SIMPLEST APPROACH TO QUANTUM GRAVITY HYPOTHESIS

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Abstract. In this short paper I will explore idea of quantazing gravity by allowing speed of light to change with speed of observer and then with frequency of wave function generating space-time interval for given wave function.

Contents

1. Light Clock

In theory of relativity there is base concept that is Light Clock, whole relativity is build under idea of measuring time and distance by Light signals. Space-time in special relativity is transforming according to Lorentz Transformation. In Lorentz transformation there is one key factor- Lorentz factor. First I want to show that I can interpret that factor as slowing down of light signal when observer moves. let's say i have observer that measures time and moving with velocity v, from point of view of Special Relativity time will slow down for that observer compared to stationary one- but what if it's not time slowing down but light signal? I take normal distance a light travels in time t that is equal to ct where c is speed of light and divide it but factor that says how much speed of light did slow down that is just speed of light squared minus velocity squared in square root. This gives gamma factor:

$$\frac{t}{\sqrt{1-\frac{v^2}{c^2}}}=\frac{ct}{\sqrt{c^2-v^2}} \tag{1.1}$$

In this interpretation is not time that did slow down but speed of light and because we build space-time based on how we measure light signals space-time seems to change. Same thing can be implied to space-time interval in flat space-time. Let's say I have space-time distance:

$$ds^2=\eta_{ab}dx^a dx^b \tag{1.2}$$

Faster I move slower the speed of light comes so from my point of view geometry of that space-time will give slower distance from one event to another because events are connected by light signals emitted from those events. Nevertheless logic of special and general relativity was very well confirmed by all possible done experiments- my interpretation will give same results but does not keep speed of light constant. So question is does time really slow down and space does contract when moving faster or it's speed of light slowing down and generating those effects? And why even bother? The answer is that to build a quantum gravity theory there is need to explain space-time independent of light signals or it's just my guess for it- but I will explore how simple quantizing gravity when we say that speed of light does slow down and is no longer keep constant. So from light clock I will move to quantum clock.

2. Quantum Clock

Quantum clock is just here a fancy term for measuring time in terms of frequency of wave function. If frequency is equal to Planck frequency I will get constantly same time moment- so time will not change, same with space I will get same point of space so all space will be same point of space. Wave function does slow down speed of light, and it does move towards object. For example on event horizon of a black hole in this model speed of light is reduced by half and field itself moves with half speed of light so photons stay motionless. Let's write first equation for wave function in Planck [1] units it's equal to, where Φ_{ab} is energy tensor:

$$\partial_a \psi \partial_b \psi^* = \Phi_{ab} \psi \psi^* \tag{2.1}$$

Now when i have equation of wave function I can move to creating a quantum space-time. First i will write general equation that states for given space-time coordinate fields X I will explain next there is distance function squared equal to:

$$d^2(X) = \partial_a X \partial_b X \delta^{ab} = \sum_{a,b} \left(\delta_{ab} \delta^{ab} - \partial_a \psi \partial_b \psi^* \delta^{ab} \right)^2 \delta_{ab} dx^a dx^b \tag{2.2}$$

General coordinate space-time field is equal to, where subscript means from one small change dx_n^a to another change that is after in direction of coordinate dx_{n+1}^a, where change is with respect to same point, for example $(x_c - x_a) - (x_b - x_a)$, where point x_c is more far away than point x_b and point x_a is closest of them all.

$$X\left(x^0, ..., x^n\right) = x^0 \left(dx_{n+1}^0 - dx_n^0\right) dx^0 + x^n \left(dx_{n+1}^n - dx_n^n\right) dx^n \tag{2.3}$$

$$\partial_a X = dx^0 \left(dx_{n+1}^0 - dx_n^0\right) \hat{e}_0 + dx^n \left(dx_{n+1}^n - dx_n^n\right) \hat{e}_n \tag{2.4}$$

Time to move to probability, probability of particle being in position x is equal to:

$$\psi\left(x\right) \psi^*\left(x\right) \tag{2.5}$$

Probability over whole space is equal to one (not space-time):

$$\int \psi\left(x\right) \psi^*\left(x\right) d^n\mathbf{x} = 1 \tag{2.6}$$

So I have all needed information in this model to quantize gravity. But what does all those equations mean? Wave function does slow down speed of light by its energy, depending on wave function energy i will get wave function for gravity. In general wave function for gravity should be falling inward for most object in universe, but there is still possibility of gravity falling outward.

3. Simplest solutions

I have an energy tensor of form, where F_P is Planck Force, M is mass, c is speed of light and R is distance from center of mass:

$$\Phi_{ab} = \begin{pmatrix} \frac{Mc^2}{F_pR} & 0 & 0 & 0 \\ 0 & \frac{Mc^2}{F_pR} & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \tag{3.1}$$

Wave function is of a form:

$$\psi\left(x\right) = \psi_0\left(r\right) e^{i\sqrt{\frac{Mc^2}{F_pR}}(r-ct)} \tag{3.2}$$

$$\psi^*\left(x\right) = \psi_0^*\left(r\right) e^{-i\sqrt{\frac{Mc^2}{F_pR}}(r-ct)} \tag{3.3}$$

From it follows that distance function squared is equal to:

$$d^2(X) = \left(1 - \frac{Mc^2}{F_pR}\right) dt^2 + \left(1 - \partial_r\psi_0\left(r\right)\partial_r\psi_0^*\left(r\right)\frac{Mc^2}{F_pR}\right) dr^2 + d\Omega^2 \tag{3.4}$$

Where solution is in spherical coordinates. Limit of value of energy tensor needs to be one, so after passing event singularity of a black hole value of energy tensor can only stay constant. This solutions differ from General relativity [2] solutions by factor $\frac{G^2M^2}{c^4R^2}$ that can be calculated using Planck units value but I will just write solution:

$$\left(1 - \frac{Mc^2}{F_pR}\right)^2 = \left(1 - \frac{2GM}{c^2R} + \frac{G^2M^2}{c^4R^2}\right) \tag{3.5}$$

It means that event like is on pushed inside a black hole, and seen event horizon is just a radius where light stops, it stops because it's slow down to half of it's speed and this wave moves inward with half speed of light so light can't escape event horizon in those solutions. At so called singularity, time stops and distance in radius goes to zero. But it goes to zero only when there is measurement done, if not wave function part of radius probability will lower value of energy so radius is still present before measurement. Let's assume that there is measurement done inside a black hole then radius would go to zero. Then all events happen at the same time and all space is same space that comes out of definition of general space-time coordinate field.

References

[1] https://en.wikipedia.org/wiki/Planck_units

[2] https://en.wikipedia.org/wiki/Schwarzschild_metric