Exact Calculation of the Age of the Universe and of the Gravitation Constant dependent on Physical Constants

Version 2

Andreas Ball

Abstract:

The british Physicist Paul Dirac (1902 - 1984) founded the Large Number Hypothesis[1], which handles with strange relations using numbers in order of magnitude 10^{40}. Also the german Physicist, Mathematician and Philosopher Hermann Weyl (1885 - 1955) was occupied with relations of High Order Numbers. In this report Equations are presented, which give the Age of the Universe and the Gravitation Constant within their Tolerance Range both in dependence on Physical Constants.

Equation for the Age of the Universe:

The Age of the Universe is given to $13{,}787 \pm 0{,}02 \cdot 10^9$ years[2].

The Age of the Universe Age_{Univ} in SI-Unit s is: $13{,}787 \cdot 10^9 \cdot 3600 \cdot 24 \cdot 356{,}256 = 4{,}35092 \cdot 10^{17}$ s.

The maximal allowable relative tolerance range is: $(13{,}787 \pm 0{,}02) / 13{,}787$

that means a relative tolerance range from 0,99855 to 1,00145

The Large Number Equation LN_T, which is known since nearly 100 years, is written by use of the Age of the Universe, the Light Velocity c_L and the Electron Radius r_e to:

$$LN_T = Age_{Univ} \cdot c_L / r_e = 4{,}6288 \cdot 10^{40} \qquad \text{(LN-T1)}$$

A pretty simple, but harmonic Approximation of the quantity LN_T can be given by the following Equation LN_{TAppr}, at which the Fine Structure Constant α and the Circle Figure π are used:

$$LN_{TAppr} = (4\,\pi / \alpha)^{4\,\pi} = 4{,}6274 \cdot 10^{40} \qquad \text{(LN-T2)}$$

The values of the used quantities Light Velocity c_L, Electron Radius r_e and Fine Structure Constant α can be taken from the section Used Data of Physical Constants at page 4.

The Equation for the Approximation Age_{Univ_Appr} of the Universe Age is given by Equating of Equations (LN-T1) and (LN-T2) and by conversion of the Equation it can be written to:

$$Age_{Univ\_Appr} = (4\,\pi / \alpha)^{4\,\pi} \cdot r_e / c_L = 4{,}3496 \cdot 10^{17} \text{ s} = 13{,}783 \cdot 10^9 \text{ a} \qquad \text{(Age-Appr)}$$

The ratio of the calculated value Age_{Univ_Appr} to the set value is:

$13{,}783 / 13{,}787 = 0{,}99969$

The calculated value Age_{Univ_Appr} is far within the tolerance range of the set value[2] of the Universe Age. If one uses the terms “$1{,}000017 \cdot (4\,\pi)$“ or “$0{,}999988 \cdot (4\,\pi)$“ at the basis as well as at the exponent of Equation (Age-Appr) instead of the term “$4\,\pi$“, the result is outside the tolerance range of the set value.

The term “$4\,\pi$“ can also be observed at the Equation of the Magnetic Field Constant μ_0[3.5]:

$$\mu_0 = 4\,\pi \cdot (m_e \cdot r_e) / e^2$$

See values of the Magnetic Field Constant μ_0[3.5], the Electron mass m_e[3.6], the Electron Charge e[3.7] at page 4 at the section Used Data of Physical Constants.

The term “$4\,\pi$“ is also used at the Equation (G-EK) of Dr. Endre Kerezturi at page 2.

The Approximation LN_{TAppr} of the Large Number LN_T isn’t to difficult to find. One takes an Equation with the form $(A \cdot B)^A$ preferably for the Quantities with relatively big tolerance range, as for example the Gravity Constant G or the Age of Universe. One can determine quite fast the exact value of the quantity A by use of the tool “Target Value Search”, which is offered by most spreadsheet programs. The quantity B is in the case of Equation (Age-Appr) the Inverse of the Fine Structure Constant α.

By this circumstance it may possible, that Equation (LN-T2) was already found by someone else, but who is unknown to the author. If this person or group had found Equation (LN-T2) before the time, when the author of this report found the Equation (LN-T2), this person or group naturally can claim its creation.

