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G (Rev. 1.1)

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0. Introduction

The purpose of this paper is to provide a second, independent calculation method for G that produces the same result as that discovered by the author in his previous paper (http://calqlata.com/Papers/Planck.pdf):

*(Refer to **Appendix 1** for an explanation of the mathematical formulas, constants, symbols and units used in this document)*

1. Conclusions

You will see the units for this constant (G) written as: $N.m^2/kg^2$, which were units of convenience originally assigned to reflect Newton's formula: $F = G.m_1.m_2 / R^2$
This was due to the fact that, until now, the formula for 'G' was unknown, hence its units were unknown.

1) Newton's gravitational constant: $G = a_o.c^2 / m_u$ = 6.67359232004332E-11 $m^3/kg/s^2$

2) The density of an electron, a proton and Planck's atom = 7.12660796350449E+16 kg/m^3

3) The ultimate density (that of all subatomic particles) = 7.12660796350449E+16 kg/m^3

4) The radius of an electron = 1.450460594262760E-16 m

5) The radius of a proton = 1.77613270336827E-15 m

6) 3E-91 is the ratio of the coupling forces in Rydberg's and Planck's atoms

7) 3E-91 m^6 is also the product of the volume of both coupled masses

8) The radius of Planck's mass = the mean radius of the coupled masses in a Rydberg atom

9) Planck's force: $F_{pl} = F_g / V_e.V_p$ (from a Rydberg atom)

2. The Planck System

Newton identified the presence of a gravitational factor 'G' but never its value.

Many estimates have been suggested but no exact value has ever been generated nor a formula for its generation until the author's previous paper; 'Planck's Atom' (http://calqlata.com/Papers/Planck.pdf)

In solving this problem, it is has been possible to define accurate properties for and relationships between electrons, protons and Planck's atomic properties

3. Methodology

Define Newton's gravitational constant (**G**) via the relationship between the coupling forces in both Rydberg's and Planck's atoms.

4. Calculations

You will see the units for this constant (G) written as: $N.m^2/kg^2$, which were units of convenience originally assigned to reflect Newton's formula: $F = G.m_1.m_2 / R^2$
because, until now, the formula for 'G' was unknown, hence its units were unknown.

From the relationship between Newton's Atom and Planck's Atom:
$F_N/F_P \equiv V_\varrho.V_e = 3E\text{-}91$ (exact)
where:
$F_N = G.m_\varrho.m_e/a_o^2$
$F_P = c^4/G$
$G = \sqrt{[3E\text{-}91.a_o^2.c^4 / m_\varrho.m_e]} = 6.67359232004334E\text{-}11$ $\{\sqrt{[m^2.m^4 / s^4.kg^2]} = m^3 / s^2.kg\}$
giving us a value and units for G, moreover;
$V_\varrho = m_\varrho/\rho_u$
$V_e = m_e/\rho_u$
$G.m_\varrho.m_e/a_o^2 \div c^4/G = m_\varrho/\rho_u \,.\, m_e/\rho_u = m_\varrho.m_e/\rho_u^2$
$G.m_\varrho.m_e/a_o^2 \div c^4/G = m_\varrho.m_e/\rho_u^2$
$G^2 / a_o^2.c^4 = 1/\rho_u^2$
$G^2 = a_o^2.c^4/\rho_u^2$
$G = a_o.c^2 / \rho_u$ $\{m^6/kg/s^2\}$

Because we know the units for G are $m^3/kg/s^2$, there must be a '*per unit volume'* component in this last formula, and given that $\rho.V$ = mass; Newton's gravitational constant may well be gravitational acceleration multiplied by an area per unit mass
i.e. $\mathbf{G = a_o.c^2 / m_u}$ $\{m^3/kg/s^2\}$
where:
F_N = Newtonian force between a proton and an electron
F_P = Planck's force
V_ϱ = volume of a proton
V_e = volume of an electron
m_ϱ = mass of a proton
m_e = mass of an electron
m_u = unit mass = $1m^3$ of substance of density; ρ_u
ρ_u = ultimate density
c = speed of light
a_o = Bohr's radius
G = Newton's gravitational constant

$G = a_o.c^2 / m_u$
G = 5.2917721067E-11 x 299792459² / 7.12660796350450E+16 = **6.67359232004334E-11**

If G = gravitational acceleration times spherical area per unit mass, the following calculations show that, contrary to popular belief, gravitational force does not diminish with the square of the distance from the centre of its source.

