Calculation of Inertial Masses Based on their Spacetime Curvature

Ivo Draschkow[1]

[1] Independent researcher

E-mail: ivo@draschkow.de

Received xxxxxx
Accepted for publication xxxxxx
Published xxxxxx

Abstract

This paper introduces a relativistic way to perform the calculation of inertial mass along with the purely mathematically derived gravitational constant $\boldsymbol{G}$, which has only been determined experimentally so far. The limits for a weak point mass are used to precisely calculate $\boldsymbol{G}$ without any further measurments. The accuracy of $\boldsymbol{G}$ depends only on the accuracy of the measurement of the speed of light. Mass is revealed not to be scalar, not invariant, and its units can be expressed in terms of time and space. The results support my hypothesis that it is spacetime itself that always moves with $\boldsymbol{c}$ and deflections in its flow rate lead to its condensation into masses. This paper goes back to the foundations of general relativity.

Keywords: Spacetime Flow Rate — Gravitational Constant — Lorentz Factor

1. Introduction and Preliminary Considerations

The relativistic nature of gravity has long been known but to date it has not impacted the understanding of inertial mass. The strict correlation of an object's size and gravity with its local relativistic transformations leads to the question, whether a supplementary gravitational component or constant is really necessary to determine the inertial mass of the object. If only a certain amount of inertial mass can result from a given mean radius paired with a given surface gravity, then the latter two components might suffice to determine it, just as they suffice to give us its whole profile of time dilation.

We need to go back to the basics of general relativity to find the overseen pieces. From the perspective of an observer within a gravitational field, everything outside the field would be moving faster because his own time is running out more slowly. However, since the speed of light must remain constant, the universe is going to have smaller dimensions from his vantage point than from the vantage point of an observer outside the field. What the observer gains in time, he thus loses in space: within a gravitational field his reality would be partially deflected from space to time. That deflection illustrates the gravitational contraction of length - one could say his surrounding universe is denser. I think that it makes sense, that this omnidirectional increase in density could give rise to the local phenomenon we call inertial mass.

Gravitational time dilation causes space to curve into time, generating a maximum deflection at the center of mass and forming a corresponding volume within the curvature. The larger this volume is, the better the object eludes temporal progress. This drag may be the reason for its inertia and hence its inertial mass. It turns out that the specific amount of a relativistic contraction $\boldsymbol{L}$ with respect to the diameter of a gravity-generating object is directly proportional to its mass. Its max. value is already used in physics - the Schwarzschild radius $\boldsymbol{r_S}$, which is directly proportional to the mass of a black hole. My derivation shows that not only that extreme case, but any gravitationally caused relativistic contraction of an object is directly proportional to its mass. $0.5\boldsymbol{L}$ produces a mass-specific relativistic spectrum between $\boldsymbol{r_S}$ and $\boldsymbol{r_{min}}$ where the mass volume is large enough for gravity to tend to zero.

2. What is Moving - the Spacetime or the Object?

By common understanding, every object should be moving through spacetime at the speed of light. An important approach of this work is the assumption, that spacetime itself actively spreads with the speed of light in the form of a replicative expansion. This would give spacetime a frequency that isotropically and periodically generates spatial wavelengths that don't develop as a continuation but drift away from each other with $\boldsymbol{c}$. The universe would represent a resonant cavity whose frequency chould be a multiple of $\boldsymbol{c}$.

With $f_c = 299792458\mathbf{000}\ Hz$ I got accurate masses. Such a spacetime would have an accelerating flow rate $Q_S = c^3$, since the volume of space created would increase eightfold with each directional doubling of the wavenumber.

