be equal to one third escape velocity of universe squared dived by speed of light squared. I can write energy momentum tensor for perfect fluid as:

$$T_{00} = \rho_0 \pi^2 \tag{4.6}$$

$$T_{aa} = \frac{1}{3}\frac{2GM_0}{c^2 r}\rho_0 \pi^2 \tag{4.7}$$

Now lets go back to field equation, I will assume only diagonal elements of both metric tensor and Ricci tensor and energy momentum extended tensor, so field equation in this case turns into:

$$R_{pbpb} - \frac{1}{2}R_{pp}g_{bb} = \kappa T_{pbpb} \tag{4.8}$$

Now I want to calculate zero-zero component of Ricci tensor that will be equal to:

$$R_{0b0b} - \frac{1}{2}R_{00}g_{bb} = \kappa T_{pbpb} \tag{4.9}$$

$$g^{bb}R_{0b0b} - 2R_{00} = \kappa g^{bb}T_{0b0b} \tag{4.10}$$

$$R_{00} = -\kappa T_{00} \tag{4.11}$$

Rest of components I can calculate in same way so I will finally get [9]:

$$g^{bb}R_{pbpb} - \frac{1}{2}g^{bb}R_{pp}g_{bb} = \kappa g^{bb}T_{pbpb} \tag{4.12}$$

$$R_{pp} = -\kappa T_{pp} \tag{4.13}$$

Now I can divide Ricci tensor by Einstein constant to arrive at energy momentum part and i will sum elements of space part of energy momentum tensor [9]:

$$\frac{1}{\kappa}g^{ii}R_{ii} = -g^{ii}T_{ii} \tag{4.14}$$

$$\frac{1}{\kappa}R = -\left(\frac{2GM_0}{c^2 r}\right)\rho_0\pi^2 \tag{4.15}$$

$$\frac{1}{\kappa}R = -2.1008 \cdot 10^{-27}[kg/m^3] \tag{4.16}$$

Now from previous equations I can calculate Ricci scalar as equal to:

$$R = -\kappa T \tag{4.17}$$

Now plug in all the numbers and i finally get [10] :

$$R = -\kappa\rho_0\pi^2\left(1 + \frac{2GM_0}{c^2 r}\right) \tag{4.18}$$

$$R = -1.166 \cdot 10^{-52}\ [m^{-2}] \tag{4.19}$$

4.3. **Black holes.** Black holes are the ultimate test of gravity. Simplest case of black holes are static non rotating ones. I will start by solving field equation in simplest case, that is only diagonal elements of Ricci tensor and Energy momentum tensor for perfect fluid. I will write all calculations in one line then will discuss them:

$$R_{aa} = -2\kappa T_{aa} \tag{4.20}$$

$$g^{aa} R_{aa} = -2\kappa g^{aa} T_{aa} \tag{4.21}$$

$$R = -2\kappa T \tag{4.22}$$

$$R = -2\kappa \rho_0 \pi^2 \left(1 + \frac{2GM}{rc^2}\right) \tag{4.23}$$

$$\lim_{r\to 0^\pm} -2\kappa \rho_0 \pi^2 \left(1 + \frac{2GM}{rc^2}\right) = \pm\infty \tag{4.24}$$

$$R\left(0^+\right) = +\infty \tag{4.25}$$

$$R\left(0^-\right) = -\infty \tag{4.26}$$

$$R\left(0^+\right) + R\left(0^-\right) = 0 \tag{4.27}$$

From equation follows that there is no singularity at $r = 0$ as one side there is plus infinity on another side there is minus infinity so they cancel out. It means that black holes connect two possible universes in one point of spacetime from each universe perspective all spacetime stays in one universe till singularity point where those two connect. It shows clear that EEFE are singularity free. Compared to EFE that generated a point that can't be removed and where all geodesic end. Here central point is where all geodesic connect.It means that this point represents a flow of all information from two connected universes. And non moving observer can stay in that point for any amount of proper time measured by its clock. From point of view of any other observer that is not at that point, that observer is both in all possible future and in all possible past. If observer inside does move it will go to any possible location in time, where that location itself is random and cant be determined as all spacetime paths are solutions. This can be written as:

$$R\left(\mathbf{x}^+\right) + R\left(\mathbf{x}^-\right) = 0 \tag{4.28}$$

It means that black holes act as a bridge between two spacetimes. That bridge has only one point where it can be seen. But when getting out of that point all points of spacetime act as solution afterwards observer is split to one universe that means that it can have positive or negative value in frame of reference of singularity but in its frame it's just:

$$R\left(\mathbf{x}\right) + R\left(\mathbf{x}\right) = 2R\left(\mathbf{x}\right) \tag{4.29}$$