Large Numbers for the Gravity Constant G:

The value of Gravity Constant G is given according literature [3.8] to:

$$G = (6{,}67430 \pm 0{,}00015) \cdot 10^{-11} \ m^3 \, kg^{-1} \, s^{-2} \qquad \text{(LN-G)}$$

In the following some Large Number LN_G are presented by use of Physical Constants and with the goal to fulfill the SI-Units of the Gravity Constants:

$$LN_{G1} = c_L^2 \cdot r_e / (m_e \cdot G) = 4{,}165609 \cdot 10^{42} \qquad \text{(LN-G1)}$$

$$LN_{G2} = c_L^2 \cdot r_p / (m_p \cdot G) = 6{,}769658 \cdot 10^{38} \qquad \text{(LN-G2)}$$

$$LN_{G3} = c_L^3 \cdot Age_{Univ\_Appr} / (m_e \cdot G) = 1{,}927584 \cdot 10^{83} \qquad \text{(LN-G3)}$$

$$LN_{G4} = c_L^3 \cdot Age_{Univ\_Appr} / (m_p \cdot G) = 1{,}049795 \cdot 10^{80} \qquad \text{(LN-G4)}$$

See value of the Proton Radius[6] r_p and the Proton Mass[7] m_p at page 4 at the section Used Data of Physical Constants.

Equation of Dr. Endre Kereszturi:

There is a spectacular Equation (G-EK) for the Gravitation Constant G of Dr. Endre Kereszturi[4]. The result with extra added Units (Meter $\mathbf{m}^{-5}$ and second **s**) is very exact referring the tolerance:

$$G_{EK} = h^5 \cdot \alpha^2 / [(c_L^2 \cdot m_e^6) \cdot (4\,\pi)^3] \cdot \mathbf{m}^{-5}\,\mathbf{s} = 6{,}6743017 \cdot 10^{-11} \, m^3 \, kg^{-1} \, s^{-2} \qquad \text{(G-EK)}$$

See the value of the Plancks Constant h[3.8] at page 4 at the section Used Data of Physical Constants.
Remarkable: Equation (G-EK) contains the term ($4\,\pi$), which is used two times at Equation (LN-T2)!
[A short Insert: dear Scientists, do you really think, that the result of Equation (G-EK) is random?
This Equation contains the relatively big exponent values 5 and 6. By this circumstance the values of the corresponding basis have to be highly exact to get this excellent result for the Gravitation Constant!].

The following Equation (G-EK0) is introduced with the goal to avoid working with extra added Units:

$$G_{EK0} = h^5 \cdot \alpha^2 / [(c_L^2 \cdot m_e^6) \cdot (4\,\pi)^3] = 6{,}6743017 \cdot 10^{-11} \, m^8 \, kg^{-1} \, s^{-3} \qquad \text{(G-EK0)}$$

To solve the missing units "$\mathbf{m}^{-5}$ **s**" at Equation (G-EK0), two kinds of Large Numbers LN_{G_EK} are introduced. The first kind of the Large Numbers possesses the just mentioned units "$\mathbf{m}^{-5}$ **s**":

$$LN_{G\_EK1} = 1 / (c_L \cdot r_e^4) = 5{,}2899568 \cdot 10^{49} \ m^{-5} \, s \qquad \text{(LN-G\_EK1)}$$

$$LN_{G\_EK2} = 1 / (c_L \cdot r_e^3 \cdot r_p) = 1{,}7727809 \cdot 10^{50} \ m^{-5} \, s \qquad \text{(LN-G\_EK2)}$$

$$LN_{G\_EK3} = 1 / (c_L \cdot r_e^2 \cdot r_p^2) = 5{,}9409787 \cdot 10^{50} \ m^{-5} \, s \qquad \text{(LN-G\_EK3)}$$

$$LN_{G\_EK4} = 1 / (c_L \cdot r_e \cdot r_p^3) = 1{,}9909526 \cdot 10^{51} \ m^{-5} \, s \qquad \text{(LN-G\_EK4)}$$

$$LN_{G\_EK5} = 1 / (c_L \cdot r_p^4) = 6{,}6721202 \cdot 10^{51} \ m^{-5} \, s \qquad \text{(LN-G\_EK5)}$$

$$LN_{G\_EK6} = 1 / (c_L \cdot r_e^{-1} \cdot r_p^5) = 2{,}2359742 \cdot 10^{52} \ m^{-5} \, s \qquad \text{(LN-G\_EK6)}$$

