About gravitation in relation to curvature

Einstein showed that gravitation can be understood in terms of curvatures. Although there has never been a real theoretic thesis that combines curvature and the traditional Newtonian gravitation laws, the ideas of Einstein are widely accepted. In this article we will try to build a bridge between curvatures an the Newtonian gravitation laws.

The resulting formula (12) is a formula that in our opinion reflects the implication of Einstein's theory about curvatures on gravity. This formula is made fit for masses on the equator of the planet. This is the situation were the forces work axial to the rotation ax of the planet. The gravitation laws of Newton are specific for this situation. Formula (12) gives an outcome that meets the outcome calculated in the traditional Newtonian way.

$$W_{object} = S_e \frac{1}{r} E_{object\ at\ peace} \qquad [kg.m.s^{-2} = m^{-1} kg.m^2 s^{-2}] \qquad (12)$$

W_{object} is the apparent weight of an object (N or $kg.m.s^{-2}$)
E is the energy of an object in peace on the surface of planet earth (J or Nm or $kg.m^2s^{-2}$)
r is the distance between the centers of the earth and the object on the surface of the earth (m)
S_e is the Smit constant on the equator (6,929255398 x 10^{-10})

Introduction

In the main article that was published on the internet on 21 November 2016 we introduced formula (0). This formula characterizes the influents of a single particle on its surrounding. In this article we are suggesting a new way in understanding gravity.

$$\sqrt{x^2 + y^2 + z^2} \times Kr = 1 \qquad (0)$$

In the formula Kr = curvature, x,y,z are coordinates in space/time (m^{-1}).

Formula (0) can also be written as: $Kr = \frac{1}{\sqrt{x^2+y^2+z^2}}$ (m^{-1})

When we use coordinates where y=0 and z=o we can simplify the formula to $Kr = \frac{1}{x}$ (m^{-1})

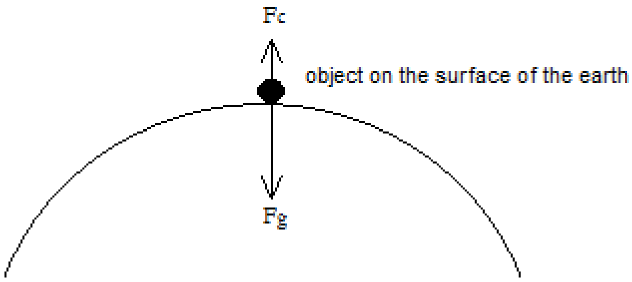
In the main article we deliberately did not give dimensions for the property Kr (curvature). Curvatures should be expressed in a dimensions that describe space/time. One can use the metric system but also other trivial systems. This depends of the specific work field. Physics will use the metric system, in chemistry some like to use Ångström, in cosmology scientist will use lightyears or parsec. In our main article we did not want to make a choice but the relations are obvious. In this article we use the metric system.

The apparent weight of an object in peace (Illustration 1) on the surface of the earth can be found traditionally as followed.

$$W_{object} = F_g - F_c \qquad (1)$$

W_{object} is the apparent weight of an object (N)
F_g is the gravitation force of the earth on an object in peace ($kg.m.s^{-2}$)
F_c is the centripetal force ($kg.m.s^{-2}$)

Illustration 1: object on the surface of the earth (at the equator)



Centripetal force

Huygens stated what is now known as the second of Newton's laws of motion in a quadratic form [note 1]. In 1659 he derived the now standard formula for the centripetal force, exerted by an object describing a circular motion, for instance on the string to which it is attached. In modern notation:

$$F_c = \frac{m\,V^2}{r} \qquad [kg.m.s^{-2} = \frac{kg\,(m.s^{-1})^2}{r}] \qquad (2)$$

F_c is the centripetal force ($kg.m.s^{-2}$)
M is the mass of an object (kg)
V the velocity ($m.s^{-1}$)
r the radius (m)

https://en.wikipedia.org/wiki/Christiaan_Huygens

Gravitation

Newton's law of universal gravitation states that a particle attracts every other particle in the universe using a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.[note 2] This is a general physical law derived from empirical observations by what Isaac Newton called inductive reasoning. It is a part of classical mechanics and was formulated in Newton's work Philosophiæ Naturalis Principia Mathematica ("the Principia"), first published on 5 July 1687. In modern notation:

$$F_g = G\frac{m1\,m2}{r^2} \qquad [kg.m.s^{-2} = kg.m.s^{-2}\,m^2kg^{-2}\,\frac{kg.kg}{m^2}] \qquad (3)$$

