PLANCK SCALE GRAVITY

TOMASZ KOBIERZYCKI
SHIZYKFIZYK@GMAIL.COM

Abstract. In this short paper i present a proof that Planck scale is self consistent with physics and lead naturally to gravity if i abandon Lorentz transformation and need that speed of light stays constant.

1. Coordinate transformation

Planck scale is goal of quantum gravity, in this paper I will present an alternative idea to gravity model of General Relativity that allows faster than speed of light movement and acceleration. First I discard Lorentz transformation of space-time and create a new one that allow for faster than speed of light movement. Next i need to quantize them to get rid of infinity and agreement with Planck scale. Let's say i have object in frame that moves with speed $\dot{x}$ in x direction i label time as t i can transform from one frame of reference to other by taking speed of light and dividing it by speed of object and multiplying it by direction x, so i just take a ratio between speed of light and object speed, where speed has direction towards light or away from it. I can write it:

$$x' = \frac{cx}{\dot{x}} \tag{1.1}$$

It means i divide speed of light cone (movement of light) by speed of object so speed of light is no longer a constant for all observers. This idea has obvious problem when speed goes to zero coordinate blows to infinity, so zero speed is problematic, that's why there is a need for minimum speed to get rid of that infinity. I take radius of universe as maximum length and take inverse of it as minimum length. Its smallest distance i can travel, by this way it looks pure random but it leads to something if i take Planck length as smallest length it's inverse is maximum length. Now I need only to define minimum speed, if object travels by one Planck length in time universe exist i have minimum speed. And that time can be maximum speed of light times universe radius so i get:

$$t_{max} = \frac{c}{l_P} \tag{1.2}$$

$$\dot{x}_{\min} = \frac{l_P}{t_{max}} \tag{1.3}$$

Now i can calculate coordinate transformation for minimum speed that gives:

$$x' = \frac{cx}{\dot{x}_{\min}} = l_P^2 x \tag{1.4}$$

That is correct solution to that problem each meter changes into Planck length and for whole universe there is one Planck length, that means there is one Planck length for whole universe, so if i take x as universe radius i get:

$$x'_{universe} = \frac{l_P^2}{l_P} = l_P \tag{1.5}$$

So it encodes that universe natural unit is Planck length. And it means i can't take less than universe radius as coordinate x. It gives dependence on x coordinate and speed, for object to use units of distance for example one meter i need at least speed of one Planck length per one second and so on. Now i go back to time. Time is inverse of it, first i write it as:

$$t' = \frac{\dot{x}t}{c} \tag{1.6}$$

So it's distance object travels divided by speed of light, meaning of it is that those transformations are set to make speed of light movement as unit movement so its unit coordinate. Now i have minimum and maximum length and time, and coordinate transformation that makes speed of light unit speed it means Planck units are natural units where speed of light is unit speed. From it i can move to gravity.

2. Gravity as change in coordinates

Gravity can be understood as acceleration. From coordinates transformation i need to create first a transformation rule for acceleration next space-time geometry so called metric tensor. First step is straight simple and if i generalize it its easy to go to step two. If i take into account just speed in one direction i need to take how it changes in time to arrive at acceleration, so i turn normal coordinates into change of them so i get straight simple calculations:

$$\dot{x}' = x \rightarrow \dot{x} = \frac{c\dot{x}}{\ddot{x}} \tag{2.1}$$

$$\dot{t}' = t \rightarrow \dot{t} = \frac{\ddot{x}\dot{t}}{c} \tag{2.2}$$

Now i can see that both of them depend on acceleration, new term is that they depend now on change of coordinates. But same thing with space, how does it change with respect to time? So i get only time direction acceleration. This leads to clear picture that i need to take how it changes with respect to that coordinate not to time only. So i write a new coordinate transformation that can be generalized for any coordinate as change in that coordinate:

$$\dot{x}' = x \rightarrow \partial_x x = \frac{c\partial_x x}{\partial_x \dot{x}_x} \tag{2.3}$$

$$\dot{t}' = t \rightarrow \partial_t t = \frac{\ddot{x}_t \dot{t}}{c} \tag{2.4}$$

So i can generalize it for any coordinate and any change so i create four order mixed tensor. Upper indexes are components of acceleration, down ones are direction that object changes with respect to. I can write it as :

$$G^{\alpha\beta}_{\mu\nu}(x^\mu) = \partial_\mu \partial_\nu G^{\alpha\beta}(x^\mu) \tag{2.5}$$

$$G^{\alpha\beta} = \begin{pmatrix} \frac{\dot{x}^{00}}{c^2} & \frac{\dot{x}^{01}}{c^2} & \frac{\dot{x}^{02}}{c^2} & \frac{\dot{x}^{03}}{c^2} \\ \frac{\dot{x}^{10}}{c^2} & \frac{c^2}{\dot{x}^{11}} & \frac{c^2}{\dot{x}^{12}} & \frac{c^2}{\dot{x}^{13}} \\ \frac{\dot{x}^{20}}{c^2} & \frac{c^2}{\dot{x}^{21}} & \frac{c^2}{\dot{x}^{22}} & \frac{c^2}{\dot{x}^{23}} \\ \frac{\dot{x}^{30}}{c^2} & \frac{c^2}{\dot{x}^{31}} & \frac{c^2}{\dot{x}^{32}} & \frac{c^2}{\dot{x}^{33}} \end{pmatrix} \tag{2.6}$$

Now this tensor represents each speed in each direction and how it changes in any direction. It has 256 components, so i need to change it to metric tensor that has 16 components, way to do it is very simple, i just use flat Minkowski Space-Time metric tensor:

$$g_{\mu\nu}(x^\mu) = G^{\alpha\beta}_{\mu\nu}(x^\mu)\eta_{\alpha\beta} = \partial_\mu\partial_\nu G^{\alpha\beta}(x^\mu)\eta_{\alpha\beta} \tag{2.7}$$

But it discards 12 components of that G tensor so i use same tensor but i fill all zeroes with either one or minus one so that tensor in matrix form is equal to, where i use metric signature $(+---)$:

$$\eta_{\alpha\beta} = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & -1 \\ 1 & -1 & -1 & -1 \\ 1 & -1 & -1 & -1 \end{pmatrix} \tag{2.8}$$

Now i have full defined metric, but i dont have energy defined so metric is undefined. And to solve that equation i need connection to some other equation that is equal to it. To do it I need to derive energy in Planck scale.

