Three Dimensional Space-Time Gravitational Metric, 3 Space + 3 Time Dimensions

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Abstract

We have recently suggested a new quantum gravity theory that can be unified with quantum mechanics, this theory we have coined collision space-time. This new theory seems to only be fully consistent with a 3-dimensional space-time, that is 3 space dimensions and three time-dimensions, so some would perhaps call it 6-dimensional. However, we have shown that collision-time and collision-length (space) are just two different sides of the same "coin" (space-time), so it is more intuitive to think of it as 3-dimensional space-time. In previous papers we have not laid out a geometric coordinate system for our theory that also take into account gravity, but we will do that here. This can be seen as an alternative to the Schwarzschild metric and general relativity theory. Our metric seems to have many benefits, it seems to be more consistent for example with the Planck units than the Schwarzschild metric. Our metric only seem to have one singularity while the Schwarzschild metric has two singularities.

Keywords: escape velocity, spherical gravitational metric, Schwarzschild radius, collision space-time.

1 Background

Todays standard physics is ruled by Minkowski [1] space-time which is the geometry of special relativity theory and flat space-time, and by several different metric systems such as the Schwarzschild metric when including gravity. These are 4-dimensional space-time theories, where there is three space dimensions and one time dimension. Our recent investigation indicates that such a four dimensional space-time geometry not can be consistent with our new unified quantum gravity theory [2, 3]. We initially [4] tried to force our new theory into a four dimensional space-time, but this lead to a few inconsistencies in some derivations that we first later got fully aware of, but even in our first published paper on this we suggest that perhaps a 6-dimensional theory with three time dimensions and three space dimensions where needed. To suggest a six dimensional theory with three space and three time dimensions are not new, see [5–9]. Most of these papers were written in the 80s and 90s and are now more or less forgotten by the majority of physicists, in particular since six dimensions did not seem to solve that much. However, with the invention of collision space-time there are strong indications that three space and three-time dimensions are needed. We will here suggest a space-time metric that is the "parallel" of the Schwarzschild metric under general relativity theory [10], while our new metric is compatible with collision space-time. However we will claim both general relativity theory and its Schwarzschild solution likely must be incomplete in some way and this is one of the reasons one has not been able to unify general relativity with quantum mechanics, Well both quantum mechanics and gravity theory are incomplete theories (at best), but a few changes in Newtonian gravity combined with a few changes in quantum mechanics that all comes out from derivation from first principles about ideas on the origin of matter and energy (atomism) seems to lead to a unification between quantum mechanics and gravity.

2 General relativity theory and the Schwarzschild metric

We will shortly mention the Schwarzschild [11, 12] solution, this so one more easily can compare our new suggested collision space-time metric with this established "consensus" theory. There is a very strong link between the Schwarzschild solution and escape velocity. The escape velocity for general relativity is given by

$$v_e = \sqrt{\frac{GM}{r^2}} \tag{1}$$

We can actually express the Schwarzschild solution in the form of the escape velocity. This gives

$$
\begin{aligned}
g = -c^2 d\tau^2 &= -\sqrt{1-\frac{v_e^2}{c^2}}^2 c^2 dt^2 + \frac{dr^2}{\sqrt{1-\frac{v_e^2}{c^2}}^2} + r^2 d\theta^2 + r^2 \sin\theta d\phi^2 \\
-c^2 d\tau^2 &= -\left(1-\frac{\sqrt{\frac{2GM}{r}}}{c^2}\right) c^2 dt^2 + \frac{dr^2}{1-\frac{\sqrt{\frac{2GM}{r}}^2}{c^2}} + r^2 d\theta^2 + r^2 \sin\theta d\phi^2 \\
-c^2 d\tau^2 &= -\left(1-\frac{2GM}{rc^2}\right) c^2 dt^2 + \frac{dr^2}{1-\frac{2GM}{rc^2}} + r^2 d\theta^2 + r^2 \sin\theta d\phi^2 \\
-c^2 d\tau^2 &= -\left(1-\frac{r_s}{r}\right) c^2 dt^2 + \frac{dr^2}{1-\frac{r_s}{r}} + r^2 d\theta^2 + r^2 \sin\theta d\phi^2 \qquad (2)
\end{aligned}
$$