It means that I can re-write field equation :

$$2R = -2\kappa T \tag{4.30}$$

$$R = -\kappa T \tag{4.31}$$

5. Physical Principles

5.1. **Meaning of field equations.** EEFE are pretty complex equations. They leave one object undefined properly. That is extended energy momentum tensor. First property of it is it's contraction leads to normal energy momentum tensor:

$$g^{ac}T_{abcd} = T_{bd} \tag{5.1}$$

Another property is conservation of energy:

$$\nabla^b g^{ac}T_{abcd} = \nabla^d g^{ac}T_{abcd} = \nabla^b T_{bd} = \nabla^d T_{bd} = 0 \tag{5.2}$$

Now I have properties of energy momentum tensor that will have to have twenty independent components I can move to field equation itself. Field equation says that physical field thus gravity field is always measured from free-falling observer point of view. It means that if I do not reverse time flow gravity is always an expansive force. From that fact it comes counter intuitive idea about gravity field- gravity is equal motion itself. This is physical meaning behind this equation, on left side of equation there is motion of spacetime and on right side of equation there is energy field or just matter field.

5.2. **Motion and spacetime expansion.** Negative Ricci tensor for positive matter field may seem like contradiction. But logic goes like this, when spacetime around earth expands volume of earth increases but earth moves with exactly rate of expansion of spacetime so those two effects cancel out and I am left with just static earth that causes object to fall onto it. In subsection about black holes i mention two universes that connect each other one universe is expanding another one is collapsing. It means that they are opposites of each other. From it follows that in one time goes forward in another it goes backwards compared to first one. It could be explanation for missing antimatter. At moment of big bang universe splits into two, one expands one collapses, I will make it formal:

$$R = -2\kappa\rho_0\pi^2\left(1 + \frac{2GM}{rc^2}\right) \tag{5.3}$$

$$R\left(0^{\pm}\right) = -2\kappa\rho_0\pi^2\left(\pm 1 + \frac{2GM}{\pm 0c^2}\right) \tag{5.4}$$

$$R\left(\mathbf{x}^{\pm}\right) = -2\kappa\rho_0\pi^2\left(\pm 1 + \frac{2GM}{\pm rc^2}\right) \tag{5.5}$$

Those equation seem time independent but they are not. Now i will split this equations into two and split time and space coordinate:

$$R\left(r, ct\right) = -2\kappa\rho_0\pi^2\left(1 + \frac{2GM}{+rc^2}\right) \tag{5.6}$$

$$R\left(-r, -ct\right) = -2\kappa\rho_0\pi^2\left(-1 + \frac{2GM}{-rc^2}\right) \tag{5.7}$$

It's now obvious that if I add those two functions I will get zero:

$$R\left(r, ct\right) + R\left(-r, -ct\right) = 0 \tag{5.8}$$

$$R\left(r, ct\right) = -R\left(-r, -ct\right) \tag{5.9}$$

But observer that is not in singularity so point of $r = 0$ will observe it another way, it will see that time goes forward in both universes so it will lead to equation:

$$R\left(r, ct\right) - R\left(-r, -ct\right) = 2R\left(r, ct\right) \tag{5.10}$$

$$2R\left(r, ct\right) = -2\kappa\rho_0\pi^2\left(1 + \frac{2GM}{+rc^2}\right) \tag{5.11}$$

$$R\left(r, ct\right) = -\kappa\rho_0\pi^2\left(1 + \frac{2GM}{+rc^2}\right) \tag{5.12}$$

$$R = -\kappa T \tag{5.13}$$

And that result is consistent with previous subsections.

