

The Metaphysics of Physics

by

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Abstract: The current physical view of the Universe (the *Metaphysics of Physics*) is one that just does not make sense and is counter-intuitive to our Experience. It begins with the Quantization of Energy Hypothesis used by Planck to derive his blackbody radiation formula and by Einstein to explain the photoelectric effect, which later evolved into Quantum Mechanics. By examining these conceptual foundations of Modern Physics we are able to show that the same experimental facts that lead to Quantum Physics can be differently explained without using energy quanta, continuously and not discretely. We are able to derive Planck's Law *without using quanta* and explain the photoelectric effect without needing photons. We summarize in this paper results presented in a series of papers that show with mathematical reasoning and rigor how this is possible. The main purpose of this endeavor is to create a view of the Universe that 'makes sense', that agrees with our Experience and provides physical meaning to our Understanding of it.

Introduction: Metaphysics provides a picture of the Universe. It gives meaning to our Experience. Through Metaphysics, we come to understand and makes sense of the Universe and our place in it. So what is the picture of the Universe that Quantum Physics presents? What is the *Metaphysics of Physics*? With Quantum Physics we have a mathematical formalism with great predictive powers, but little physical meaning; energy quanta, wave-particle duality, parallel worlds, multidimensional universes, dark energy and antimatter, particles of particles of particles, photons with consciousness and independent will, quarks with charm and color, probability waves that are able to traverse the Universe and pass in a single bounce through open slits to create interference, particles that can be at two places at the same time, gravitons and God-like bosons. The list is endless and we are reminded of the Medieval quest to determine "how many angels can sit at the head of a pin". Though these concepts of Quantum Physics have valid and explicit mathematical reality (which we are not disputing), this formalism just lacks physical meaning. And though these abstract ideas acquire some physical presence to the theorists and practitioners that work with them, they just doesn't 'make sense'. They have no physical meaning.

To change this unnatural view of Nature, we must go back and seek a different and more sensible explanation of these early beginnings of Quantum Physics. We examine the roots of Understanding without expanding the boundaries of Knowledge. This we've done in a series of short papers. Among other things we've shown how Planck's Law can be derived without using energy quanta and how the photoelectric effect can be explained without photons. This paper is a summary of these results, with references to where more detailed discussion can be found. And though nothing new is invented, new meaning is created. This is the justification. To find meaning where meaning is not found.

The Mathematics: All the results referenced in this summary are supported by the following mathematical results. ([*proven elsewhere*](#))

Notation: $E(t)$ any integrable function, $\eta = \int_0^{\tau} E(t)dt$, $\Delta E = E(\tau) - E(0)$, $E_{av} = \frac{\eta}{\tau}$, $\mathcal{T} = \left(\frac{1}{\kappa} \right) \frac{\eta}{\tau}$,

κ an arbitrary scalar constant

I) 'Planck-like' Characterization of Exponential Functions:

$$E(t) = E_0 e^{\eta t} \text{ if and only if } E_0 = \frac{\Delta E}{e^{\Delta E/E_{av}} - 1} = \frac{\eta v}{e^{\eta v/kT} - 1}$$

II) 'Planck-like' Characterization of Integrable Functions:

$$E(t) \text{ is integrable if and only if } \lim_{\tau \rightarrow 0} \frac{\Delta E}{e^{\Delta E/E_{av}} - 1} = E_0, \quad \lim_{\tau \rightarrow 0} \frac{\eta v}{e^{\eta v/kT} - 1} = E_0$$

III) "Quantum-like" Characterization of Exponential Functions:

$$E(t) = E_0 e^{\eta t} \text{ if and only if } \Delta E = \eta v$$

IV) Time-invariance Characterization of Exponential Functions:

$$E(t) = E_0 e^{\eta t} \text{ if and only if } \frac{\eta v}{e^{\eta v/kT} - 1} \text{ is invariant with respect to } \tau$$

V) Mathematical Identity: $\eta = \int_0^{\eta/E_{av}} E(u) du$

Summary of Physics Results: Using the above mathematical propositions we are able to mathematically derive the following results in Physics:

