

Non-Physical Unit Systems in General Relativity, and in Quantum Field Theory

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Abstract: Unit Systems that aim to simplify formulas are Non-Physical, and lead to the demise of the theories.

The assumption $c = 1$ sets physics back hundreds of years, as it implies that light speed is infinite, and axiomatizes the fallacy, unsupported by the Lorentz Transformation, that light speed is the greatest possible speed.

In General Relativity, the assumption $c = 1$, combines two separate CGS systems, the ESU, and the EMU, into a non-physical unit system, in which the crucial dependence of light speed on the vacuum permittivity, and permeability is lost, and allows Einstein to claim that Gravitational Potential is similar to Electromagnetic Potential. Then, Einstein's formula for the precession of the perihelion of a planet works only for Magnetic attraction between a Pulsar, and its companion. Einstein's Theory of Gravitation does not apply to gravitational potentials.

The assumption $\hbar = 1$ transforms Quantum Physics into Classical Physics, and negates the Quantum Hypothesis, setting physics back to its pre-quantum times.

In Quantum Field Theory, imposing the two paradoxial assumptions $\hbar = c = 1$, in order to obtain “Natural Units”, mandates infinite light speed, and a quantum-less theory, guaranteed to lead to paradoxial results.

Keywords Unit Systems, Light Speed, Planck Constant, General Relativity, Quantum Field Theory, Electro Static Units, ESU, Electro Magnetic Units, EMU, Lorentz Transformation, Gravitational Potential, Retarded Electro Magnetic Potential, Gravito-Magnetism, Gravitational Waves, Tests of General Relativity, Quantum Physics, Classical Physics, Quantum Hypothesis, Natural Units,

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0.

Light Speed and Planck's Constant

It is well known that

$$c = 299,792,458 \text{ Meter / Second}$$

is the speed of light in the vacuum.

and that

$$\hbar = \frac{h}{2\pi} = 1.05457266(63) \times 10^{-34} \text{ Joule} \times \text{Second},$$

where h is the Planck constant.

Thus,

$$\frac{c}{\hbar} \sim 10^{42}.$$

That enormous ratio is ignored when both constants are set to 1, in order to make them disappear from formulas, in Quantum Field Theory.

As it turns out, setting the constants to 1, not only ensures Non-sensible Math, but sets physics back hundreds of years.

The “Natural Units” are not units, and their implications go beyond being notational artifacts.

1.

The Electro Static Unit System, and the Electro Magnetic Unit System

Both the Electro Static Unit (ESU) system, and the Electro Magnetic Unit (EMU) system use Centimeter, Gram, and Second.

The Coulomb Electrostatic Force between two charges Q_1 , and Q_2 at distance r from each other is

$$F_e = k_e \frac{Q_1 Q_2}{r^2},$$

where

$$k_e = \frac{1}{4\pi\epsilon_0},$$

and

ϵ_0 = the permittivity in the air.

The Ampere Electromagnetic Force per unit length between two parallel wires carrying currents I_1 , and I_2 , at distance r from each other is

$$\frac{dF_m}{dl} = 2k_m \frac{I_1 I_2}{r^2},$$

where

$$k_m = \frac{\mu_0}{4\pi},$$

and

μ_0 = the permeability in the air.

And

$$c^2 = \frac{k_e}{k_m} = \frac{1}{\varepsilon_0 \mu_0}.$$

In ESU,

$$k_e = 1.$$

Hence,

$$\varepsilon_0 = \frac{1}{4\pi},$$

$$c^2 = \frac{1}{k_m} = \frac{4\pi}{\mu_0}.$$

In EMU,

$$k_m = 1.$$

Hence,

$$\mu_0 = 4\pi,$$

$$c^2 = k_e = \frac{1}{4\pi\varepsilon_0}.$$

There is no physical unit system in which both $k_e = 1$, and

$$k_m = 1.$$

In such non-physical system,

$$c^2 = 1,$$

Hence,

$$c = 1.$$

Yet, this is the condition Einstein imposed on his theory of General Relativity.