The second kind of the Large Numbers takes the values of the just presented Equations, but these Large Numbers are reduced to values without any SI-Units:

$$LN_{G\_EK1\#} = LN_{G\_EK1} \cdot m^5 \, s^{-1} = 5{,}2899568 \cdot 10^{49} \qquad \text{(LN-G\_EK1\#)}$$

$$LN_{G\_EK2\#} = LN_{G\_EK2} \cdot m^5 \, s^{-1} = 1{,}7727809 \cdot 10^{50} \qquad \text{(LN-G\_EK2\#)}$$

$$LN_{G\_EK3\#} = LN_{G\_EK3} \cdot m^5 \, s^{-1} = 5{,}9409787 \cdot 10^{50} \qquad \text{(LN-G\_EK3\#)}$$

$$LN_{G\_EK4\#} = LN_{G\_EK4} \cdot m^5 \, s^{-1} = 1{,}9909526 \cdot 10^{51} \qquad \text{(LN-G\_EK4\#)}$$

$LN_{G\_EK5\#} = LN_{G\_EK5} \cdot m^5\ s^{-1} = 6{,}6721202 \cdot 10^{51}$ (LN-G_EK5#)
$LN_{G\_EK6\#} = LN_{G\_EK6} \cdot m^5\ s^{-1} = 2{,}2359742 \cdot 10^{52}$ (LN-G_EK6#)

The Equations for the Gravitation Constant G are written in the following:

$G_{EK1} = G_{EK0} \cdot LN_{G\_EK1} / LN_{G\_EK1\#}$ (G-EK1)
$G_{EK2} = G_{EK0} \cdot LN_{G\_EK2} / LN_{G\_EK2\#}$ (G-EK2)
$G_{EK3} = G_{EK0} \cdot LN_{G\_EK3} / LN_{G\_EK3\#}$ (G-EK3)
$G_{EK4} = G_{EK0} \cdot LN_{G\_EK4} / LN_{G\_EK4\#}$ (G-EK4)
$G_{EK5} = G_{EK0} \cdot LN_{G\_EK5} / LN_{G\_EK5\#}$ (G-EK5)
$G_{EK6} = G_{EK0} \cdot LN_{G\_EK6} / LN_{G\_EK6\#}$ (G-EK6)

The mathematical art is now to find appropriate, reasonable Approximations for the Large Numbers $LN_{G\_EK1\#}$ to $LN_{G\_EK6\#}$. Furthermore the results of the Equations (G-EK1) to (G-EK6) have to be within the tolerance range of the Graviation Constant G.
This was already partly performed in the author's report [5] (see page 6 and 7), although at that time the Large Number Hypothesis was not yet known to the author.
·

An example of a Large Number Term for the Graviation Constant, but which lies outside the tolerance range, might be the following Equation:

$LN_{G\_EK6\#\_Appr} = 0{,}99 \cdot (5\,\pi / \alpha)^{5\,\pi} = 2{,}236469 \cdot 10^{52}$ (LN-G_EK6_Appr)
$G_{EK6\_Appr} = G_{EK0} \cdot LN_{G\_EK6} / LN_{G\_EK6\#\_Appr} =$
$= 6{,}6743017 \cdot 10^{-11}\ m^8\ kg^{-1}\ s^{-3} \cdot (2{,}2359742 \cdot 10^{52}\ m^{-5}\ s) / (2{,}236469 \cdot 10^{52}) =$
$= 6{,}67283 \cdot 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$ (G-EK6_Appr)

Result of Equation G_{EK6_Appr} lies below the lower value ($= 6{,}67400 \cdot 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$) of the tolerance range of the Gravitation Constant G, that means it lies outside the tolerance range of G.

The ratio G_{EK6_Appr} / G is: $6{,}67283 \cdot 10^{-11}\ m^3\ kg^{-1}\ s^{-2} / 6{,}67430 \cdot 10^{-11}\ m^3\ kg^{-1}\ s^{-2} = 0{,}99978$

If the value "$8{,}40833 \cdot 10^{-16}$ m", which lies far within the tolerance range of the Proton Radius r_p [$=(8{,}4087 \pm 0{,}0039) \cdot 10^{-16}$ m] according to Pohl[6], is set instead of the Set Radius r_p at Equation LN_{G_EK6}, the result of Equation (G-EK6a_Appr) corresponds closely to set value of the Gravitation Constant G.