F_g is the force between the masses ($kg.m.s^{-2}$)
G is the gravitational constant ($6{,}67384 \times 10^{-11}$ $N\cdot m^2kg^{-2}$)
m1 is the first mass (kg)
m2 is the second mass (kg)
r is the distance between the centers of the masses (m).
https://en.wikipedia.org/wiki/Newton%27s_law_of_universal_gravitation

Apparent weight of an object in peace on the surface of the earth

For the calculation of the apparent weight of an object in peace on the surface of the earth we can use the following equation (4).

$$W_{object} = G\frac{m1\,m2}{r^2} - \frac{m2\,V^2}{r} \qquad [kg.m.s^{-2} = kg.m.s^{-2}m^2kg^{-2}\,\frac{kg.kg}{m^2} - \frac{kg\,(m.s^{-1})^2}{m}] \qquad (4)$$

W_{object} is the apparent weight of an object (N or $kg.m.s^{-2}$)
G is the gravitational constant ($6{,}67384 \times 10^{-11}$ $N\cdot m^2kg^{-2}$)
m1 mass of the earth (kg)
m2 mass object in peace (kg)
r is the distance between the centers of the earth and the object on the surface of the earth (m)
V the velocity surface of the earth ($m.s^{-1}$)
https://www.youtube.com/watch?v=lVtdC3Pynr0

In terms of curvature

Using formula (0) an object on earth will undergo the following curvature.

$$Kr_{\text{earth->object}} = \sum_{i=1}^{n} Kr_i \qquad [m^{-1} = m^{-1}] \qquad (5)$$

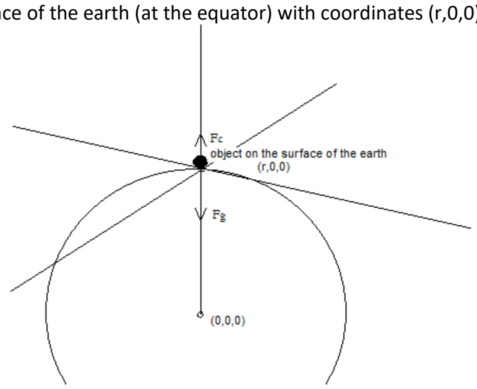
$Kr_{\text{earth-.object}}$ is the sum of the curvatures the object will experience from every particle (n) that is a part of planet earth (m^{-1})

We suggest that the weight of an object can be derived from the following formula (6).

$$W_{\text{object}} = \sum_{i=1}^{n} Kr_i \, E_{\text{object at peace}} \qquad [kg.m.s^{-2} = m^{-1} kg.m^2 s^{-2}] \qquad (6)$$

W_{object} is the apparent weight of an object (N)
Kr_i curvatures the object will experience from a particle (i) that is a part of planet earth (m^{-1})
$E_{\text{object at peace}}$ is the energy of an object in peace on the surface of planet earth (J or N.m or $kg.m^2s^{-2}$)

Illustration 2: object on the surface of the earth (at the equator) with coordinates (r,0,0)



The coordinates are chosen in a system where y = 0, z = 0. We can now write formula (6) as follows.

$$W_{\text{object}} = \sum_{i=1}^{n} \frac{1}{x_i} E_{\text{object at peace}} \qquad [kg.m.s^{-2} = m^{-1} kg.m^2 s^{-2}] \qquad (7)$$

W_{object} is the apparent weight of an object (N)
$E_{\text{object at peace}}$ is the energy of an object in peace on the surface of planet earth (J or N.m or $kg.m.s^{-2}$)
x_i is the position of a particle i that will have a curvature that is felt by the object (m)

In formula (7) x_i is always a fraction of the radius of the earth (r). We can now write formula (7) as follows.