3. Basic Derivation of Inertial Mass

If matter and thus inertial mass were the result of a condensed spacetime flow, the approach should be similar to how multiplying between material density, volumetric flow rate and time or the number of volumetric flow units gives mass in a classic flow scenario:

$$M = \varrho \cdot Q \cdot t \tag{1}$$

I made the assumption for the density ϱ that it depicts the expression of the relativistic contraction in a spacetime flow. Instead of an arbitrary period of time, the unit count would stand for the count of generated spatial wavelengths in a mass-free environment. It would be the product of f_c and the specific time t_G it would take to generate a condensed wavelength of space. With this in mind, the initial formula should be as follows:

$$M = L \cdot Q_S \cdot f_c \cdot t_G \tag{2}$$

Which amount of time t_G should be considered here? It depends on the SI units that we use. If the spatial SI units are meters then more time would be needed to generate the corresponding wavelengths compared to millimeters.

Should we really be able to use my formula to calculate masses equal to the known ones, this would also lead to an exciting new way to express mass units as pure spacetime:

$$M \ \rightarrow \ kg = m \cdot \frac{m^3}{s^3} \cdot \frac{1}{s} \cdot s = \frac{m^4}{s^3} \tag{3}$$

With these units the currently used gravitational constant G would receive a very appropriate role as an expansion pace concerning the condensed spacetime propagation:

$$G \ \rightarrow \ \frac{m^3}{kg \cdot s^2} = \frac{m^3 \cdot s^3}{m^4 \cdot s^2} = \frac{s}{m} \tag{4}$$

If we look at the reciprocal of the speed of light, there might be a connection in this regard. Uncondensed spacetime would have a pace that equals $1/c$, and if my approach is correct, it should be a multiple of G. Being a pace, G would express how much time t_G is needed to generate one meter of condensed space. Against this background we may assume the following:

$$f_c \cdot t_G = c \cdot G \cdot 10^3 \tag{5}$$

$$M = L \cdot c^4 \cdot G \cdot 10^3 \tag{6}$$

Units confirmation:

$$M \ \rightarrow \ kg = m \cdot \frac{m^4}{s^4} \cdot \frac{m^3}{kg \cdot s^2} \ \rightarrow \ kg = \sqrt{\frac{m^8}{s^6}} = \frac{m^4}{s^3} \tag{7}$$

L and possibly the experimentally determined G remain the only variables of my basic formula and are detailed below.

4. Radial Gravitational Lorentz Contraction

Typically, to obtain the gravitational time dilation on a mass surface, the reciprocal Lorentz factor α depending on the surface escape velocity v_{Em}, which is expressed by the mean radius r_m and surface gravity g_m, can be used to avoid G.

$$\alpha = \sqrt{1 - \frac{{v_{Em}}^2}{c^2}} = \sqrt{1 - \frac{2g_m r_m}{c^2}} \tag{8}$$

For time dilation states below the surface of the mass, science resorts to the gravitational potential although the Lorentz factor is also able to provide correct data. For this, it has to be adjusted to include the increase of v_E on its way from the surface to the center of mass. At a corresponding radius r_x

$$\alpha(r_x) = \sqrt{1 - \frac{{v_{Em}}^2 + d{v_E}^2}{c^2}}$$
$$= \sqrt{1 - \frac{2g_m r_m + \frac{(2g_m r_m - 2g_m r_x)}{2}}{c^2}} = \sqrt{1 - \frac{3g_m r_m - g_m r_x}{c^2}} \tag{9}$$

is going to deliver the locally appropriate Lorentz factor.

We can use this optimized Lorentz function to obtain the searched amount of relativistic contraction L concerning the diameter of a spherical object. To do this, we need to integrate $1 - \alpha(r_x)$ from 0 to r_m and double the result:

$$L = 2 \cdot [L(r_x)]_0^{r_m} = 2 \cdot \int_0^{r_m} \big(1 - \alpha(r_x)\big) dr_x$$

$$= 2\left(r_m - \frac{2c^2 \cdot \left(\left(1 - \frac{2g_m r_m}{c^2}\right)^{\frac{3}{2}} - \left(1 - \frac{3g_m r_m}{c^2}\right)^{\frac{3}{2}} \right)}{3g_m} \right) \tag{10}$$

For our earth L is ~**0.011** m and for our sun ~**3695.66** m, which is not very far from their Schwarzschild radii r_S. In the case of a Black Hole $0.5L_{min} = r_S = r_m$, because $\alpha(r_x) = 0$ leads to $1 - \alpha(r_x) = 1$ and $0.5L_{min} = 1 \cdot r_m$. The radius of the object would be completely contracted relativistically and therefore directly proportional to the black hole's mass.