$LN_{G\_EK6a} = 1 / [c_L \cdot r_e^{-1} \cdot (8{,}40833 \cdot 10^{-16}\ m)^5] = 2{,}236469 \cdot 10^{52}\ m^{-5}\ s$ (LN-G_EK6a_Appr)
$G_{EK6a\_Appr} = G_{EK0} \cdot LN_{G\_EK6a} / LN_{G\_EK6\#\_Appr} = 6{,}674295 \cdot 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$ (G-EK6a_Appr)

Result value of Equation (G-EK6a_Appr) corresponds very close to the set value of the Gravitation Constant ($= 6{,}67430 \cdot 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$) by use of the adapted Proton Radius ($=8{,}40833 \cdot 10^{-16}$ m).

The term 0,99 of Equation (LN-G_EK6_Appr) consists of the figures 0,9 and 1,1. And these figures - the 9 and 11 in combination with 10-powers - are named in the author's report [5] (see page 2) as helpful figures performing Approximations of Physical Constants and of Data of Earth, Moon and Sun.

Electric and Gravitation Forces:

The electric Force between a Proton and a Electron is determined to:

$F_e = e^2 \cdot \mu_0 \cdot c_L^2 / [4\,\pi \cdot (r_e + r_p)^2] = 17{,}2339$ N

The Gravitation Force between a Proton and a Electron is determined to:

$F_G = G \cdot m_e \cdot m_p / (r_e + r_p)^2 = 7{,}5965 \cdot 10^{-39}$ N

The ratio "F_e / F_G", which also can be seen as a Large Number, is written to:

$F_e / F_G = 2{,}2687 \cdot 10^{39}$

The ratio “F_e / F_G“ combined with the Large Number LN_{TAppr} delivers the following Equations:

$LN_{TAppr} \cdot F_e / F_G = 4{,}6274 \cdot 10^{40} \cdot 2{,}2687 \cdot 10^{39} = 1{,}0498 \cdot 10^{80} = c_L^3 \cdot Age_{Univ\_Appr} / (m_p \cdot G)$ $[\approx 10^{80}]$

$LN_{TAppr} \cdot F_G / F_e = 4{,}6274 \cdot 10^{40} / (2{,}2687 \cdot 10^{39}) = 20{,}3970$

Conclusion

By application of the Physical Constants Light Velocity c_L, Electron Radius r_e and Fine Structure Constant α and of a relative simple, but harmonic Equation for a Large Number LN a good Approximation could be presented for the Age of the Universe.
Furthermore some Large Numbers LN in dependence on the Proton Radius are presented for a possible calculation of the Gravitation Constant. One of this Large Numbers leads to an Equation for the Gravitation Constant G with a similar term as used for the Equation for the Age of the Universe.

Please look again at the impressive used terms: $\mathbf{(4\pi / \alpha)^{4\pi}}$ and $\mathbf{(5\pi / \alpha)^{5\pi}}$

At the end the author takes the permission to present an Aphorism, which begins with a question:

Dear Reader, can you imagine the invisible note below this mathematical terms and the signature?

“Dear Physicists, I hope it is now possible for you to see, that I am the Creator of the Universe.
Acknowledge it and realize, that your professional income is dependent on my creations!”

[Signature] God

Used Data of Physical Constants:

Fine Structure Constant α[3.1]:	$7{,}297\,352\,5693(11) \cdot 10^{-3}$
Inverse of Fine Structure Constant 1/α[3.2]:	137,035 999 084(21)
Light velocity c_L[3.3]:	299 792 458 m/s
Radius of Electron r_e[3.4]:	$2{,}817\,940\,3262(13) \cdot 10^{-15}$ m
Magnetic Field Constant μ_0[3.5]:	$1{,}256\,637\,062\,12(19) \cdot 10^{-6}$ kg m C^{-2}
Mass of Electron m_e[3.6]:	$9{,}109\,383\,7015(28) \cdot 10^{-31}$ kg
Electron Charge e[3.7]:	$1{,}602\,176\,634 \cdot 10^{-19}$ C
Plancks Constant h[3.8]:	$6{,}626\,070\,15 \cdot 10^{-34}$ J s
Radius of Proton r_p[6]:	$0{,}84087(39) \cdot 10^{-15}$ m
Mass of Proton m_p[7]:	$1{,}672\,621\,923\,69(51) \cdot 10^{-27}$ kg

The figures in the brackets behind the data descibe the uncertainty referring the last places of the given value[3].