We will see that the assumption that $c = 1$, means that the speed of light is infinite. A non-physical fallacy.

And we will prove that the messed up unit system that Einstein used, lead him to a false theory of Gravitation.

2.

$c = 1$, means that Light Speed is Infinite

the assumption

$$c = 1,$$

means that

$$c^2 = 1,$$

$$c^3 = 1,$$

$$c^4 = 1,$$

$$c^{10^{10^{10}}} = 1.$$

For all practical purposes

$$(3 \cdot 10^8)^{10^{10^{10}}}$$

cannot be distinguished from infinity. If we can build a computer that will distinguish it from infinity, that computer will not be able to distinguish

$$(3 \cdot 10^8)^{10^{10^{10^{10}}}}$$

from infinity. In other words, the assumption $c = 1$, maps infinity effectively into 1.

Even if one believes that light speed is the largest possible speed, experiment proves that light speed is not infinity. And it better be finite, because no one knows what infinity means.

3.

$c = 1$ is the Fallacy that Light Speed is the Greatest Possible Speed

$c = 1$ means that superluminal speed is impossible.

Any speed $v > c$, is between some $c^m = 1$, and $c^{m+1} = 1$.

Therefore, $v = 1$, and no speed may exceed light speed.

Thus, the assumption $c = 1$ is a contraction that squeezes the interval of numbers between 1, and ∞ into the point $z = 1$.

In [Dan1] we showed that since the Lorentz Transformation breaks down only at light speed, and since superluminal speeds $v > c$ lead to no singularity in the Lorentz Transformation, Special Relativity extends to Faster Than Light speeds, $v > c$.

The belief that light speed is the greatest possible speed is a fallacy that stems from panic over the breakdown of the Lorentz Transformation at light speed.

That fallacy is not supported by the Mathematics of the Lorentz Transformation, and a correct derivation of Special Relativity

Consequently,

the assumption $c = 1$ amounts to hypothesizing the fallacy that light speed is the greatest possible speed.

We will show that Einstein went further to confuse the Retarded Gravitational Potential with a Retarded Electrodynamics Potential, and to produce a false formula for the precession of the

perihelion of Mercury. [Dan2]

Einstein's General Relativity is not a Gravitational Theory but an Electromagnetic Theory. His Precession of a planet formula that fails for Gravitation, does work for Pulsars where the attraction is due to enormous Magnetic Fields between the Neutron star and its companion. [Dan3]

We proceed to elaborate on Einstein's General Relativity

4.

Einstein's Gravitational Potential is Electro-Magnetic

Space-time coordinates are

$$x^\mu = (x, y, z, t).$$

A metric on space-time is the differential form

$$(ds)^2 = \sum_{\mu=1}^{\mu=4} \sum_{\nu=1}^{\nu=4} g_{\mu\nu} dx^\mu dx^\nu .$$

The 4×4 symmetric matrix $g_{\mu\nu}(x^\alpha)$ is the metric tensor.

To first order, take [Einstein2],

$$g_{\mu\nu}(x^\alpha) = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} + \gamma_{\mu\nu}(x^\alpha), \quad \text{with } |\gamma_{\mu\nu}(x^\alpha)| \ll 1.$$

Christoffel symbols are the Gravitational Potentials.

Christoffel symbols of the 1st kind are the components of the $4 \times 4 \times 4$ symmetric matrix

$$\Gamma_{\lambda\mu\nu}(x^\alpha) = \frac{1}{2} \left[\partial_{x_\lambda} g_{\mu\nu} + \partial_{x_\mu} g_{\lambda\nu} - \partial_{x_\nu} g_{\lambda\mu} \right]$$