We should now be able to determine the inertial mass of celestial bodies:

$$M = 2\left(r_m - \frac{2c^2\left(\left(1 - \frac{2g_m r_m}{c^2}\right)^{\frac{3}{2}} - \left(1 - \frac{3g_m r_m}{c^2}\right)^{\frac{3}{2}} \right)}{3\,g_m} \right) c^4 \cdot G \cdot 10^3 \tag{11}$$

Verification with Earth data: $r_m = 6371000\,m$ $\quad g_m = 9.807\,\frac{m}{s^2}$

$M_\oplus$ = *2*(**6371000**-(2*299792458^2*((1-(2***9.807*****6371000**)/299792458^2)^1.5-(1-(3***9.807*****6371000**)/299792458^2)^1.5))/(3***9.807**))*299792458^4***6.6742*10^-11***10^3*

$\approx \mathbf{5.97 \cdot 10^{24}}\ \frac{m^4}{s^3}$ → agrees with the NASA reference, noting that *1 kg* is actually equal to exactly $1\,\frac{m^4}{s^3}$

5. Precise Calculation of the Gravitational Constant

With the classic formula

$$M = \frac{g_m {r_m}^2}{G} \tag{12}$$

different g_m and r_m always lead to identical masses as long as the product $g_m {r_m}^2$ is fixed. However, in my formula they do not provide a constant L, but produce a relativistic spectrum. L increases together with g_m and r_m and does not produce the fixed masses that $g_m {r_m}^2$ provides in the classic way, but always higher ones. This is particularly noticeable for its upper limit and thus with Black Holes. Dividing the Limits of L gives us its total spectrum:

$$L_{max} = 2 \cdot r_s \qquad L_{min} = 2 \cdot \int_0^{r_m} \frac{3g_m r_m - g_m r_x}{2c^2} dr_x = \frac{5 g_m {r_m}^2}{2c^2}$$

$$\frac{L_{max}}{L_{min}} = \frac{2 \cdot 2 g_m {r_m}^2}{c^2} : \frac{5 g_m {r_m}^2}{2c^2} = \frac{1.6}{1} \tag{13}$$

This also means that the mass of Black Holes calculated with my formula would be 1.6 times higher than calculated with the classic one. This significant increase would be something that science would need to observe astronomically to fully prove my approach. Nevertheless, for planets and pre-supernova stars there is almost no relevant difference between the results of both formulas.

Despite the different assumptions on which both formulas are based, it should be possible to calculate G exactly by equating them. However, the equation would only be harmless for the limit value at which $(g_m, r_m) \to (0, 0)$. Since in this case L and thus also the relativistic effect itself tend to zero, both formulas should deliver identical results for the assumed point mass, from which G can be determined purely mathematically:

$$L \cdot c^4 \cdot G \cdot 10^3 = \frac{g_m {r_m}^2}{G} \qquad G = \sqrt{\frac{g_m {r_m}^2}{L \cdot c^4 \cdot 10^3}} \tag{14}$$

With the limit scenario we get:

$$G = \lim_{(g_m, r_m) \to (0,0)} \sqrt{\frac{g_m {r_m}^2}{L \cdot c^4 \cdot 10^3}} = \frac{1}{50 \cdot c} \tag{15}$$

$\approx 6.6712819 \cdot 10^{-11} \frac{s}{m}$ → the pace is exactly 50 times lower than spacetime's $1/c$

Verification:

*(**0.000001*****0.000001**^2/(10^3*(2*299792458^4*(**0.000001**-(2*299792458^2*((1-2***0.000001*****0.000001**/299792458^2)^1.5-(1-3***0.000001*****0.000001**/299792458^2)^1.5))/(3***0.000001**)))))^0.5*

That result is very likely to be the true value of the gravitational constant. This does not mean that it cannot also show measurable evolutionary fluctuations that a mathematically idealized formula cannot depict.