5.3. **Quantum operator and spacetime.** Quantum field equation is just same equation but for complex spacetime that leads to probability that is a scalar field. I I will write this equation again:

$$\psi = R^{\dagger}_{abcd}\left(\kappa T_{abcd} + \frac{1}{2}R_{ac}g_{bd}\right) \tag{5.14}$$

Now key component of field equation is that I can act complex Riemann tensor on both side of equation and will get:

$$R_{abcd}\psi = R_{abcd}R^{\dagger}_{abcd}\left(\kappa T_{abcd} + \frac{1}{2}R_{ac}g_{bd}\right) \tag{5.15}$$

$$R_{abcd}R_{abcd}R^{\dagger}_{abcd} = R_{abcd}R^{\dagger}_{abcd}\left(\kappa T_{abcd} + \frac{1}{2}R_{ac}g_{bd}\right) \tag{5.16}$$

$$\psi R_{abcd} = \psi\left(\kappa T_{abcd} + \frac{1}{2}R_{ac}g_{bd}\right) \tag{5.17}$$

$$R_{abcd} = \left(\kappa T_{abcd} + \frac{1}{2}R_{ac}g_{bd}\right) \tag{5.18}$$

That leads back to field equation for both complex and real spacetime. Now if I act complex Riemann tensor with dagger operation I will get back to probability of field equation, so Riemann tensor a complex one acts as operator. Using it on scalar field gives as back field equation a tensor field equation, using in with dagger operation gives scalar field. Next important property of field is that probability is equal to curvature real scalar, from fact that it is derived from curvature tensor it connects two things, probability and curvature, infinite curvature would require probability that would be equal to zero. So singularity of simplest kind is removed but I can write that integral again:

$$\frac{1}{N}\int_{x^a(\mathbf{x})\in\mathbf{M}^4}\sqrt{\det\left(g_{ab}\overline{g}_{ab}\right)}R^{\dagger}_{abcd}\left(\kappa T_{abcd} + \frac{1}{2}R_{ac}g_{bd}\right)d^4\mathbf{x} \tag{5.19}$$

If number N goes to infinity, probability goes to zero but probability is whole integral so if it goes to infinity they both cancel out if they both go at same rate. It means that there can be infinite big manifold that is quantum one, and probability could be in principle defined over infinite manifold. But it sets limit of both probability and integral to be connected. So complex infinite manifold are possible but they are more complicated than finite manifolds and still probability on them has to be defined properly.

6. Summary

In this paper is showed clear that EFE are not final world in gravitation theory. Set of new equations emerges from EFE that leads to EEFE. Simple calculations did lead to consistent result , it means that model has a big potential in becoming next theory of gravity and replacing Theory Of Relativity. Model is singularity free but i did not show for specific metric tensor as solutions I did show work for any possible simplest case black hole.

Model itself is very complex and could be easy miss-leading when dealing with physical field itself. Another problem with complexity of that model is how hard it is to solve field equation directly. Still predictions about early universe, black holes and quantum effects are a solid proof this model is a good agreement with observation.

One thing that was left is general way to get a real field from scalar field, and method is pretty simple for scalar field or turning tensor field into scalar field by using † operator. But another way of doing it is just multiply field by it's complex conjugate formally its Hadamard product of two tensor fields that gives another tensor field:

$$Z_{ab...n}\overline{Z}_{ab...n} = X_{ab..n} \odot X_{ab..n} + Y_{ab..n} \odot Y_{ab..n} \tag{6.1}$$

Where Z is complex tensor field and X is real part of that field Y is imaginary part but without a imaginary unit. This definition of product is very important for whole idea to work when taking into account complex fields. Geodesic equation takes form of:

$$\delta \int \sqrt{ds d\overline{s}} = 0 \tag{6.2}$$

This definition of geodesic works both for complex spacetime and real spacetime where for for real it gives just real spacetime integral:

$$\delta \int \sqrt{ds^2} = 0 \tag{6.3}$$

It's good to remember that complex spacetime turns into real spacetime, still is sum of two tensor fields one represented by real part and one by imaginary but without imaginary unit so real tensor field.

$$Z_{ab...n}\overline{Z}_{ab...n} = X_{ab..n}e^{ab...n} \odot X_{ab..n}e^{ab...n} + Y_{ab..n}e^{ab...n} \odot Y_{ab..n}e^{ab...n} \tag{6.4}$$

$$Z_{ab...n}\overline{Z}_{ab...n} = X_{ab..n} \odot X_{ab..n}e^{ab...n} \odot e^{ab...n} + Y_{ab..n} \odot Y_{ab..n}e^{ab...n} \odot e^{ab...n} \tag{6.5}$$

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