Christoffel symbols of the 2nd kind are the components of the

$4 \times 4 \times 4$ symmetric matrix

$$\Gamma_{\lambda\mu}^{\tau}(x^{\alpha}) = g^{\tau\nu}\Gamma_{\lambda\mu\nu}$$

Following [Einstein1] notations, the equation of motion of a material point along a geodesic in space-time is

$$\frac{d^2x_{\tau}}{ds^2} = \Gamma_{\mu\nu\tau} \frac{dx_{\mu}}{ds} \frac{dx_{\nu}}{ds}. \quad (22), \text{ on p.132}$$

(equation (46), p.158, is the same, except for a misprint)

On p. 158, Einstein assumes non-relativistic speed

$$v = \sqrt{\left(\frac{dx_1}{dx_4}\right)^2 + \left(\frac{dx_2}{dx_4}\right)^2 + \left(\frac{dx_3}{dx_4}\right)^2} \ll 1,$$

and concludes that

$$\left|\frac{dx_1}{ds}\right|, \left|\frac{dx_2}{ds}\right|, \left|\frac{dx_3}{ds}\right| \sim 0, \text{ while } \left|\frac{dx_4}{ds}\right| \sim 1.$$

Also, $\Gamma_{\mu\nu\tau}$ are small. Thus, equation (46) keeps only the terms with $\mu = \nu = 4$, and becomes

$$\begin{aligned} \frac{d^2x_{\tau}}{ds^2} &= \Gamma_{44\tau} = \frac{1}{2}[\partial_4 g_{4\tau} + \partial_4 g_{4\tau} - \partial_{\tau} g_{44}], \\ &\sim -\partial_{\tau}(\frac{1}{2}g_{44}), \quad (67), \end{aligned}$$

neglecting the smaller size terms.

Taking $dx_4 = ds = dt$,

$$\frac{d^2 x_\tau}{dt^2} = \Gamma_{44\tau} \sim -\nabla\left(\frac{1}{2}g_{44}\right)$$

Thus, by Newton's law the Gravitational Potential is $\frac{1}{2}g_{44}$.

From equation (53) on p. 149, (correcting the misprint)

$$\partial_{x_\tau} T_{\mu\nu\tau} + T_{\mu\beta}^\alpha T_{\nu\alpha}^\beta = -\kappa(T_{\mu\nu} - \frac{1}{2}g_{\mu\nu}T).$$

Substituting

$$\mu = \nu = 4,$$

and

$$T_{44} = T = \rho = \text{matter density},$$

$$\underbrace{\partial_{x_\tau}}_{\nabla \cdot} \underbrace{T_{44\tau}}_{-\nabla(\frac{1}{2}g_{44})} + \underbrace{T_{4\beta}^\alpha T_{4\alpha}^\beta}_{\text{2nd order}} = -\kappa \underbrace{(T_{44} - \frac{1}{2}g_{44}T)}_{\sim 1}.$$

$\frac{1}{2}\rho$

$$\nabla^2\left(\frac{1}{2}g_{44}\right) = \frac{1}{2}\kappa\rho.$$

The Gravitational Potential is

$$\frac{1}{2}g_{44} = -\frac{1}{8\pi}\kappa \int \frac{\rho}{r} d\tau,$$

because $\nabla^2\left(-\frac{1}{8\pi}\kappa \int \frac{\rho}{r} d\tau\right) = -\frac{1}{8\pi}\kappa \int \underbrace{\nabla^2 \frac{1}{r}}_{-4\pi\delta(r)} \rho(\vec{r}) d\tau = \frac{1}{2}\kappa\rho.$

Einstein concludes with the fatally erroneous guess

"...Newton's Theory, with our chosen unit of time,

gives (for the Gravitational Potential) $-\frac{G}{c^2} \int \frac{\rho}{r} d\tau$

where $G = 6.7 \times 10^{-8}$ is the Gravitation constant.

By comparison, $\kappa = \frac{1}{c^2} 8\pi G$ ”

**Gravitational Potential generated by matter
need not be affected by light speed and Lorentz
transformations that deal with charges, and photons,**
The formulas for Electromagnetic Fields that embellish
[Einstein1] did not help Einstein understand
Electromagnetic retarded potentials.