This is the well-known Schwarzschild solution, we have not shown a derivation of it here, but simply shown how it can be expressed in combination with the escape velocity. An important point here is that the escape velocity that one get from general relativity theory is identical to that one get from standard non-relativistic Newton mechanics, see [13]. The Newtonian escape velocity is derived by solving the following equation with respect to v

$$\frac{1}{2}mv^2 - \frac{GMm}{r} = 0 \qquad (3)$$

which gives $v_e = \sqrt{\frac{GM}{r^2}}$. Pay attention to that one here has used a non-relativistic kinetic energy approximation in the derivation. This because $\frac{1}{2}mv^2$ is the first Taylor series expansion term one get from the relativistic kinetic energy of Einstein $E_k = mc^2\gamma - mc^2$. The first term of the Taylor expansion is only a good approximation when $v << c$. In for example the case where the escape velocity is close to c this derivation and escape velocity can clearly not be used. Second the small mass that is escaping with velocity c is a rest-mass in the Newton gravitational energy potential formula $G\frac{Mm}{r}$. That is the Newton derivation that leads to the escape velocity derived from Newtonian mechanics do not take into account relativistic energy or relativistic mass. One can wonder then how general relativity theory that supposedly should take into account all relativistic effects can give the same formula. We suspect something has gone wrong during the way or the foundation of the theory, we suspect one error has been to incorporate standard Newton theory as a weak field limit. For a massive gravitational body the gravitational acceleration field at the Schwarzschild radius is very weak, but at the same time the escape velocity is c there, that is m when close to this radius moves at speeds close to c, the Newton escape velocity is then clearly not valid. Several derivations of the Schwarzschild metric suddenly uses non-relativistic Newton mechanics as input for the derivations. Further one has mistakenly assumed Newton theory is consistent with infinite gravity speed, something that recently have been questioned [20]. Standard Newton theory seems to be consistent with that gravity moves at the speed of light, but at the same time it assumes the small mass m is moving very slow relative to c. We simply think standard physics not really have understood Newton gravitational theory, and by incorporating Newton as a weak field limit their theory is not fully consistent.

3 6-dimensional space-time geometry

We [2, 4] have recently suggested a quantum gravity theory that unifies gravity and quantum mechanics and simplify many things in physics. The latest version of our theory strongly indicates we must have a three-dimensional space-time. Time and space are two different sides of the same coin. One cannot move in space without moving in time (as also thought in standard theory), but we can also not move in time without moving in space. However, we cannot moving for example only in the x direction off space and at the same time in the t_y direction of time. If we move only in the x direction of space, we must also move in the t_x direction in time. That is space and time are basically two sides of the same coin. This we have described in some detail in [2], here we will extend this space-time geometry to also hold for gravity. We suggest we must have the following space-time metric (Cartesian coordinate system)

$$ds^2 = dx^2 + dy^2 + dz^2 - c^2 dt_x^2 - c^2 dt_y^2 - c^2 dt_z^2 \qquad (4)$$

in the special case for the Planck mass particle this can be simplified to, this as the indivisible particle stand still when colliding or move at the speed of light when not colliding, that is

$$0 = dx^2 + dy^2 + dz^2 - c^2 dt_x^2 - c^2 dt_y^2 - c^2 dt_z^2 \qquad (5)$$

Already in 1960, Rindle [14] showed that the Minkowski space-time could be simplified from $dt^2c^2 - dx^2 - dy^2 - dz^2 = ds^2$ to $dt^2c^2 - dx^2 - dy^2 - dz^2 = 0$ when dealing with light signals, see also [2]. Further also in the moving system $dt'^2c^2 - dx'^2 - dy'^2 - dz'^2 = 0$, see also [15]. The above flat space-time geometry we are quite certain off. However, when it comes to add gravity, we know that our escape velocity is