Literature and wikipedia.de-Entries:

The data of the physical Constants are taken from the entries of Wikipedia Germany. The Physical Constants given in the corresponding entries refer mostly to CODATA 2018.
The reason of this choice can be read in the authors report[8] at section 8 (Page 13 and 14). For the calculation of the Universe Age by the Equation (Age) it takes a very neclegtable influence independent, if one uses the values of CODATA 2018 or a later CODATA-Version.

[1] Wikipedia.de-Entry “Large Number Hypothesis“; Status February 2025

[2] Wikipedia.de-Entry “Universum“; Status February 2025
2. Planck 2018 results. VI. Cosmological parameters. In: Astronomy & Astrophysics. Band 641.
Planck Collaboration, 2020, S. A6, PDF Seiten 15, Tabelle 2: "Age/Gyr", letzte Spalte,

doi:10.1051/0004-6361/201833910 (https://doi.org/10.1051/0004-6361%2F201833910), arxiv:1807.06209 (https://arxiv.org/abs/1807.06209), bibcode:2020A&A...641A...6P (https://ui.adsabs.harvard.edu/abs/2020A&A...641A...6P) (englisch)

[3] Wikipedia.de-Entry “Physikalische Konstante“; Status May 2024

[3.1] Fine Structure Constant α:
25. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?alph) NIST, abgerufen am 20. April 2020 (englisch, Wert für die Feinstrukturkonstante)

[3.2] Inverse of Fine Structure Constant α^{-1}:
26. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?alphinv) NIST, abgerufen am 20. April 2020 (englisch, Kehrwert der Feinstrukturkonstante)

[3.3] Light Velocity c:
12. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?c) NIST, abgerufen am 3. Juni 2019 (englisch, Wert für die Lichtgeschwindigkeit).

[3.4] Electron Radius r_e:
45. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?re) NIST, abgerufen am 3. Juni 2019 (englisch, Wert für den klassischen Elektronenradius).

[3.5] Magnetic Field Constant μ_0:
66. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?gn) NIST, abgerufen am 21. März 2022 (englisch, Wert für die Normfallbeschleunigung).

[3.6] Electron Mass m_e:
41. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?me) NIST, abgerufen am 3. Juni 2019 (englisch, Wert für die Elektronenmasse in Kilogramm).

[3.7] Electron Charge e:
13. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?e) NIST, abgerufen am 3. Juni 2019 (englisch, Wert für die Elementarladung).

[3.8] Plancks Constant h:
17. CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Value?h) NIST, abgerufen am 3. Juni 2019 (englisch, Wert für die Planck-Konstante in der Einheit Js).

[4] LAUFENDE KOPPLUNGSKONSTANTEN ZEIGEN DEN WEG ZUR WELTFORMEL DER NATURKONSTANTEN; Dr. Endre Kereszturi; 12.12.2010
[The Formula for the Gravitation Constant is listed at page 16 with Equation (19)]

[5] Exact Approximations of Physical Constants using the Figures Φ, π, 144 and 666; Andreas Ball; Published at viXra: viXra submission 2406.0018v1; 2024-06-13

[6] Muonic hydrogen and the proton radius puzzle; Randolf Pohl.
Published at arXiv: 1301.0905v2, doi: 10.1146/annurev-nucl-102212-170627
[The Proton Radius is listed at page 3 and page 58]

[7] Wikipedia.de-Entry “Proton“; Status March 2024
1. Die Angaben über die Teilcheneigenschaften (Infobox) sind, wenn nicht anders angegeben, entnommen aus: CODATA Recommended Values. (https://physics.nist.gov/cgi-bin/cuu/Category?view=html&Atomic+and+nuclear.x=114&Atomic+and+nuclear.y=16) National Institute of Standards and Technology, abgerufen am 21. Juli 2019.

[8] From the Electron to the Flower of Life - Proofs of God;
Andreas Ball; Published at viXra: viXra submission 2410.0077v3; 2024-11-28