Calculation Of Radius And Energy Of Smallest Particle In The Universe

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Abstract: This theory predicts the existence of smallest particle P_e. Proposes calculations of smallest particle radius possible in the universe and to calculate the limit of maximum energy any particle can attain using Planck Maxwell and Einstein's equations along with some fundamental assumptions. This theory shows that the equations involved for calculation of Energy of the smallest particle derived from only of Physical Constants. This information may help lead to the fundamental question of where the universe began and might lead to new discoveries.

1. Introduction

THIS Theory of existence of smallest particle (P_e) may lead to the fundamental question of where the universe began. It also gives insight into the limit of maximum energy any particle can attain that might lead to new discoveries. This theory uses Planck Maxwell and Einstein's equations in addition to some fundamental assumptions to arrive at this theory. Starting with calculation of Kinetic Energy (KE) of a proton with already existing formulas, KE of the smallest particle (P_e) is derived. This theory shows that the equations involved in calculation of Energy of the smallest particle ($P_{e)}$ can be derived using Physical Constants. This theory concludes that Planck's energy is half of E_e. Also, Planck's Energy E_p is derived differently than the already existing Planck's Energy formulas. This new Planck's energy derivation is arrived using different set of Physical Constants. This theory follows Bohr's model of standing wave in Quantum mechanics where phase of wave would not change and utilizes some of his derived formulas for wavelength, Lambda.

2. Existing history and calculations

Kinetic Energy of Proton

Nomenclature

- **i.** Velocity of Light in a vacuum c = $(2.998)10^8$ m/ s [6]
- **ii.** Planck Constant h = $(6.626)10^{-34}$ kg.m^2/s or J s [6]
- **iii.** Planck's Reduced Constant (h/2π) $\hbar$ = $(1.055)10^{-34}$ kg. m^2/s or J s [6]
- **iv.** Radius of Proton r=$(.084087)\ 10^{-15}$ m *charge radius of a proton—0.84087(39) fm*
- **v.** Value of 1 Electron Volt in Joules eV = $(1.6021765)\ 10^{-19}$ J
- **vi.** Value of 1 Mega Electron Volt in Joules MeV = (eV)/10^6 J
- **vii.** Wavelength in meters = λ (Lambda)
- **viii.** Frequency (υ) is frequency in hertz, 1/s or s^{-1}
- **ix.** Energy (E) in Joules

Existing equations used (References)

- **x.** One of the Physical constants, I call it A = (c) $\hbar$ = $(3.162)\ 10^{-26}$ kg.m^3/s^2 (1) [Table 3]
- **xi.** Wavelength (λ) = 2×π×r (see Bohr's model for Hydrogen Reference) (2)
- **xii.** c = λ × υ or υ =c/λ (3) [Ref. 12]
- **xiii.** E=h × υ (4) [Ref. 12]
- **xiv.** Energy (E) and Wavelength (λ) relationships:

Since energy is calculated from frequency, we can substitute frequency (υ) in the equation

E=h × υ, using υ=c/λ, (from Equation (3)).

The new combined equation is E= ch/λ (5)[Ref.12] (Reference Blackbody Radiation)

- **xv.** From Quantum Mechanics, Bohr Hydrogen electron model we know: 2πr=n × λ [Reference 11 eq. 1.2.7] (6)

Where n is a positive integer, r is the radius of circular particle trajectory. [11]

- **xvi.** ∴ E= ch÷(2πr/n) (substituting for λ from (6) in (5))
- **xvii.** ∴ E= cħ/r (Since $\hbar$ = h/2π and for lower order particle integer n is 1) (7)
- **xviii.** ∴ KE of a Proton in Joules E_{proton} = hc / r = $(3.76)\ 10^{-11}$ J (8)
- **xix.** KE of a Proton in Electron Volts E_{proton} in eV = E_{proton}/ eV = $(2.347)\ 10^8$ J (9)
- **xx.** KE of a Proton in Mega-Electron Volts= E_{proton} in MeV= E_{proton} in eV/10^6 = 234.67 J (10)

3. New Theory

Based on the above Calculations, KE of Smallest Diameter Particle is as follows:

I call this P_{emani} (P_e) Particle.

