Quantum Pulse Theory

Brian Dale Nelson, BS Mechanical Engineering

E-mail: bdnelson111@comcast.net

Abstract
Plank's Law confirmed that energy comes in discrete packets (quanta) of energy. However, because these energy quanta are proportional to their frequency, and the electromagnetic spectrum sets no limits on frequency, Plank's energy quanta can range from zero to infinity. These singularities exist in most physics equations which not only blind our understanding of nature at extreme conditions but call into question the validity of the equations themselves. It is possible to remove all singularities in these equations while maintaining identical results. This can be accomplished by introducing an indivisible unit of energy with a fixed wavelength. This paper introduces the quantized forms of Plank's Law, Einstein's energy-momentum equation, and deBroglie's wave equation. Future challenges include deriving the quantized forms of quantum mechanics and general relativity.

1. Plank's Law

Plank's Law relates to electromagnetic wave emission and states that energy is transmitted in packets of energy called quanta, later found to be elementary particles called photons. Photon energy is governed by Plank's Law that states that energy is proportional to the photon frequency and inversely proportional to its wavelength as shown in Equation (1). The electromagnetic spectrum does not limit the photon wavelength at either end of the spectrum. A photon may have a wavelength the length of the universe resulting in a near zero energy, or an infinitesimally short wavelength with an infinite energy.

$$(1) \qquad E = \frac{hc}{\lambda}$$

Photon Energy (E)	in Joules
Plank's Constant (h)	6.62606896E-34 Js
Speed of Light (c)	2.99792456E08 m/s
Photon Wavelength(λ)	in meters

To eliminate these singularities, Plank's Law may be further quantized by placing a limit on the smallest amount of energy a photon may possess. Photon energy is then simply an integer multiple (n_v) of this minimum allowed energy with a wavelength of λ_u as shown in Equation (2). Plank's Law, Equation (1), and its quantized version Equation (2) are mathematically identical because the photon wavelength (λ) is equivilent to its quantized counterpart (n_v/λ_u). However, the allowed values of the photon wavelength are restricted by the quantized equation as they must be in integer multiples of λ_u. This unit wavelength (λ_u) is a non-zero, fundamental constant in nature. It cannot be directly derived from Plank's Law because the photon wavelength is a ratio of a variable (n_v) and an unknown constant (λ_u). Until it can be derived or measured in the future, the unit wavelength will be set to unity for the purposes of calculations made in this paper.

$$(2)\qquad E = \frac{hcn_v}{\lambda_u}$$

Unit Energy Wavelength (λ_u)	in meters
Number of Kinetic Energy Units (n_v)	dimensionless integer

For ultra long radio wave photons Equation (2) needs an additional term (k) that allows photon unit wavelengths to chain together to form wavelengths longer than a single unit wavelength (λ_u). In normal atomic emission processes, k=1 and Equation (2) applies. In radio wave applications involving multiple atoms/molecules linked across an antennae or charged plasmas, k>1.

$$(3)\qquad E = \frac{hcn_v}{k\lambda_u}$$

Number of unit wavelengths (k) dimensionless integer

2. Einstein's Energy Momentum Equation

Einstein equated energy with rest mass in his famous equation $E=mc^2$. The expanded version of this equation is shown in Equation (4) with the momentum term included.

$$(4)\qquad E^2 = (mc^2)^2 + (pc)^2$$

Energy (E)	in Joules
Mass (m)	in Kg
Speed of Light (c)	2.99792456E08 m/s
Momentum (p)	mv in Kgm/s

The relativistic energy momentum equation can be quantized by including a rest mass (n_m) and kinetic energy (n_v) term. The total energy is simply the sum of these two unit energy multipliers as shown in Equation (5).

$$(5)\qquad E = \frac{hc(n_m + n_v)}{\lambda_u}$$

Energy (E)	in Joules
Plank's Constant (h)	6.62606896E-34 Js
Speed of Light (c)	2.99792456E08 m/s
Unit Energy Wavelength (λ_u)	in meters
Number of Rest Mass Energy Units (n_m)	dimensionless integer
Number of Kinetic Energy Units (n_v)	dimensionless integer

Equation (6) equates the number of rest mass energy units (n_m) with rest mass.

$$(6)\qquad m = \frac{hn_m}{\lambda_u c}$$

Figure (1) illustrates the relationship between kinetic energy and rest mass from Einstein's Equation (4). This equation is in the form $C^2=A^2+B^2$ which is Pythagorean's Theorem equating the sides of a right triangle. In this case, the hypotenuse C is the total unit energy count ($n_m +$

n_v), the adjacent side A is the rest mass energy count (n_m), and the opposite side B can be calculated using Pythagorean's Theorem to be $\sqrt{n_v^2 + 2n_m n_v}$.

