Abstract Units of Measure

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Abstract

The units of measure in physics can be translated to “abstract units of measure” to use only seconds and meters. The standard kilogram and Coulomb are causing unnecessary blockage of theoretical physics. When those seemingly prime units of measure are analyzed into several factors, new insights are revealed. For example, the magnetic field intensity H is a velocity. This progress is due to the understanding that electron mobility measures the same phenomenon as conductance. Units are reconciled so that charge is an area of spacetime, as shown in a voltage equation. Voltage involves mass and charge. There are other electromagnetic units of measure that also can be abstracted. Capacitance will become seconds squared using a permittivity equation without involving a voltage. Inductance will be known as dimensionless, with the lengths cancelling out. Each Weber of magnetic flux will be seen as having the same units and magnitude as a certain current, but displaced, and at an angle to the current. The flux representation as area per second should be used as the units of measure of the quantum wavefunction. Flux squared is energy, abstractly. The units of measure for the gravitational curvature of space are provided for the first time. The curvature of time is not important, when calculated at positions that relatively are far from a nucleus. The speed of time is c and its density is constant, far from a nucleus. The density of time is higher in the gaps between nucleons. This paper justifies The Mass Equals Area Abstraction.

Introduction

The Farad, the Henry, and the Weber are units of measure which can be theoretically redefined in terms of only meters and seconds [1]. The gram can now be defined as square meters. One kilogram is 1.21 square meters because the area of a proton is 20.4 barns. Mass is like a parachute in a fluid called spacetime. Electrical charge is also an area, abstractly. This abstraction theory is justified by understanding that electron mobility represents the same property as conductance. A voltage equation is first used for the evaluation of the Coulomb. Voltage always involves mass. A different formula is used without mass, to confirm this theory. That is the speed of light formula that uses permittivity. The following equations use the Volt, so they involve both charge and mass.

Equations Are Numbered from 1 to 62

Eq. #

1. Units of electron mobility = conductance
2. meter^2 / Volt second = Ampere/Volt
3. meter^2 / second = Ampere
4. meter^2 = Coulomb

Electric charge is area. Your acceptance of that simple calculation depends on your opinion of these two statements: “Conductance is how easily an electrical current can flow through a conductor” [2] and “Mobility is the ease with which any particular type of charged particle moves through a solid material [3]”. It is reasonable for a student to understand the similarity between conductance and mobility, and to question these basic ideas. A strict authority may insist they are different, somehow.

The Mass Equals Area Abstraction using Voltage

Now that charge is known to be an area of spacetime, mass can be evaluated to find its essence. These are abstract units of measure that I first published during 2015 [1]. The force equation or an energy equation could bring mass into the calculation. That algebra will combine capacitance multiplied by mass. That is The Composite Formula. The speed of light equation will be described later, so voltage is not involved in calculating the capacitance unit of measure.

Eq. #

5. $i = C\, dV/dt$
6. Coulomb/second = Farad [Volt] / second
7. [Volt] = Joule/Coulomb = [Kg meter^2 / (Coulomb second^2)]
8. Coulomb/second = Farad [Kg meter^2 / (Coulomb second^2)]/ second
9. Coulomb/second = Farad Kg meter^2 / (Coulomb second^3)
10. Coulomb^2/second = Farad Kg meter^2 / second^3
11. Coulomb^2 second^2/meter^2 = Farad Kg
12. **second^2 meter^2 = Farad Kg**

The last equation is the “composite formula”. It is true because charge equals area. It seems like Farad = second^2 and mass equals meter^2. This paper also uses independent formulas to confirm that abstract definition of capacitance, using permittivity without voltage. By doing that, it is proven that mass = area. In other words, the Composite Formula has known units of measure for Farads and seconds, so that only leaves mass and meters needing a definition. The logic makes it easy to disambiguate the proof that mass is area.