3. Energy and rotation

From this logic comes naturally very simple energy tensor, first i take a look at Planck's energy its written as:

$$E_P = \frac{\hbar}{t_P} = \frac{\hbar c}{l_P} \tag{3.1}$$

That's time from transformation and length from transformation of space-time. Its maximum time and minimum length. So time of whole universe generates Planck energy and minimum length does so to. That lead to very simple principle, Planck acceleration is equal to either Planck length or maximum time. So if i get acceleration equal to Planck energy i need it to match with Planck length or maximum time, where Planck length can be thought as length of acceleration .

$$T^{\alpha\beta} = \begin{pmatrix} \hbar^2 T^{00} & \hbar^2 T^{01} & \hbar^2 T^{02} & \hbar^2 T^{03} \\ \hbar^2 T^{10} & \frac{c^2\hbar^2}{T^{11}} & \frac{c^2\hbar^2}{T^{12}} & \frac{c^2\hbar^2}{T^{13}} \\ \hbar^2 T^{20} & \frac{c^2\hbar^2}{T^{21}} & \frac{c^2\hbar^2}{T^{22}} & \frac{c^2\hbar^2}{T^{23}} \\ \hbar^2 T^{30} & \frac{c^2\hbar^2}{T^{31}} & \frac{c^2\hbar^2}{T^{32}} & \frac{c^2\hbar^2}{T^{33}} \end{pmatrix} \tag{3.2}$$

Only thing left is to connect all those ideas and add rotation. Its simple to see that those two tensors are equal if i add how they change in any direction:

$$\kappa T^{\alpha\beta}_{\mu\nu}(x^\mu)\eta_{\alpha\beta} = G^{\alpha\beta}_{\mu\nu}\eta_{\alpha\beta}(x^\mu) \tag{3.3}$$

Where constant is just $\kappa = \frac{1}{\hbar^2 c^2}$ to match acceleration in space now last part is to add rotation that is equal to angular momentum of frame of reference. So i can write it as when i use G field notation this time:

$$R^\mu_{\mu'} R^\nu_{\nu'} G^{\alpha\beta}_{\mu\nu}\left(x^{\mu\prime}\right) = G^{\alpha\beta}_{\mu'\nu'}\left(R^\mu_{\mu'}\left(\theta(x^\mu)\right)x^\mu\right) \tag{3.4}$$

$$\theta^2(x^\mu) = \frac{1}{4}\pi^2\sigma^2(x^\mu)E^2(x^\mu) \tag{3.5}$$

$$E^2(x^\mu) = \sum_{\alpha,\beta} T^{\alpha\beta}(x^\mu) \tag{3.6}$$

Where $\sigma(x^\mu)$ is spin function that gives each point of space-time a spin number. I can write full field equation again now using full version of Gravity tensor:

$$R^\mu_{\mu'} R^\nu_{\nu'} \partial_\mu \partial_\nu G^{\alpha\beta}\left(x^{\mu\prime}\right) = \kappa R^\mu_{\mu'} R^\nu_{\nu'} \partial_\mu \partial_\nu T^{\alpha\beta}\left(x^{\mu\prime}\right) \tag{3.7}$$

$$g_{\mu'\nu'}\left(x^{\mu\prime}\right) = R^\mu_{\mu'} R^\nu_{\nu'} \partial_\mu \partial_\nu G^{\alpha\beta}\left(x^{\mu\prime}\right)\eta_{\alpha\beta} = \kappa R^\mu_{\mu'} R^\nu_{\nu'} \partial_\mu \partial_\nu T^{\alpha\beta}\left(x^{\mu\prime}\right)\eta_{\alpha\beta} \tag{3.8}$$

4. Many universes Planck scale

In first subsection I said that I take minimum length as inverse of universe maximum radius. This principle can be generalized without breaking rules of Planck scale for any number of universes, it means that minimum length no longer is Planck length but it to power of number of universes. What defines objects gravity in this way of thinking is its energy. Laws for any scale are same but energy limit increases it means there has to be more dimensions than four each representing one universe. So N universes means $4N$ dimensions of space-time and N times repeated Planck Scale. There is no reason to think that is number does not goes to infinity.

$$\kappa^n T^{\alpha_1\beta_1\ldots\alpha_n\beta_n}_{\mu'_1\nu'_1\ldots\mu'_n\nu'_n}\left(x^{\mu'_1\ldots\mu'_n}\right)\eta_{\alpha_1\beta_1\ldots\alpha_n\beta_n} = G^{\alpha_1\beta_1\ldots\alpha_n\beta_n}_{\mu'_1\nu'_1\ldots\mu'_n\nu'_n}\left(x^{\mu'_1\ldots\mu'_n}\right)\eta_{\alpha_1\beta_1\ldots\alpha_n\beta_n} \tag{4.1}$$