His assumption $c = 1$, imposes a non-physical unit system in
which, as in ESU system

$$\varepsilon_0 = \frac{1}{4\pi},$$

and as in the EMU system

$$\mu_0 = 4\pi.$$

But while in either the ESU, or the EMU systems c is given
by

$$c^2 = \frac{1}{\varepsilon_0 \mu_0},$$

in Einstein’s non-physical unit system,

$$c^2 = 1,$$

and both ε_0 , and μ_0 have no effect on c .

5.

Retarded Potentials and Gravito-Magnetism

In Electrostatics, we assume an Electric Field $\vec{E}(r)$, derived from an Electric Potential $\phi(r)$, so that

$$\vec{E} = -\nabla\phi,$$

and generated by a charge distribution with density $\rho(r)$ so that

$$\nabla \cdot \underbrace{\vec{E}}_{-\nabla\phi} = \frac{\rho}{\epsilon_0},$$

where ϵ_0 is the Electric Permittivity of the vacuum. Thus,

$$\nabla^2\phi = -\frac{\rho}{\epsilon_0},$$

$$\phi = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(r)}{r} dV.$$

In Electrodynamics, we assume Magnetic Induction $\vec{B}(\vec{r}, t)$, derived from a Magnetic Vector Potential $\vec{A}(\vec{r}, t)$, so that

$$\vec{B} = \vec{\nabla} \times \vec{A},$$

and Electric Field $\vec{E}(\vec{r}, t)$, derived from an Electric Potential

$\phi(\vec{r}, t)$, so that

$$\vec{E} = -\nabla\phi - \partial_t\vec{A}.$$

Then,

$$\nabla \cdot \underbrace{\vec{E}}_{-\nabla\phi - \partial_t\vec{A}} = \frac{\rho}{\epsilon_0},$$

$$\nabla^2\phi + \partial_t\nabla \cdot \vec{A} = -\frac{\rho}{\epsilon_0}.$$

Assuming Lorentz Condition, $\nabla \cdot \vec{A} = -\epsilon_0\mu_0\partial_t\phi$, where μ_0 is the Magnetic Permeability of the vacuum

$$\nabla^2\phi - \underbrace{\epsilon_0\mu_0}_{\frac{1}{c^2}}\partial_t^2\phi = -\frac{\rho}{\epsilon_0}.$$

This is an electromagnetic wave equation for ϕ , with propagation speed

$$c = \frac{1}{\sqrt{\epsilon_0\mu_0}}.$$

Then, the potential $\phi(\vec{r}, t)$ at \vec{r} , at time t , is the summation on contributions at $\vec{\xi}$, at the retarded time $t - \frac{r}{c}$,

$$\phi(\vec{r}, t) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(\vec{\xi}, t - \frac{r}{c})}{|\vec{r} - \vec{\xi}|} dV_{\vec{\xi}}.$$

For Gravitation to follow from a similar formulation, we

have to assume a Gravitto-Magnetic Field \vec{B}_G , derived from a Gravitto-Magnetic potential \vec{A}_G , that was never detected, so that

$$\vec{B}_G = \vec{\nabla} \times \vec{A}_G,$$

and a Gravitational Field $\vec{E}_G(\vec{r}, t)$, derived from a Potential $\phi_G(\vec{r}, t)$, so that

$$\vec{E}_G = -\nabla\phi_G - \partial_t\vec{A}_G.$$

Then we would need a Gravitational Lorentz Condition

$$\nabla \cdot \vec{A}_G = -\varepsilon_G\mu_G\partial_t\phi_G,$$

where we would have to give meaning to

$$\varepsilon_G, \text{ and } \mu_G,$$

and explain how

$$\frac{1}{\sqrt{\varepsilon_G\mu_G}} = \frac{1}{\sqrt{\varepsilon_0\mu_0}} = c.$$

The relation $\frac{1}{\varepsilon_0\mu_0} = c^2$ is exclusive to Electro-Magnetics.