Table 1 Abstract Units of Measure

Unit of Measure	**MKS Definition**	**Abstract Definition**	**Symbols**
permeability	Henry/meter	1/meter	$\mu = meter^{-1}$
electric displacement	$Coulomb/meter^2$	1	**D field**
inductance Henry	Weber/Ampere	1	H
magnetic flux density	Weber / $meter^2$	frequency	**B field** = Tesla = Hz
resistance Ohm	Volt/Ampere	frequency of event	$\Omega = second^{-1}$
electron mobility	$meter^2$/Volt sec	time for something	μ = second
capacitance Farad	Coulomb/Volt	square seconds	F
magnetic field intensity	Ampere/meter	velocity	**H field**
viscosity	Pascal second	velocity [4]	η = meters per second
gravitat. speed of space	curved spacetime	velocity	S
charge Coulomb	primitive fact	area	Q
mass Kilogram	primitive fact	area	Kg = square meters
entropy	d(energy)/T	area	dS
Boltzmann's constant K	energy/T	area	K_B
current Ampere	Coulomb/second	flux	i = $meter^2$ per second
lines of flux Weber	energy/Ampere	flux	Wb = ϕ = lines of flux
quantum wavefunction	1	flux = $meter^2$/second	Ψ = probability wave
electric field intensity	Volt/meter	acceleration	**E field** = meter / $second^2$
gravitational field	$GM/R^2 = g$	acceleration	**g-field**
Universal gravitational G	$6*10^{11}$ m^3/Kg $second^2$	V/2 π m τ second	G, see Eq. 24
permittivity	Farad/meter	sec^2/meter	E
momentum	Kg meter/second	$meter^3$/sec	mv = p
Volt	Joule/Coulomb	potential	V = $meter^2$ / $second^2$
temperature	energy/K_B	potential	T = degrees Celsius
force Newton	mass acceleration	$meter^3/sec^2$	N
action Planck Constant	Joule second	angular momentum	h = $meter^4$ / second
spin magnetic moment	m = Torque / Tesla	angular momentum	torque=m x B
energy Joule	Kg $meter^2/second^2$	$meter^4/sec^2$ energy	J
energy	Weber Ampere	$meter^4/sec^2$	Joule
energy	Hamiltonian (Ψ Ψ^*)	$meter^4/sec^2$	quantum energy level
power Watt	energy/second	$meter^4/sec^3$	W
power, quantum	energy / lifetime of state	$\hbar$/ $(5.1ns)^2$	2.51eV / second

Categories of Abstract Units of Measure

- "**1**" means dimensionless: Henry = (flux/flux) = 1 and displacement D = (area/area) = 1
- **Frequency**: Ohm, Tesla, Hz, $second^{-1}$
- **Time** period: Conductance, electron mobility, second
- **Square seconds**: Farad, Kepler's astronomy, $second^2$
- **Velocity**: H field, viscosity, meter/second
- **Area**: mass, entropy, charge, Boltzmann's constant, $meters^2$
- **Flux**: Ampere, Weber, conveyor belt, quantum wavefunction, $meter^2$/second
- **Acceleration**: E field, $meter/second^2$
- **Potential**: Volt, temperature, $meter^2/second^2$
- **Angular momentum**: Planck Constant, spin magnetic moment, $meter^4$/sec
- **Energy**: kinetic, magnetic, quantum, $meter^4/sec^2$ has six powers of seconds and meters
- **Power**: seven powers of meters and seconds for the Watt implies a human level of care

The category of area is emphasized in this paper. A proton area is the proton mass. The proton cross section is 20.4 barns. The mass is known. That means a kilogram is 1.21 square meters. But that 1.21 is also applied for charge. Usually, cancellation of the 1.21 / 1.21 occurs. That means in most calculations, a Kg is 1.000 square meters, when a cancellation of areas is evaluated. Sometimes, cancellation occurs for the charge to mass ratio, and for the mass divided by radius squared.