- **a.** Following Assumptions are made:
  - **i.** If there is such a thing as a smallest particle in the Universe and it fits in the Planck's length.
  - **ii.** Mass of this smallest particle is 0 (Zero).
  - **iii.** A photon with a speed equivalent to velocity of light c.
  - **iv.** Planck's smallest Length l_p is taken as a Diameter of smallest particle.
  - **v.** Bohr model of standing wave where phase of wave would not change – reference matter-waves
- **b.** Planck's length l_p = $(1.616199)10^{-35}$ m (11)[Ref.4]

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I am assuming this as Diameter of smallest particle P_e

$\therefore$ Radius of P_e $R_e = l_p /2 = (8.081)10^{-36}$ m (12)

(This is the smallest radius of a particle that could exist in the universe)

c. $\therefore$ KE of P_e : E_e = (c) $\hbar$ /R_e = $(3.912)10^9$ J (13)

d. This is equivalent to twice the Planck's Energy E_p.

e. This is the Maximum Energy any particle can attain since mass is equivalent to zero for this particle, all the mass is converted to Energy.

f. KE of P_e in electron volts = E_e / eV = $(2.442)10^{28}$ (14)

g. KE of P_e in Mega-electron volts (MeV) = E_e in eV/ 10^6 = $(2.442)10^{22}$ (15)

Comparing KE of P_e particle to Proton

h. KE RATIO

KE of P_e (from eqn. 7) / KE of Proton (from eqn. 2) = E_e / E_{proton} = $(1.041)10^{20}$ (16)

Which is the same ratio as r (radius of proton)/R_e (Radius of P_e (6)) = $(1.041)10^{20}$ (17)

Showing KE of P_e Equation can be rewritten to consist only of Physical Constants:

Planck's Reduced Constant $\hbar = h/2\pi$ (18)

Radius of smallest Particle $R_e = lp /2$

Re-stated from (12)

KE of P_e (small Particle) $E_e = c \hbar /R_e$

Re-stated from (13)

Substituting for $\hbar$ from Equation (12) into (13) $KE = c\ h /2\pi R_e$ (19)

Substituting for R_e from Equation (7): $KE = c\ h /2\pi (l_p /2)$ (20)

KE of P_e: $E_e = c \times h / \pi \times l_p = (3.912)\ 10^9$ J (21)

We know from history that Planck's Energy E_p = $(1.956)\ X10^9$ J (22)

From (22) we can infer E_p = Ee/2 (23)

So E_p can be written as

E_p = (c) $h/2\times\pi\times l_p = (1.956)\ X10^9$ J (24)

Substituting for Planck's reduced constant $\hbar = h/2\pi$

Or $E_p = c\times \hbar / l_p = (1.956)\ X10^9$ J (25)

Planck's two famous Energy equations (26) and (27):

$E_p = \sqrt{\hbar c^5/G} = 1.956 \times 10^9$ J (26)[Ref.13]

and $E_p = \hbar /t_p$ (27)[Ref.13]

Summary:

The significance of Equations (21), (24) and (25) are as follows:

- Equation (21) For KE of P_e is the most important Equation because it consists of all Physical constants.
- Planck's Energy constant E_p can be also derived using equation (24).
- The new equation (24) for Planck's Energy (E_p) rendered the same numerical value as his two famous equations as shown in equations (26) and (27).
- Equation (25) show that Planck's Energy E_p can also be written in terms different Physical constants than Planck's famous Energy formulas as shown in (26) and (27).
- It is important to note that the numerical value of Energy E_e of smallest Particle P_e is twice the energy of Planck's Energy value E_p.
- This paper utilized equation (6) calculated by Bohr in his Hydrogen model and his assumptions. This information confirms Bohr's assumptions (see Section 3.a.v) are true for calculating the Energy E_e of the smallest particle P_e because Equation (25) matches with numerical value of Planck's Energy E_p.
- This theory's energy calculations for E_e and E_p fit the photon energy multiple principle.