6. Ready-to-Use Formula

As soon as we replace the variables L and G with their above derived terms in my basic $M = L \cdot c^4 \cdot G \cdot 10^3$, we get the finished formula:

$$M = 40 \cdot \left(r_m - \frac{2c^2\left(\left(1-\frac{2g_m r_m}{c^2}\right)^{\frac{3}{2}} - \left(1-\frac{3g_m r_m}{c^2}\right)^{\frac{3}{2}}\right)}{3\, g_m} \right) \cdot c^3 \tag{16}$$

7. Exemplary Calculations on Celestial Bodies

According to my previous derivations, we observed that L is subject to a relativistic increase which mainly affects objects under extreme conditions. As a result, the mass of Black Holes with a Schwarzschild radius r_s would be

$$M_B = 40 \cdot r_s \cdot c^3 \tag{17}$$

To prove the accuracy of my formula, I provide the calculated masses of four celestial bodies in our solar system. Besides c, r_m and g_m are the only inputs required, sourced from the referenced NASA and NIST websites.

Moon: $r_m = 1737400\, m$ $\quad g_m = 1.62 \frac{m}{s^2}$

$M_☾$ = *40*((**1737400**-(2*299792458^2*((1-2***1.62*****1737400**/299792458^2)^1.5-(1-3* **1.62*****1737400**/299792458^2)^1.5))/(3***1.62**))*299792458^3*

$\approx 7.34 \cdot 10^{22} \frac{m^4}{s^3} (kg)$

Venus: $r_m = 6051800\, m$ $\quad g_m = 8.87 \frac{m}{s^2}$

$M_♀$ = *40*((**6051800**-(2*299792458^2*((1-2***8.87*****6051800**/299792458^2)^1.5-(1-3***8.87*****6051800**/299792458^2)^1.5))/(3***8.87**))*299792458^3*

$\approx 4.87 \cdot 10^{24} \frac{m^4}{s^3} (kg)$

Earth: $r_m = 6371000\, m$ $\quad g_m = 9.807 \frac{m}{s^2}$

$M_\oplus$ = *40*((**6371000**-(2* 299792458^2*((1-2***9.807*****6371000**/299792458^2)^1.5-(1-3* **9.807*****6371000**/299792458^2)^1.5))/(3***9.807**))*299792458^3*

$\approx 5.97 \cdot 10^{24} \frac{m^4}{s^3} (kg)$

Sun: $r_m = 695700000\, m$ $\quad g_m = 274 \frac{m}{s^2}$

$M_\odot$ = *40*((**695700000**-(2*299792458^2*((1-2***274*****695700000**/299792458^2)^1.5-(1-3***274*****695700000**/299792458^2)^1.5))/(3***274**))*299792458^3*

$\approx 1.99 \cdot 10^{30} \frac{m^4}{s^3} (kg)$

The calculated results agree with the NASA reference values.

8. Conclusions

As initially assumed, inertial mass can be fully calculated by just knowing $\boldsymbol{r_m}$ and $\boldsymbol{g_m}$. The relevant variable in my basic formula is $\boldsymbol{L}$ and it determines the resulting masses entirely by itself. $\boldsymbol{L}$ proves that relativity is not just a curiosity that produces pointless time dilation scenarios in our universe. The defining effect of relativity is the formation of inertial mass, which is thus of relativistic origin. $\boldsymbol{L}$ ultimately yields the mass amounts by also being a relativistic slider that forms them according to their parameters between the limits described. Moreover, the assumption that mass experiences an additional more or less pronounced relativistic effect with increasing gravitational force is quite conclusive. This is where my results differ from the classic computational methods. The values of $\boldsymbol{G}$ measured by science so far appear less accurate than assumed and generally too high.