Examples of Abstract Units

Three examples are highlighted here. They are the magnetic field intensity **H**, the electric field intensity **E** and the Henry of inductance **L**. The mathematics here has substituted area for mass and area for charge. So, grams and Coulombs are different areas in spacetime. The magnetic field intensity H is a **velocity**. The electric field intensity E is an **acceleration.** Notice that the categories of units, above, start with low powers of seconds or meters and trend to more complicated units of measure. Energy is a high-level concept for scientists and it has six powers of meters and seconds. Using this abstraction can help students see relationships between various phenomena, in an abstract, easy way. It also focusses the attention to the essence of the meaning of a variable, like the number of Ohms. That focusing occurs by eliminating the traditional Coulomb, which is usually cancelled by an inverse Coulomb. This abstracting process also eliminates the traditional kilogram, which was a sure marker for official "energy". Energy can be transformed into a different form but the kilogram is a strict requirement. That mass has been replaced by square meters to streamline the formulas. Then logic can be applied to work, instead of expecting a *Weber per Ampere* to be meaningful enough to suffice as a Henry. Or an *Ampere meter* to be a convincing kind of magnetic field definition.

Eq. #

13. H = Ampere / meter = meter/second [5] see Heaviside references
14. E = Volt per meter = Joules per (Coulomb meter) = $meter/second^2$
15. L = Henry = inductance = **dimensionless** = 1
16. L = Weber / Ampere = Volt second / (Coulomb / second) = Kg $meter^2$ / $Coulomb^2$

In Eq. 16 at the right side, notice that time is not involved in the units of measure of inductance, implying again that the Henry is dimensionless. Time is cancelled out! In other words, if you accept that time is not in the gram or the Coulomb, then you agree that time is not involved in the ratio of flux divided by current. Coulomb is cancelled by $meter^2$. That leaves Henry = $Kg/meter^2$. Logic implies that inductance is dimensionless. The number of loops squared is dimensionless. The lengths and areas in electromagnetic transformers all cancel out for inductance units of measure! They only affect the magnitude of inductance.

Oliver Heaviside wrote that units of measure for some electromagnetic phenomena are analogous to some mechanical phenomena. Permeability is like mass density because Henrys per meter are like grams per cubic meter. That is $meter^{-1}$. Also, magnetic energy density is like kinetic energy density units for mv^2 / $meter^3$ = μH^2 [6]. There, μ is permeability, which is $meter^{-1}$.

Abstract Units of Fields

In Table 1, the g field the four fields from Maxwell's equations (H, B, D, E) are printed in dark letters. MKS means meter-kilogram-second international system of units of measure. The rows in Table 1 have increasing powers of dimensions from $meter^{-1}$ to $meter^4/second^3$ at the end of the table. EM is electromagnetic. (These are not cgs, centimeter-gram-second units.)

The mass equals area abstraction implies that charge is also an area in spacetime. Area is like Boltzmann's constant K_B. The magnitude of K_B is like the size of a molecule. Entropy S is an area. For examples using different areas:

Eq. #

17. $e = K_BT$ = thermal energy
18. $e = ½\ mv^2$ for kinetic energy
19. e = QV for electric energy
20. e = SdT for energy in entropy

The area multiplies a **potential**, like temperature, velocity squared, and Voltage. That is a repeated theme in physics. (Chemistry uses "potential" as an energy, unlike physics). A potential can be used to calculate an energy by multiplying by the appropriate area such as K_B, Boltzmann's constant, m, a mass, or q a charge area abstraction.

Electron mobility evaluation resulted in the Composite Formula (gram Farad = $meter^2\ second^2$). The Electron mobility evaluation results in the Massless Composite Formula: **Farad = $second^2$ per Henry**.

Gravitational Units

The basic formula for the proposed particulate **source of gravity** is named the momentum of free space:

21. $NV/\tau = zA$ / second

Where N is number of nucleons in star, V is proton volume, τ is 5.1ns, z is height fallen in a second, A is area of star, second is the test duration for a falling object. Space is treated as a liquid, as was done for a Higgs field or any ether. When S approaches c, the star goes nova when the density is that which was predicted by other researchers. Eq. 21 is used to find τ, the 5.1 nanosecond gravitational time constant. The speed of space for gravity is S. This velocity is for any distance R from the center of a star, while that is above the surface. S is the momentum of free space P divided by the area of a sphere A under the test mass, around the star.