$$W_{\text{object}} = \left(\frac{1}{a1\times r} + \frac{1}{a_2\times r} + \frac{1}{a_3\times r} + \frac{1}{a_4\times r} \ldots\ldots\ldots\ldots\ldots\ldots \frac{1}{a_n\times r}\right) E_{\text{object at peace}} \quad [\text{see } 7] \qquad (8)$$

$$W_{\text{object}} = \left(\frac{1}{a1} + \frac{1}{a_2} + \frac{1}{a_3} + \frac{1}{a_4} \ldots\ldots\ldots\ldots\ldots \frac{1}{a_n}\right)\frac{1}{r} E_{\text{object at peace}} \quad [\text{see } 7] \qquad (9)$$

$$W_{\text{object}} = S\frac{1}{r} E_{\text{object at peace}} \qquad [kg.m.s^{-2} = m^{-1} kg.m^2 s^{-2}] \qquad (10)$$

W_{object} is the apparent weight of an object (N)
$E_{\text{object at peace}}$ is the energy of an object in peace on the surface of planet earth (J or Nm or $kgms^{-2}$)
r is the distance between the centers of the earth and the object on the surface of the earth (6378×10^3 m)
a_i is the specific position of a particle "i" as a fraction of the radius of planet earth
S is the Smit constant

Using formula (4) we can write the following range for the apparent mass of an object.

$$W_{object} = S\frac{1}{r}\ E = G\frac{m1\ m2}{r^2} - \frac{m2\ V^2}{r}\ \ [kg.m.s^{-2} = m^{-1}kg.m^2s^{-2} = kg.m.s^{-2}m^2kg^{-2}\frac{kg.kg}{m^2} - \frac{kg\ (m.s^{-1})^2}{m}] \qquad (11)$$

W_{object} is the apparent weight of an object (N)
E is the energy of an object in peace on the surface of planet earth (J or Nm or $kg.m^2s^{-2}$)

- $E_{1\ kg}$ is $8{,}987551783 \times 10^{16}$ J
- $E_{atomic\ unit\ (1{,}66 \times 10^{-27}\ kg)}$ is $1{,}492417954 \times 10^{-10}$ J

r is the distance between the centers of the earth and the object (m) (r to the surface of the earth is 6378×10^3 m)
S is the Smit constant
G is the gravitational constant ($6{,}67384 \times 10^{-11}$ N· m^2kg^{-2})
m1 mass of the earth ($5{,}9722 \times 10^{24}$ kg)
m2 mass object in peace
V the velocity surface of the earth (464,23 $m.s^{-1}$)

To find the property for constant S we can simplify formula (11). For this we will some substitutions (formula a, b and c into 11). This will result in formula (d) and finally in formula (j). Using known quantities we can derive the value of the Smit constant.

$$E_{object\ at\ peace} = m_2C^2 \qquad (a)$$

$$m_1 = \frac{4}{3}\pi r^3\rho\ (kg) \qquad (b)$$

$$V = \frac{2\pi r}{86400}\ (m.s^{-1}) \qquad (c)$$

$$S\frac{1}{r}\ m_2C^2 = G\frac{\frac{4}{3}\pi r^3\rho\ m2}{r^2} - \frac{(\frac{2\pi r}{86400})^2 m2}{r} \qquad (d)$$

$$S\frac{1}{1}\ C^2 = G\frac{\frac{4}{3}\pi r^2\rho}{1} - \frac{(\frac{2\pi r}{86400})^2}{1} \qquad (e)$$

$$S = (G\frac{4}{3}\pi\rho - (\frac{2\pi}{86400})^2)\frac{1}{c^2}r^2 \qquad (f)$$

$$S = (1{,}536231227 \times 10^{-6} - 5{,}288496871 \times 10^{-9})\frac{1}{c^2}r^2 \qquad (g)$$

$$S = 1{,}53094273 \times 10^{-6}\frac{1}{c^2}r^2 \qquad (h)$$

$$S = 1{,}703403515 \times 10^{-23}\ r^2 \qquad (i)$$

$$S_{equator}\ (S_e) = 6{,}929255398 \times 10^{-10} \qquad (j)$$

ρ_{earth} is the density of planet earth ($\frac{4}{3}\pi r^3\rho = 5{,}9722 \times 10^{24} \rightarrow \rho = 5495{,}309903\ kg.m^{-3}$)
r_{earth} is the radius of planet earth (m) ($r_{equator}$ is 6378×10^3 m)
G is the gravitational constant ($6{,}67384 \times 10^{-11}$ N· $m^2.kg^{-2}$)
C is the lightspeed (299792458 m.s)
Π is 3,141 592 653 ……etcetera