In Gravitation, ε_0 , and μ_0 , have no parallel, and at most we can assume that Gravitational Waves exist, and propagate at some speed v_G .

Einstein's Gravitational waves propagate at light speed because he assumed so.

6.

Einstein's Gravitational Waves

Keeping $\kappa = \frac{8\pi G}{c^2}$, Einstein renews his erroneous claim that

Gravitational Waves propagate at light speed.

To first order he has [Einstein2],

$$g_{\mu\nu}(x^\alpha) \sim \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} + \gamma_{\mu\nu}(x^\alpha), \quad (1) \text{ on p.201}$$

where $|\gamma_{\mu\nu}(x^\alpha)| \ll 1$.

To first order, the Field Equations are

$$\sum_{\alpha} \left[\frac{\partial^2 \gamma_{\mu\alpha}}{\partial x_{\nu} \partial x_{\alpha}} + \frac{\partial^2 \gamma_{\nu\alpha}}{\partial x_{\mu} \partial x_{\alpha}} - \frac{\partial^2 \gamma_{\mu\nu}}{\partial x_{\alpha}^2} \right] - \frac{\partial^2 \sum_{\alpha} \gamma_{\alpha\alpha}}{\partial x_{\mu} \partial x_{\nu}} \sim -2\kappa (T_{\mu\nu} - \frac{1}{2} \delta_{\mu\nu}) \sum_{\alpha} T_{\alpha\alpha}, \quad (2)$$

where κ is understood as $\kappa = \frac{8\pi G}{c^2}$ from [Einstein1].

He substitutes

$$\gamma_{\mu\nu} = \gamma'_{\mu\nu} + \psi \delta_{\mu\nu}, \quad (3)$$

where

$$\sum_{\nu} \partial_{x_{\nu}} \gamma'_{\mu\nu} = 0, \quad (4)$$

$$\sum_{\alpha} \gamma'_{\alpha\alpha} = -2\psi, \quad (5)$$

and obtains

$$\sum_{\alpha} \frac{\partial^2 \gamma'_{\mu\nu}}{\partial x_{\alpha}^2} = 2\kappa T_{\mu\nu}. \quad (6)$$

He concludes with

“... the $\gamma'_{\mu\nu}$ are the retarded potentials

$$\gamma'_{\nu\mu} = -\frac{1}{2\pi} \kappa \int \frac{T_{\mu\nu}(x_0, y_0, z_0, t - r)}{r} dV_0 \quad (9)”$$

And sums up on page 206,

“It follows from (6) and (9) that gravitational fields always propagate with velocity 1, that is, with the speed of light.”

But

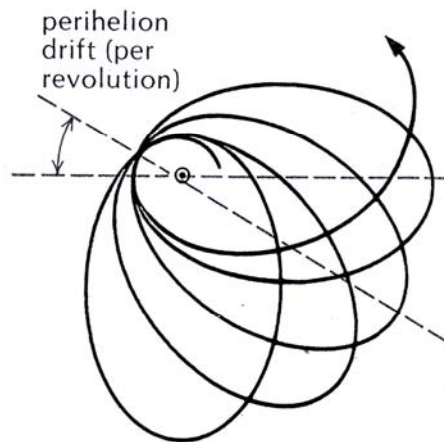
$\kappa = \frac{8\pi G}{c^2}$ **was established erroneously in [Einstein1].**

7.

General Relativity is Not Confirmed by the Precession of the Perihelion of Mercury

Einstein claimed that the unexplained part in the observed precession of the perihelion of the planet Mercury around the sun is explained by his General Relativity.

A planet elliptical orbit rotates slowly in the direction of its motion and its perihelion encircles the sun.