Since $(\boldsymbol{3g_m r_m}) \to (\boldsymbol{c^2})$ determines the extreme case for time dilation, the singularity of a Black Hole and thus a complete standstill in time at the center of mass would occur before a mass implosion reaches the Schwarzschild radius. The singularity would already form at

$$\boldsymbol{r_{Si}} = \frac{\boldsymbol{3g_m r_m}^2}{\boldsymbol{c^2}} \tag{18}$$

which is 1.5 times the Schwarzschild radius.

Last but not least, the resulting spacetime units for mass as well as the mandatory requirement of the $\boldsymbol{10^3}$ multiplier within the equations is hard evidence for the actual existance of the assumed $\boldsymbol{f_c}$ and its possibly exciting consequences. Hypothetically, there could even be a very interesting connection with the CMB if, contrary to current assumptions, the CMB were constant and not decreasing: the universe would be working like a sustained cavity resonator i.e. replicator. Being an open system, such a spacetime resonator would not deviate from the characteristics of a black body object: full absorption in its directions of expansion with the CMB temperature generating periodic, replicative vibrations representing an excitation frequency. After all, the classic formula describing damped natural frequencies

$$\boldsymbol{\omega_d} = \boldsymbol{\omega_n} \cdot \sqrt{\boldsymbol{1 - \zeta^2}} \tag{19}$$

corresponds to the escape velocity resulting from the Lorentz factor:

$$\boldsymbol{v_{Em}} = \boldsymbol{c} \cdot \sqrt{\boldsymbol{1 - \alpha^2}} \tag{20}$$

When comparing both formulas, there is a clear analogy: unattainable states for both, $\boldsymbol{\omega_d}$ and $\boldsymbol{v_{Em}}$, system predetermining constants and damping / contraction ratios. In such a scenario, $\boldsymbol{f_c}$ could be paying the role of a natural, undamped diffusion frequency of spacetime, while the CMB would generate the excitation and thus spacetime replication frequencies.

My results could lead to the insight that spacetime has undergone an evolution leading to its condensed states (matter) and the Big Bang does not have to have happened. The universe may have come into being with the advent of quantum ability to systematically replicate and distribute similar states and events that depict time and space. It would be a holistic but open construct of evolving reference systems. Elementary space would be the primary quantum field, time its progression. These spatial fields of spacetime quanta would merge with one another and thereby allow the total amount of space and thus our universe to grow.

All of the energy in our universe would be the result of the ever self-expanding spacetime and it would keep increasing in total. The very similar behaviour of the assumed dark energy is another indication that my approach might be correct. Evolution may have elegantly misused this whole process for its main goal - quantum distribution and condensation. In this way it may have nested the diffusion strive energy by shaping it into higher complexity that we call matter. There is of course a catch with my calculation basis: should this primary form of replication ever end, spacetime would vanish instantaneously. In contrast, the universe of the Standard Model is a closed machine that consistently unfolds according to given design principles and is condemned to an immutable energy volume.

References

[1] NASA Space Science Data Coordinated Archive, Moon Fact Sheet. Retrieved from https://nssdc.gsfc.nasa.gov/planetary/factsheet/moonfact.html

[2] NASA Space Science Data Coordinated Archive,Venus Fact Sheet. Retrieved from https://nssdc.gsfc.nasa.gov/planetary/factsheet/venusfact.html

[3] NASA Space Science Data Coordinated Archive, Earth Fact Sheet. Retrieved from https://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html

[4] David B. Newell and Eite Tiesinga,Editors,NIST SP 330, 2019 edition,The International System of Units (SI),46. https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.330-2019.pdf

[5] NASA Space Science Data Coordinated Archive, Sun Fact Sheet. Retrieved from https://nssdc.gsfc.nasa.gov/planetary/factsheet/sunfact.html

[6] The NIST Reference on COnstants, Units, and Uncertainity, Newtonian constant of gravitation. Retrieved 17 January 2023 from https://physics.nist.gov/cgi-bin/cuu/Value?bg

[7] University of Washington Big G Measurement, Jens H. Gundlach and Stephen M. Merkowitz. Retrieved from https://asd.gsfc.nasa.gov/Stephen.Merkowitz/G/Big_G.html