The resulting formula (12) is a formula that in our opinion reflects the implication of Einstein's theory about curvatures. The formula is made fit for an object on the equator.

$$W_{\text{object}} = S_e \frac{1}{r} E_{\text{object at peace}} \qquad [\text{kg.m.s}^{-2} = m^{-1}\text{kg}.m^2 s^{-2}] \qquad (12)$$

W_{object} is the apparent weight of an object (N)
E is the energy of an object in peace on the surface of planet earth (J or Nm or kg.m^2s^{-2})
r is the distance between the centers of the earth and the object on the surface of the earth (m)
S_e is the Smit constant on the equator (6,929255398 x 10^{-10})

Planet earth

In the following example we will give the outcome of the calculation of the apparent mass of 1 kg and 1 u, on the equator of planet earth, through formula (12) and formula (4). The outcomes slightly differ.

$$W_{\text{object}} = S_e \frac{1}{r} E_{\text{object at peace}} \qquad (12)$$

$S_{equator}$ = 6,929255398 x 10^{-10}
r_{earth} is the radius of planet earth (m) ($r_{equator}$ is 6378x10^3 m)
E_u is 1,492417954 x 10^{-10} (J or Nm or kg.m^2.s^{-2})
E_{kg} is 8,987551783 x 10^{16} (J or Nm or kg.m^2.s^{-2})

Formula (12) gives:

$W_{u,\text{ at the equator}}$ = 1,621408774 x 10^{-26}N
$W_{1kg,\text{ at the equator}}$ = 9,764352729 N

$$W_{\text{object}} = G\frac{m1\,m2}{r^2} - \frac{m2\,V^2}{r} \qquad (4)$$

W_{object} is the apparent weight of an object (N)
G is the gravitational constant (6,67384 x 10^{-11} N· m^2.kg^{-2})
m1 mass of the earth (kg) (5,9722x10^{24} kg)
m2 mass object in peace (kg) (1 kg / 1 u or 1,660538921x10^{-27} kg)
r is the distance between the centers of the earth and the object on the surface of the earth (m)
V the velocity surface of the earth (m.s^{-1}) (464,23 m.s^{-1})

Formula (4) gives:

$W_{u,\text{ at the equator}}$ = 1,6213989x10^{-26} N
$W_{1kg,\text{ at the equator}}$ = 9,764293262 N

The moon

When we want do calculate the apparent mass of 1 kg on the equator of the moon we first have to define the Smit constant $S_{e\text{-moon}}$. For this we have to put in the correct numbers (ρ_{moon} = 3344 kg.m^{-3} , $r_{\text{moon at the equator}}$ = 1738,1 x 10^3 m) into formula (g). These numbers are given on the site https://nssdc.gsfc.nasa.gov/planetary/ factsheet/moonfact.html.

$$W_{\text{object}} = S_e \frac{1}{r} E_{\text{object at peace}} \qquad (12)$$

$S_{e\text{ moon}}$ is 3,124459609 x 10^{-11}
$r_{\text{moon at the equator}}$ = 1738,1 x 10^3 m
E_{kg} is 8,987551783 x 10^{16} (J or Nm or kg.m^2.s^{-2})

Formula (12) gives:

$W_{1kg,\text{ at the equator of the moon}}$ = 1,615628705 N

This is about 16,5 % of the weight on earth. This meets the value that is given on the site of Nasa.

Jelle Ebel van der Schoot, Gerhard Jan Smit, juni 21, 2017, Nijmegen, www.dbphysics.org

References

1) Ernst Mach, The Science of Mechanics (1919), e.g. p.143, p.172 and p.187 <https://archive.org/details/scienceofmechani005860mbp>.
2) Isaac Newton: "In [experimental] philosophy particular propositions are inferred from the phenomena and afterwards rendered general by induction": "Principia", Book 3, General Scholium, at p.392 in Volume 2 of Andrew Motte's English translation published 1729.