Factors 1.5 & 4 below are exact values and will be explained in due course
$G = \mathbf{1{\cdot}5}.c^2 / A.\rho_u = 6.67359232004334E\text{-}11$ $\{m^2/s^2 / (m^2.kg/m^3) = m^3 / s^2.kg\}$
$A = \mathbf{1{\cdot}5}.c^2 / G.\rho_u = \underline{2.83458918818674E\text{+}10}$ $\{m^2/s^2 / (m^3 / s^2.kg \,.\, kg/m^3) = m^2\}$
$R = \sqrt{[A / 4.\pi]} = 47494.1512680647$ $\{m\}$ ##
$V = {}^4/_3.\pi.R^3 = 4.48754692288540E\text{+}14$ $\{m^3\}$
$Rs = 2.G.m / c^2 = 47494.1512680647$ $\{m^3 / s^2.kg \,.\, kg / (m^2/s^2) = m\}$ #
$R = Rs$
$m = R.c^2 / 2.G = 3.19809876372352E\text{+}31$ $\{m \,.\, m^2/s^2 / (m^3 / s^2.kg) = kg\}$
$\rho = m/V = 7.12660796350450E\text{+}16$ $\{kg/m^3\}$
$\rho = \rho_u$

$G = Rs.c^2 / 2.m = 6.67359232004334E\text{-}11$ $\{m . m^2/s^2 / kg = m^3 / s^2.kg\}$
$Rs = 2.G.m / c^2 = 47494.1512680647$ $\{m^3 / s^2.kg . kg / (m^2/s^2) = m\}$ #
$g = G.m / R^2 = 9.46174592804013E\text{+}11$ $\{m^3 / s^2.kg . kg / m^2 = m/s^2\}$ ##
$F^N = G.m^2 / R^2 = 3.02595979551312E\text{+}43$ $\{m^3 / s^2.kg . kg^2 / m^2 = kg.m/s^2 = N\}$
$F^P = c^4 / G = 1.21038391820525E\text{+}44$ $\{m^4/s^4 / (m^3 / s^2.kg) = kg.m/s^2 = N\}$
$F^P/F^N = \mathbf{4}$
$R = \sqrt[4]{[9.F^P / 16.\pi^2.G.\rho^2.\mathbf{4}]} = 47494.1512680647$ # $\{\sqrt[4]{[kg.m/s^2 / (m^3 / s^2.kg) / (kg^2/m^6])} = m\}$
Schwarzschild radius (Rs) of mass 'm'

From the above formulas ##:
$G = g.A / 4.\pi.m = 6.67359232004334E\text{-}11$ $\{m^3 / s^2.kg\}$
$4.\pi.G = g.A / m = 8.38628344228057E\text{-}10$ $\{m^3 / s^2.kg\}$
This is strong evidence that $F^N = 4.\pi.G.m_1.m_2 / 4.\pi.R^2$

In other words
Newton's gravitational force should read thus: $F^N = 4.\pi.G.m_1.m_2 / A$
In which his gravitational constant should be: **$G = 4.\pi.G = 8.38628344228057E\text{-}10\ m^3/s^2/kg$**
I.e. gravitational force is constant irrespective of distance from the centre of its source, but a point force at any distance (R) will vary according to its distribution over the spherical area (at R).
This argument is supported by the conservation of energy law.

Two aspects of this discovery require further explanation:
1) $a_o = \mathbf{1{\cdot}5}/A.V$ ($V = 1m^3$) where A = <u>2.83458918818674E+10</u> m^2; what is 'A'? > TBA
2) $F^P/F^N = \mathbf{4}$ > TBA
Neither of which alter the final result

If the relationship between Planck's and Newton's sub-atomic particles is correct:
$V_e.V_\varrho$ [Planck] = $V_e.V_\varrho$ [Newton] must hold true
where V_e & V_ϱ are the force-centre and satellite (proton & electron) volumes respectively
If G & ρ_u are exactly as defined above:
$V_e.V_\varrho$ [Newton] = $V_e.V_\varrho$ [Planck] = 3E-91 $\{m^6\}$ (exactly)
If G & ρ_u are not exactly as defined above:
$V_e.V_\varrho$ [Newton] $\neq$ $V_e.V_\varrho$ [Planck] $\neq$ 3E-91 $\{m^6\}$ (exactly)
Because V_e [Planck] = V_ϱ [Planck]; $R = \sqrt[6]{[9 \times 3E\text{-}91 \div 16\pi^2]} = 5.07563837996471E\text{-}16$ m,
is the radius of the Planck particle, it may be inferred that all the above relationships are correct.