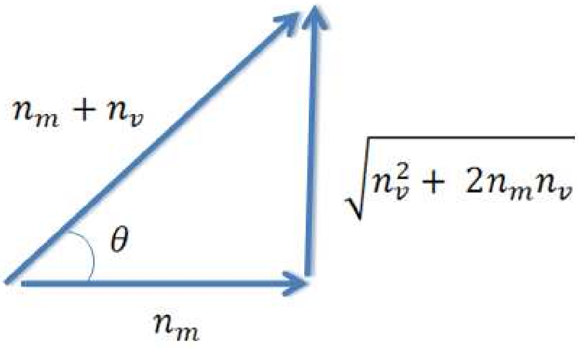

Figure (1)

Equation (7) equates velocity with the energy relationship shown in Figure (1). The velocity equation is an energy relationship multiplier of the speed of light (c), with the maximum speed being light speed when $n_m = 0$, or, the rest mass equals zero.

$$(7) \qquad v = \frac{\sqrt{n_v^2 + 2n_m n_v}}{n_m + n_v} c$$

$$(8) \qquad \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

The quantized Lorentz factor Equation (9) is a much simpler equation than the classic Lorentz version Equation (8), yet both of these equations yield identical results as shown in Table (1). The relativistic mass increases as the sum of n_m and n_v divided by n_m, only when n_v=0 (no kinetic energy), does the relativistic mass equal rest mass.

$$(9) \qquad \gamma = \frac{n_m + n_v}{n_m}$$

The first two columns of Table (1) provide various ratios of kinetic energy units (n_v) and rest mass units (n_m). Setting the unit wavelength λ_u to 1, the quantized mass can be calculated using Equation (6). Since the number of rest mass units (n_m) is held constant at 100000000, the resulting mass is also a constant 2.2102E-34 kg. Column 4 is the velocity of the inertial system from Equation (7) displayed as a decimal multiple of the speed of light (c). The next two columns show the classical Equation (8) and quantized Equation (9) Lorentz factors which show identical values over all velocities including those nearing light speed. The next two columns show the classical Equation (4) and quantized Equation (5) energy momentum equation results which also show identical values over all velocities.

Nm (integer)	Nv (integer)	Equation (6) Quantized Mass (xE-34 kg)	Equation (7) Quantized Velocity (x c m/s)	Equation (8) Classic Lorentz Factor	Equation (9) Quantized Lorentz Factor	Equation (4) Classic Energy Momentum (xE-17 J)	Equation (5) Quantized Energy Momentum (xE-17 J)
100000000	1	2.2102	0.0001414	1.0000000	1.0000000	1.9864	1.9864
100000000	10	2.2102	0.0004472	1.0000001	1.0000001	1.9864	1.9864
100000000	100	2.2102	0.0014142	1.0000010	1.0000010	1.9864	1.9864
100000000	1000	2.2102	0.0044721	1.0000100	1.0000100	1.9864	1.9865
100000000	10000	2.2102	0.0141411	1.0001000	1.0001000	1.9866	1.9866
100000000	100000	2.2102	0.0446879	1.0010000	1.0010000	1.9884	1.9884
100000000	1000000	2.2102	0.1403708	1.0100000	1.0100000	2.0063	2.0063
100000000	10000000	2.2102	0.4165978	1.1000000	1.1000000	2.1851	2.1851
100000000	100000000	2.2102	0.8660254	2.0000000	2.0000000	3.9729	3.9729
100000000	1000000000	2.2102	0.9958592	11.0000000	11.0000000	21.8507	21.8507

Table (1)

3. deBroglie's Wave Equation

Louis de Broglie introduced the matter wave shown in his famous Equation (10). The Lorentz factor has been added in this version to account for relativity.

$$(10) \qquad \lambda = \frac{h}{\gamma m v}$$

By inserting the quantized Lorentz Equation (9), the quantized mass Equation (6), and the quantized velocity Equation (7) into Equation (10) and simplifying, the quantized deBroglie Equation (11) can be calculated. Singularities are eliminated in this quantized version with the maximum value of the deBroglie wavelength can obtain is λ_u when $n_v = 1$ and $n_m = 0$.

$$(11) \quad \lambda = \frac{\lambda_u}{\sqrt{n_v^2 + 2n_v n_m}}$$

The last two columns in Table (2) show how the classical Equation (10) and the quantized Equation (11) version of deBroglie's matter wave equations provide identical results at all velocities including those approaching light speed (c).

Nm (integer)	Nv (integer)	Equation (6) Quantized Mass (xE-34 kg)	Equation (7) Quantized Velocity (x c m/s)	Equation (8) Classic Lorentz Factor	Equation (9) Quantized Lorentz Factor	Equation (10) Classical Relativistic De Broglie Wavelength (m)	Equation (11) Quantized Relativistic De Broglie Wavelength (m)
100000000	1	2.2102	0.0001414	1.0000000	1.0000000	7.071E-05	7.071E-05
100000000	10	2.2102	0.0004472	1.0000001	1.0000001	2.236E-05	2.236E-05
100000000	100	2.2102	0.0014142	1.0000010	1.0000010	7.071E-06	7.071E-06
100000000	1000	2.2102	0.0044721	1.0000100	1.0000100	2.236E-06	2.236E-06
100000000	10000	2.2102	0.0141411	1.0001000	1.0001000	7.071E-07	7.071E-07
100000000	100000	2.2102	0.0446879	1.0010000	1.0010000	2.236E-07	2.236E-07
100000000	1000000	2.2102	0.1403708	1.0100000	1.0100000	7.054E-08	7.053E-08
100000000	10000000	2.2102	0.4165978	1.1000000	1.1000000	2.182E-08	2.182E-08
100000000	100000000	2.2102	0.8660254	2.0000000	2.0000000	5.774E-09	5.774E-09
100000000	1000000000	2.2102	0.9958592	11.0000000	11.0000000	9.129E-10	9.129E-10

Table (2)