$$v_e = \sqrt{\frac{2GM}{r} - \frac{G^2M^2}{r^2c^2}} \tag{6}$$

This can simply be derived from relativistic modified Newton, that is we solve the following equation with resect to v

$$mc^2\gamma - mc^2 - \frac{GMm\gamma}{r} = 0 \tag{7}$$

where $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ and v is the velocity of the small mass m relative to the large gravitational object M. This in contrast to general relativity that gives an escape velocity of $v_e = \sqrt{\frac{2GM}{r}}$. Combining this with the assumption that we must have three space and three time dimensions to be consistent with collision space-time we will likely end up with the following metric (based on spherical polar coordinates)

$$ds^2 = \left(1 - \frac{2GM}{rc^2} + \frac{G^2M^2}{c^4r^2}\right)c^2dt^2 - c^2t^2d\theta^2 - c^2t^2\sin^2\theta d\phi^2 + \frac{dr^2}{1 - \frac{2GM}{rc^2} + \frac{G^2M^2}{c^4r^2}} + r^2d\theta^2 + r^2\sin^2\theta d\phi^2 \tag{8}$$

Bear in mind that the gravitational constant likely is a composite constant of the form $G = \frac{l_p^2c^3}{\hbar}$ as suggested by [16, 17]. This would lead to a circular problem if we not can find the Planck length independent of G, but recent findings have shown that we easily can find the Planck length with no knowledge of G, see for example [18–20] so this is not an issue. Further any mass in terms of kilogram can be expressed as

$$m = \frac{\hbar}{\bar{\lambda}}\frac{1}{c} \tag{9}$$

where $\bar{\lambda}$ is the reduced Compton wavelength [21]. This is simply the Compton wavelength formula $\bar{\lambda} = \frac{\hbar}{mc}$ solved with respect to m. This means our escape velocity formula also can be expressed as

$$v_e = \sqrt{\frac{2GM}{r} - \frac{G^2M^2}{r^2c^2}} = \sqrt{\frac{2c^2l_p^2}{\bar{\lambda}r} - \frac{c^2l_p^4}{\bar{\lambda}^2r^2}} \tag{10}$$

This correspond also to the version of this escape velocity formula as given by [4]. This means our metric also can be written on the form

$$ds^2 = -\left(1 - \frac{2l_p^2}{\bar{\lambda}r} + \frac{l_p^4}{\bar{\lambda}^2r^2}\right)c^2dt^2 - c^2t^2d\theta^2 - c^2t^2\sin^2\theta d\phi^2 + \frac{dr^2}{1 - \frac{2l_p^2}{\bar{\lambda}r} + \frac{l_p^4}{\bar{\lambda}^2r^2}} + r^2d\theta^2 + r^2\sin^2\theta d\phi^2 \tag{11}$$

It is therefore clear from the metric itself that it is linked to the Planck scale. By re-writing G and M in the same way also in the Schwarzschild solution then one can also see that it is linked to the Planck scale, but we have reason to think general relativity and its Schwarzschild solution is doing so in an incomplete way.

4 Tensor form

With coordinates $(x^2, x^2, x^3, x^4, x^5, x^6) = (ct, \theta, \phi, r, \theta, \phi)$ we can also write our metric theory on tensor form

$$g_{\mu,v} = \begin{pmatrix} -\left(1 - \frac{2GM}{rc^2} + \frac{G^2M^2}{c^4r^2}\right) & 0 & 0 & 0 & 0 & 0 \\ 0 & -c^2t^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -c^2t^2\sin^2\theta & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(1 - \frac{2GM}{rc^2} + \frac{G^2M^2}{c^4r^2}\right)^{-1} & 0 & 0 \\ 0 & 0 & 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \tag{12}$$

or alternatively as

$$g_{\mu,v} = \begin{pmatrix} -\left(1-\frac{2l_p^2}{\lambda r}+\frac{l_p^4}{\lambda^2 r^2}\right) & 0 & 0 & 0 & 0 & 0 \\ 0 & -c^2t^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -c^2t^2\sin^2\theta & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(1-\frac{2l_p^2}{\lambda r}+\frac{l_p^4}{\lambda^2 r^2}\right)^{-1} & 0 & 0 \\ 0 & 0 & 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \tag{13}$$