And finally; according to Planck: $\mathbf{G} = 2\pi.\lambda^2.c^3 / h = \lambda^2.c^3 / \hbar$ $\{\mathbf{m^3 / s^2.kg}\}$, confirming the units for 'G'

In this solution to 'G', Planck's atom, Rydberg's atom and Newton's theories have been fully analysed and found to complement each other perfectly.
The discovery of so many sub-atomic associations with G means that Newton actually did anticipate both Poincaré and Planck, which probably means his theories can be applied throughout all science, from the largest to the smallest ...
i.e. there is probably no need for a unification theory

5. Claims

Claim 1: Newton's gravitational constant: $G = 4\pi \times 6.67359232004334E{-}11\ m^3/kg/s^2$

Claim 2: The density of an electron, a proton and Planck's atom are all equal to 7.12660796350449E+16 kg/m^3

Claim 3: The ultimate mass-density (that of all subatomic particles) = 7.12660796350449E+16 kg/m^3

Claim 4: The radius of an electron is 1.45046059426276E-16 m

Claim 5: The radius of a proton is 1.77613270336827E-15 m

Claim 6: 3E-91 is the ratio of the coupling forces in both Rydberg's and Planck's atoms

Claim 7: 3E-91 m^6 is the product of the volume of both coupled masses in the Rydberg and the Planck atoms

Claim 8: 3E-91 is the radius of a sub-atomic particle in a Planck atom

Claim 9: The radius of Planck's mass is the mean radius of the coupled masses in a Rydberg atom

Claim 10: Planck's force may be calculated via the coupling force and properties of an electron and a proton: $F_{pl} = F_g / V_e.V_p$

Claim 11: Gravitational force remains constant irrespective of distance from its source. However, the gravitational force at any point on a given radius from the centre of the source will diminish according to its distribution over the spherical area at that radius.

Appendices

Appendix 1: Mathematical Constants, Formulas, Symbols & Units

Appendix 1: Mathematical Symbols & Units

G = Newton's gravitational constant

c = the speed of light in a vacuum (299792459 m/s)

a_o = Bohr radius of separation between a ground-state electron in Shell 1 and its proton (5.2917721067E-11 m)

λ_{pl} = Planck length (1.61616952231127E-35 m)

F_g = the gravitational coupling force between two masses as defined by Newton

F_{pl} = the gravitational coupling force between two Planck masses as defined by the author

F_N = gravitational coupling force as defined by Newton

F_P = gravitational coupling force as defined by Planck

V_e = volume of an electron (see Table below)

V_p = volume of a proton (see Table below)

m_e = mass of an electron (see Table below)

m_p = mass of a proton (see Table below)

m_{pl} = Planck mass (see Table below)

ρ_u = [ultimate] density of fundamental masses (see Table below)

m_u = one unit volume of matter of ultimate density

The following Table includes the properties of the Rydberg atom and the Planck atom

Sym (units)	electron	proton	Planck mass
mass (kg)	9.1093897E-31	1.67262163783E-27	2.1765500017459E-08
radius (m)	1.45046059426276E-16	1.77613270336827E-15	5.07563837996471E-16
volume (m³)	1.27822236702922E-47	2.34700946985653E-44	5.47722557505167E-46
density (kg/m³)[1]	7.12660796350449E+16		3.97381844498046E+37

[1] Current estimates for the electron and proton radii (9.0873458355E-017m & 1.112772961E-15m respectively) and their masses (9.1093897E-31kg & 1.67262163783E-27kg respectively) result in respective densities (9.659802539E+16kg/m³ & 9.65980042E+16 kg/m³) that are close enough to assume that the radii are probably incorrect but the densities should be identical. The same density is used to establish the radius and volume of the Planck mass

Refer to CalQlata's **Definitions** (http://calqlata.com/help_definitions.htm) for an explanation of the terms used in this paper