22. S = P / A
23. $S = (NV/\tau) / (4\pi R^2)$

Where τ is 5.1ns when a proton radius is assumed to be 0.95fm. V is the volume of a proton, R is the radius from a star's center to a test mass. Eq. 23 shows where the inverse square law comes from. It is from an area that encloses a star being in a denominator for S. the acceleration tracks with S. When an acceleration function g(S, t) = 9.8 $meter/second^2$ the S is 4.9 meters per second. The acceleration function units are g = 2*S/second.

A curved spacetime is describing the varying speed of space (S) at different positions. Imagine drawing a curve on a piece of paper (Fig. 1). That curve with speed on the vertical axis and distance on the horizontal axis is easy understand for a high school graduate. The curved spacetime is not baffling. It is a velocity distribution of the space near a star. Assume the star is not rotating significantly in one second and it is almost spherical. The curvature of space can be calculated and plotted on paper using the horizontal axis of R, the distance to the center of the star. The vertical axis is S, the speed of space for gravity (Eq. 23). Time makes acceleration for a mass. Time interacts with mass to involve S. That makes acceleration by differentiating S. Time curvature is not covered here, but the units of time are always seconds, regardless of relativistic effects that can change a magnitude or direction.

Newton's Universal Gravitational Constant is shown relative to a proton volume:

24. $G = V / (2 \pi m \tau \text{ second})$

Where V is a proton volume, and τ is about 5ns. The m is the proton mass. One second the planned time for a falling test mass to reach an unknown average velocity. On Earth that velocity is 4.9 meters per second. Acceleration is twice the average velocity per second. This is about the Gravity Volume theory. Space is treated separately from time in the spacetime idea. Space is treated as a liquid that flows slowly into neutrons and protons. Time is treated as being emitted from neutrons and protons radially at a speed c. Inside nuclei, time can be denser. Time escapes nuclei through the gaps that are between spherical nucleons. That dense time expansion could be causing the strong nuclear force, where the space sinks in, through the gaps.

Compare the units in Eq. 24 with the official G: $\text{meter}^3 / (\text{Kg second}^2)$ to see they are the same. Relativity theory can now eliminate G and put in the proton volume and the 5.13ns universal time constant. That is the time it takes for a proton to withdraw outer space in the amount of a proton volume V. In an abstract philosophy, 5 nanoseconds have the same magnitude as a proton volume. This is particulate relativity.

General Relativity uses G, Newton's Constant. That can be replaced using Eq. 24:

25. $G_{\mu\nu} = 8\pi G T_{\mu\nu} / c^4 \quad = R_{\mu\nu} - R\, g_{\mu\nu} / 2$
26. $G_{\mu\nu} = 4V T_{\mu\nu} / (m \tau \text{ second } c^4) \quad = R_{\mu\nu} - R\, g_{\mu\nu} / 2$

Electrons have no known volume so they are the sources of no known gravity. Energy is said to be a source of gravity, but energy is always associated with nucleons (protons and neutrons), so really, matter causes gravity. No photons have ever been observed to cause gravity, but they are affected by it.