Analysis:

It is possible to theoretically come up with maximum energy a smallest particle can attain in this universe. Radius and energy calculations of this particle are derived from some most fundamental assumptions that need to be investigated. It is important to note when Planck deduced the E_p (Energy equations), he has given only two equations; one equation consisted C and G in one formula and tp in another formula. This paper contributed 2 more new equations using physical constants for Planck's energy E_p. The Energy calculation of this small Particle Ee consists of all Physical constants. It is also significant to note that Planck's energy $E_p = E_e /2$.

Conclusions:

The Maximum Energy of the smallest particle was derived from already established and proven scientific formulas. These calculations prove that the maximum energy of smallest particle can be calculated using only Physical constants. The postulates used for this theory are most fundamental and need to be thoroughly tested and investigated. The limit of maximum energy any particle can achieve can be established, if the postulates are deemed appropriate. Since the calculations for E_e only involve Physical Constants (Equation 21), E_e would be further established as another new fundamental Physical constant. This energy is established in this theory as twice the energy of Planck's energy. Also Planck's Energy is written using a new equation in this theory and using only universal constants.

References:

[1]. ^ The values are given in the so-called *concise form*; the number in brackets is the *standard uncertainty*, which is the value multiplied by the *relative standard uncertainty*.

[2]. Jump up ^ P.J. Mohr, B.N. Taylor, and D.B. Newell (2011), "The 2010 CODATA Recommended Values of the Fundamental Physical Constants" (Web Version 6.0). This database was developed by J. Baker, M. Douma, and S. Kotochigova. Available: http://physics.nist.gov/constants [Thursday, 02-Jun-2011 21:00:12 EDT]. National Institute of Standards and Technology, Gaithersburg, MD 20899.

[3]. ^ Latest (2010) Values of the Constants; NIST, 2011.

[4]. ^ CODATA — Planck length

[5]. ^ CODATA — Planck constant over 2 pi

[6]. Table 1 from http://en.wikipedia.org/wiki/Speed_of_light

[7]. Table 2 from http://en.wikipedia.org/wiki/Planck_length

[8]. Table 3 from Planck's constant and variation table from the section heading Black body Radiation, http://physics.info/planck/

[9]. Planck's Energy info taken from: In physics, Planck energy, denoted by E_P, is the unit of energy in the system of natural units known as Planck units.

[10]. Gravitational constant info was taken from: Where *c* is the speed of light in a vacuum, $\hbar$ is the reduced Planck's constant, and *G* is the gravitational constant. E_P is a *derived*, as opposed to *basic*, Planck unit. http://en.wikipedia.org/wiki/Gravitational_constant

[11]. http://en.wikipedia.org/wiki/Planck_units

[12]. Principle of semiconductor devices; Chapter 1; Review of Modern Physics; http://ecee.colorado.edu/~bart/book/book/chapter1/ch1_eq.htm#eq1_2_2

[13]. Mr. Kent's Chemistry Page; http://www.kentchemistry.com/links/AtomicStructure/waveequations.htm

Tables of Universal constants:

Table 1

Quantity	Symbol	Value	Uncertainty
speed of light in vacuum	c	299 792 458 $m \cdot s^{-1}$	defined
Planck constant	h	6.626 069 57(29) × 10^{-34} J·s	4.4 × 10^{-8}
reduced Planck constant	$\hbar$ =h/2π	1.054 571 726(47) × 10^{-34} J·s	4.4 × 10^{-8}

Table 2

Name	Dimension	Expression	Value[11] (SI units)
Planck length	Length (L)	$l_{\mathrm{P}} = \sqrt{\frac{\hbar G}{c^3}}$	1.616 199(97) × 10^{-35} m[12]

Table 3

Symbol	Name	Joules
H	Planck constant	6.62606896× 10^{-34} J s
Hc	"h c"	1.986445 × 10^{-25} J m
$\hbar = \frac{H}{2\pi}$	"h bar", dirac constant, Reduced plank constant	1.054571628 × 10^{-34} J s