Einstein proposed that the unexplained precession in radians per

revolution is

$$24\pi^3 \frac{a^2}{T^2 c^2 (1 - e^2)},$$

where

a = half the major axis of the ellipse (in centimeters)

e = eccentricity

c = light speed in the vacuum (in centimeters)

T = period of a revolution (in seconds)

Substituting $c^2 = \frac{8\pi G}{\kappa}$, the unexplained precession is

$$3\pi^2 \frac{a^2}{T^2 G (1 - e^2)} \kappa$$

According to Einstein, it equals the unexplained precession of the perihelion of Mercury by 43" per hundred years.

But $\kappa = \frac{8\pi G}{c^2}$ is based on the erroneous guess that retarded gravitational and electromagnetic potentials are identical.

And the 43" value is highly speculative.

By the Wikipedia's "Tests of General Relativity",

the observed perihelion precession of Mercury is 574".

By unspecified arguments, Gravitational pull of other planets accounts for 531", and 43" is unaccounted for.

Since the certainty of these claims is unknown, we have to consider them in terms of statistical confidence.

Note that 97% confidence in 531", allows for 3% error in 531" which is 15.93". But that means a 37% error in 43" which allows only 63% confidence in the 43".

Note that 95% confidence in 531" allows for 26.55" error, and only 38% confidence in the 43".

By obtaining the 43" with erroneous κ , Einstein's General Relativity establishes with 100% confidence that the unaccounted for perihelion precession of Mercury is NOT 43".

In a 11/28/1919 letter to the London Times, Einstein submitted that had any of his tests been wrong, the whole theory would be beyond repair, and would have to be given up:

"The chief attraction of the theory lies in its logical completeness. If a single one of the conclusions drawn from it proves wrong, it must be given up; to modify it without destroying the whole structure seems to be impossible"

He must have been aware of his unsubstantiated guess that Gravitational and Electromagnetic retarded potentials are identical, and of the speculative perihelion precession of Mercury that never confirmed his Theory.

8.

$\hbar = 1$ transforms Quantum Physics into Classical Physics

the assumption

$$\hbar = 1,$$

means that

$$\hbar^2 = 1,$$

$$\hbar^3 = 1,$$

$$\hbar^{10^{10^{10}}} = 1.$$

For all practical purposes,

$$\hbar^{10^{10^{10}}}$$

cannot be distinguished from zero. If we can build a computer that will distinguish it from zero, that computer will not be able to distinguish

$$\hbar^{10^{10^{10^{10}}}}$$

from zero. In other words, the assumption $\hbar = 1$, maps 0 effectively to 1.

Namely, the assumption $\hbar = 1$, is equivalent to $\hbar = 0$.

And even for $\hbar \rightarrow 0$, Quantum Mechanics transforms into Classical Mechanics

9.

$\hbar = 1$ Negates the Quantum Hypothesis

$\hbar = 1$ means that the Quantum Hypothesis is false.

Any fraction q is between some $\hbar^m = 1$, and $\hbar^{m+1} = 1$.

Therefore, $q = 1$, and all fractions vanish.

Thus, the assumption $\hbar = 1$ is a contraction that squeezes the interval of numbers between 0, and 1 into the point $z = 1$.

Due to the assumption $\hbar = 1$, 1 is identified with zero, and \hbar is set to zero.

Then, Quantum Mechanics transforms into Classical Mechanics, energy is not emitted or absorbed in quanta, and the quantum hypothesis is false.

Consequently, Planck's formula for black body radiation is unavailable, the Photo-Electric effect cannot be explained, Compton effect is a puzzle, and Lasers are pure fiction.

the assumption $\hbar = 1$ negates the Quantum Hypothesis.

10.

“Natural Units” in Quantum Field Theory

By imposing the combined assumptions

$$c = 1, \quad \text{and} \quad \hbar = 1,$$

on a Centimeter- Gram-Second system, a non-physical unit system called “Natural Units” is obtained.

It is non-physical because it confuses the ESU, and the EMU systems.

It mandates infinite light speed, and no Quantum Hypothesis. Quantum Field Theory is quantum-less.

Based on erroneous assumptions, Quantum Field Theory must lead to paradoxes, even if we do not wish to study, and point out those paradoxes

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