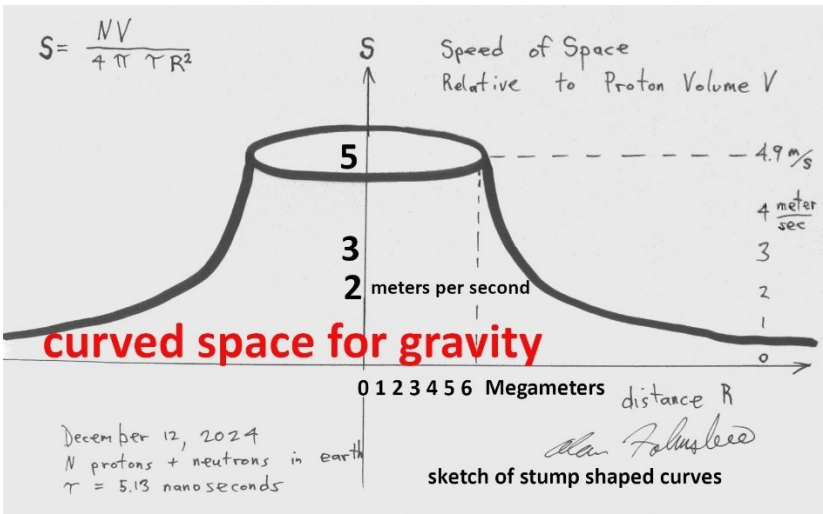

Figure 1: spacetime curvature for gravity with “one over R squared behavior”. See Eq. 23.

In Fig. 1, the horizontal axis is not to scale because the slope is really smaller than shown. The vertical axis is **S = NV / 4 π τ R²**. Those variables are described, above. The six megameters is labeled to show the size of the Earth. The curve inside the planet is not drawn. Space goes into planets for gravity and time comes out in an equal quantity. Each proton emits 5ns as it takes in its own volume V from the surrounding space. That is the conservation of the spacetime continuum. In theory, the 4D gravitational coordinate system is mirrored in the center of each proton to reflect electromagnetic 4D activities. There is traction between inertial motion and electromagnetic phenomena inside each proton. The units of measure for both domains are connected in my theory. It is The Theory of Enough. Everything is not modeled, only the 21st century’s practical stuff.

Fig. 1 is captioned spacetime curvature for gravity. It also shows “curved space for gravity” and this does not need to show time to be called spacetime. It shows a speed of meters per second, so time is there once. A second power of time comes to make acceleration out of a constant speed. That speed S is relative to a mass, even if the mass accelerates to high speeds. S might change very little as acceleration goes on and on for minutes, and R changes. The speed of light is independent of the velocity of the test mass and the same is true for the speed of space. The speed of light in a vacuum is really the speed of time, c.