1. Planck's Formula $E_0 = \frac{h\nu}{e^{h\nu/kT} - 1}$ has the exact same mathematical form as $E_0 = \frac{\eta v}{e^{\eta v/kT} - 1}$ and from the mathematical equivalence I) above we arrive at the *time-dependent local representation of energy as the exponential* $E(t) = E_0 e^{\eta t}$, where E_0 is the intensity and ν is the frequency of radiation. (["A Time-dependent Local Representation of Energy"](#))
2. From III) above, we can explain what Planck's constant is and why it must exist. Planck's constant in our view should be thought as 'accumulation of energy'. The existence of Planck's constant is a mathematical necessity due to the invariance of $E_0 = \frac{\eta v}{e^{\eta v/kT} - 1}$ with time τ , average energy E_{av} , and energy absorbed ΔE . (["Let there be h" ! An Existence Argument for Planck's Constant"](#))
3. We can define the 'temperature of radiation' as $T = \left(\frac{1}{k}\right) \frac{\eta}{\tau}$ and generally can describe temperature as being *inversely proportional to the time τ for an accumulation of energy η to occur*. For Kelvin temperature T , an accumulation h occurs for a time interval of h/kT . Planck's constant h is the *minimal accumulation of energy* that can be manifested when the average energy (per degree of freedom) is $E_{av} = kT$ in Kelvin degrees. (["The Temperature of Radiation"](#))
4. If we start with the exponential representation of energy locally $E(t) = E_0 e^{\eta t}$ and use the *accumulation of energy is h when the average energy is kT* , substituting in the mathematical

identity V) above we are able to derive Planck's Formula *without using energy quanta*, and show that it is *an exact mathematical identity that describes the interaction of energy*. ([“Planck's Law is a Mathematical Identity”](#))

5. From III) above we can mathematically derive the *Quantization of Energy Hypothesis* as a characterization of exponential functions and the interaction of measurement. ([“The Interaction of Measurement”](#))
6. Using the view of energy as *propagating continuously* as a wave while locally *manifested in discrete units* when a minimum accumulation of energy is reached, we are able to provide a simple and intuitive explanation of the double-slit experiment. ([“A Plausible Explanation of the double-slit Experiment in Quantum Physics”](#))
7. Using the *local representation of energy* as described above, we are able to explain the *Photoelectric Effect without using photons* and derive equations that conform well with experimental results. ([“The Photoelectric Effect without Photons”](#))
8. If we start with the *accumulation of energy* as the *prime physical variable* $\eta(\vec{x}, t)$, we are able to define *energy, momentum and force* in terms of it and mathematically derive *Basic Law of Physics*, like the *Conservation of Energy and Momentum* and *Newton's Second Law of Motion*. ([“Prime physics and the Mathematical Derivation of Basic Law”](#))
9. Using the *definition of energy* $\frac{\partial \eta}{\partial t} = E$ and comparing it with *Schrödinger's Equation*, we arrive at a *new meaning to the wave-function* Ψ as describing the '*accumulation of energy locally*' at any (\vec{x}, t) . This meaning of Ψ is compatible with the '*probability interpretation*' of Quantum Mechanics. ([“The meaning of \$\Psi\$ ” ! An Interpretation of Schrödinger's Equation”](#))

A Different View: All the above results taken together provide a different view of the Universe and of Quantum Physics. One that 'makes sense' and agrees with our Experience. In this view, globally energy propagates continuously as a wave while locally interacts discretely. The local discreteness of energy has to do with the *interaction of measurement*. Planck's Formula describes this interaction of energy and is a mathematical identity, not some mysterious Law of the Universe. The *Quantization of Energy Hypothesis* is likewise a mathematical consequence and characteristic of exponential functions, and not a fact of Nature. *Manifestation of energy* occurs when *local equilibrium* is reached and some minimal accumulation threshold is attained. *Planck's constant* is a mathematical necessity based on the time-invariance of Planck's Formula. Its value is determined by the calibration system of units in Physics and the *interaction of energy*. It is the *accumulation of energy* that occurs when the average energy per degree of freedom is given by kT in Kelvin degrees. The *prime quantity of Nature* is *accumulation of energy*. In terms of this we can define energy, momentum and force. Basic Law of Physics are mathematical derivations and not Universal Law. The *Schrödinger's Equation* can be viewed as *describing energy locally*. The wave-function is then *accumulation of energy locally*. This view agrees with the '*probability interpretation*' of Quantum Physics and comes close to Schrödinger's view of being *distribution of charge*. The *double-slit experiment* can be simply and intuitively explained using this view outlined here.