In the special case where $v_e = c$, then we have $r = \frac{GM}{c^2}$, that is we have an escape velocity of c at half the Schwarzschild radius $r_s = \frac{2GM}{c^2}$, then we have $g_{0,0} = 0$ and $g_{3,3}$ will converges to infinitly. That is also our metric has a singularity at r when the escape velocity is c. However we do not have a second singularity as there is no meaning in our theory to have $r = 0$ as the Planck length is the smallest possible length, see [4] for a discussion on this.

5 Conclusion

We have suggested a parallel to the Schwarzschild metric for our collision space-time theory that seems it must be linked to a 3-Dimensional space-time, that is three dimensions in space and three in time that are closely linked.

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Appendix A

We are not fully sure on that that we really should have $(1-v_e^2/c^2)$ in $g_{0,0}$ and $(1-v_e^2/c^2)^{-1}$ in $g_{3,3}$, so one should not yet fully exclude that one should have ^{1} in both or $^{-1}$ in both. Just in case it should be ^{1} for both $g_{0,0} and g_{3,3}$ this would in the metric form give

$$ds^2 = \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)c^2dt^2 - c^2t^2d\theta^2 - c^2t^2\sin^2\theta d\phi^2 + \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)cdr^2 + r^2d\theta^2 + r^2\sin^2\theta d\phi^2 \tag{14}$$

and in the tensor form

$$g_{\mu,v} = \begin{pmatrix} -\left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right) & 0 & 0 & 0 & 0 & 0 \\ 0 & -c^2t^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -c^2t^2\sin^2\theta & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right) & 0 & 0 \\ 0 & 0 & 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \tag{15}$$

that also can be written as

$$g_{\mu,v} = \begin{pmatrix} -\left(1-\frac{2l_p^2}{\lambda r}+\frac{l_p^4}{\lambda^2r^2}\right) & 0 & 0 & 0 & 0 & 0 \\ 0 & -c^2t^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -c^2t^2\sin^2\theta & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(1-\frac{2l_p^2}{\lambda r}+\frac{l_p^4}{\lambda^2r^2}\right) & 0 & 0 \\ 0 & 0 & 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \tag{16}$$

On the other hand if $^{-1}$ for both, then the following metric would apply

$$ds^2 = \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)^{-1}c^2dt^2 - c^2t^2d\theta^2 - c^2t^2\sin^2\theta d\phi^2 + \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)^{-1}cdr^2 + r^2d\theta^2 + r^2\sin^2\theta d\phi^2 \tag{17}$$

and in the tensor form

$$g_{\mu,v} = \begin{pmatrix} -\left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)^{-1} & 0 & 0 & 0 & 0 & 0 \\ 0 & -c^2t^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -c^2t^2\sin^2\theta & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(1-\frac{2GM}{rc^2}+\frac{G^2M^2}{c^4r^2}\right)^{-1} & 0 & 0 \\ 0 & 0 & 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \tag{18}$$

that also can be written as

$$g_{\mu,v} = \begin{pmatrix} -\left(1-\frac{2l_p^2}{\lambda r}+\frac{l_p^4}{\lambda^2r^2}\right)^{-1} & 0 & 0 & 0 & 0 & 0 \\ 0 & -c^2t^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & -c^2t^2\sin^2\theta & 0 & 0 & 0 \\ 0 & 0 & 0 & \left(1-\frac{2l_p^2}{\lambda r}+\frac{l_p^4}{\lambda^2r^2}\right)^{-1} & 0 & 0 \\ 0 & 0 & 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \tag{19}$$

This should be investigated further; one here has to be very careful in consider who is the observer and what frame is observed.