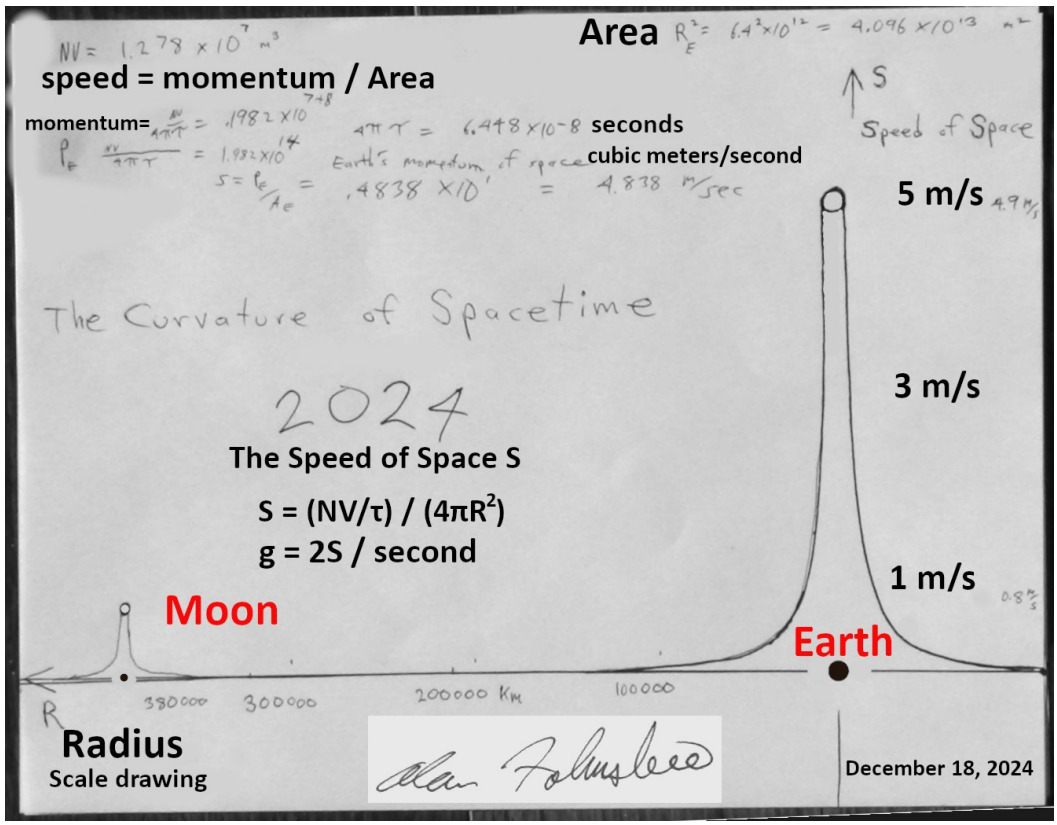

Figure 2: Scale drawing of Moon-Earth gravitational curvature of spacetime.

For the square seconds, see Kepler’s third law: the ratio of the **squares of the periods** of revolution around the Sun of any two planets equal the ratio of the cubes of the semimajor axes of their respective orbital ellipses. Also, capacitance uses square seconds.

Confirmation of the Abstract Units of Measure

Two paths were examined for algebra. First, I tried isolating mass multiplied by capacitance on the left side of an equation. Second, I tried to isolate mass divided by capacitance for the left side of an equation, but that

equation does not exist in standard formulas. Additional confirmation will use logic to improve confidence in these abstractions. A Voltage-based evaluation will be done and then a permittivity-based evaluation will be done. It will be shown that:

Eq. #

27. Farad = second^2 / Henry
28. Kilogram = meter^2 / Henry
29. Henry = 1 (dimensionless unit of measure for inductor loop count squared)
30. Henry = Weber / Ampere = Joule second^2 / Coulomb^2
31. Henry = Weber / Ampere = Kg meter^2 / Coulomb^2

The Composite Formula is useful to isolate mass times capacitance on the left side of an equation. But the ratio kg / Farad never occurs in physics, as far as I have found. The product occurs because when mass is on the left, energy is on the right side of an equation. Seconds squared is in the denominator of energy, and Farads will be shown to be seconds squared. These facts confirm that mass is area because:

32. Mass* capacitance = meter^2 second^2 is ambiguous

Disambiguation occurs in the next section.

Permittivity Formula Confirms Farad = second^2

Voltage was used earlier to get the Composite Formula, which hinted that Farad equals second^2. Next, voltage will not be used to get the same indication about the Farad. This will use permittivity, which is Farad per meter. Permeability is Henry per meter.

A common formula for the speed of light c is

33. c = (permittivity*permeability)$^{-1/2}$

That form does not mention mass. However, the Henry is in the permeability. Henry = Weber / Ampere. Weber is energy per Ampere. The energy has mass in it:

34. E = Kg meter^2 / second^2
35. Permeability = Henry/meter
36. Permittivity = Farad / meter

That mass can be ignored for a light speed [7] calculation because Henry is dimensionless. Also, a mass never goes at light speed c. A Henry is a Weber per ampere, a ratio of flux over flux, abstractly. Algebra can still be useful by using the speed of light as a massless way to define capacitance, abstractly. Keep in mind that the Henry is dimensionless.

37. c^2 = meter^2 / Farad*Henry

That equation makes it unambiguous: the Farad is square seconds. That is proof which cascades to the proof of mass being area. The two simultaneous equations are first*, the Voltage evaluation* and second, the permittivity evaluation.

Eq. #

38. *Mass*capacitance = meter^2 * second^2 :* ***The Composite Formula***
39. c^2 = meter^2 / Farad*Henry
40. Farad = meter^2 / c^2 *Henry
41. Farad = second^2 / Henry

42. c^2 = meter^2 / Farad*Henry
43. Henry = meter^2 / Farad*c^2
44. Henry = meter^2 * second^2/ Farad*meter^2
45. Henry = second^2/ Farad
46. Farad = second^2/ henry **The Massless Composite Formula**
47. *Capacitance = second^2 meter^2 / Kg*

Next, set the two definitions of Farad to be equal, Eq. 46 = *47*:

48. second^2/ henry = *second^2 meter^2 / Kg*
49. henry = Kg / *meter^2*

The conclusion is that if inductance is square meters per gram, then mass must be area. That is because I do not believe that inductance involves mass in its units of measure or its physics. Mass is in energy, so that contaminates some algebra that seeks human understanding of the essence of the Henry. Inductance is a magnitude without dimensions of time, distance, mass, charge, or quantum phenomena. The number of loops of wire are important to the essence of inductance. That number of loops is squared, to set the magnitude of Henrys. The squaring of inductance can abstractly be compared to an ambient atmosphere in which more wind speed is added on top of the ambient speed. It is modeling relative speeds of fluxes.

Discussion of Quantum Units of Measure

The wavefunction was defined as dimensionless, and energy was multiplied into the formulas. That could be changed to the wavefunction having flux. That is meter^2 / second. Then energy is the wavefunction squared.

The quantum power is listed in Table 1 using Planck's Constant $\hbar$ for atoms and h for photons.

50. $\hbar$ / (5.1ns)^2 = 2.51eV / second

This power theory is applied to an erbium laser fiber amplifier [8]. A population inversion has a state that can be calculated with the 2.51eV / second of power.

Mass has been ascribed to the Higgs Field. That field has been compared to a viscous fluid, and a mass is like an object sinking through syrup. This quantum theory of a field in space around an object is compatible with The Mass Equals Area theory. The standard model of particle physics has adopted the "gauge" units of measure. That is not evaluated in this paper. That vague gauge description is used in physical experiments where electrons "scatter" from protons, without mentioning attraction or repulsion. Grams are not used in some modern physics books, with electron-Volts being in fashion this year to replace grams. Electron Volts are also used for temperature, as if mass equals temperature gauge.

My **atomic scale formula** uses abstract units of measure:

2.41 Angstroms = m/(r*α) = q/(4*π*a_b) = area / length

Where m is proton mass, r is proton radius, α is 1/137 fine structure constant. That alpha is used for atomic scale systems [9]. The variable q is proton charge, a_b is the Bohr radius 0.53 Angstroms. This comes from the comparisons of Planck's constant $\hbar$ with a small gravitational momentum and a large distance to calculate an angular momentum [10]. 2.41 x 10^{-10} meters is about the radius of the largest elements. Like potassium. The van der Waals interaction is near that scale.

Conclusion

The use of abstract units of measure does not mean the old units are gone. They remain to be useful where keeping track of two categories is useful. One category of formulas in physics is that using mass. The second category of special units is called charge. Cancellation often occurs when an answer about force is wanted. Then Coulombs disappear from Coulomb's force equation. Mass and charge were created as symbols for ideas with unknown internal contents. They are placeholders that allow us to wait comfortably until the inner workings of the gram and the charge are authoritatively condoned. Until then, the charge to mass ratio will serve a sign for hope that guiding principles can be shared between various disciplines of engineering.

Here is a list of some units of measure with their abstract essences.

Eq. #

51. Electron mobility = conductance = second
52. Charge = area
53. Mass = area
54. Entropy = area
55. Farad = second^2
56. Weber = Ampere = flux = meter^2/second
57. Henry is dimensionless Weber/Ampere
58. H = velocity
59. E = acceleration = meter / second^2
60. Ohm is quantum events per second
61. Tesla is geometric events per second
62. Potential is velocity^2 = meter^2 / second^2

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