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Light Speed Derivation

James J Keene

Director, Binary Mechanics Lab, USA

ABSTRACT

Physics literature presents equations in which a measured physical constant is expressed as one or more other measured physical constants. These expressions (1) show dependencies among so-called "fundamental" constants which are in fact unexplained observations and (2) are not derivations from first principles. That is, a true derivation from first principles cannot use any unexplained data as one or more "input" parameters. Adding to previous reports, a procedure to derive light speed with unidirectional measurements is described based only on the first principles of binary mechanics including the time-development laws and a physical interpretation of binary mechanical space [1-4].

***Corresponding author**

James J Keene, Director, Binary Mechanics Lab, USA.

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Introduction

With first principles describing electron geometry, zero electron electric dipole moment was derived in 2011 and confirmed by two different labs [5, 6]. With the discovery of the proton (hadron) bit cycle in 2011, the non-spherical proton shape was described, confirmed by proton scattering data [7, 8].

Using the classical definition of total angular momentum, intrinsic electron spin and hence, Planck's constant, were derived in 2015 [9]. In 2018, Planck's constant and both electron and proton intrinsic spin where derived using a different method by summation of the angular momentum of each quanta motion in the electron and proton bit cycles [10]. Fractional and elementary charge derivation was based on analysis of the time-development scalar (electrostatic) bit operation and paved the way to derive intrinsic electron magnetic moment based solely on first principles, the elementary charge derivation and the classical definition of magnetic dipole moment [11, 12].

These first-ever derivations of previously unexplained constants required full quantization of energy, space and time, namely the units of measurement in physics (Figure 1). A **primary constant** value for each unit of measurement could be assigned that was consistent with the full set of derivations -- mass M as energy expressed in kg, length L in meters and time T in seconds [13]. These three values may complete the list of primary constants, if fine-structure constant α in Fig. 1 can also be successfully derived from first principles [Keene, in preparation].

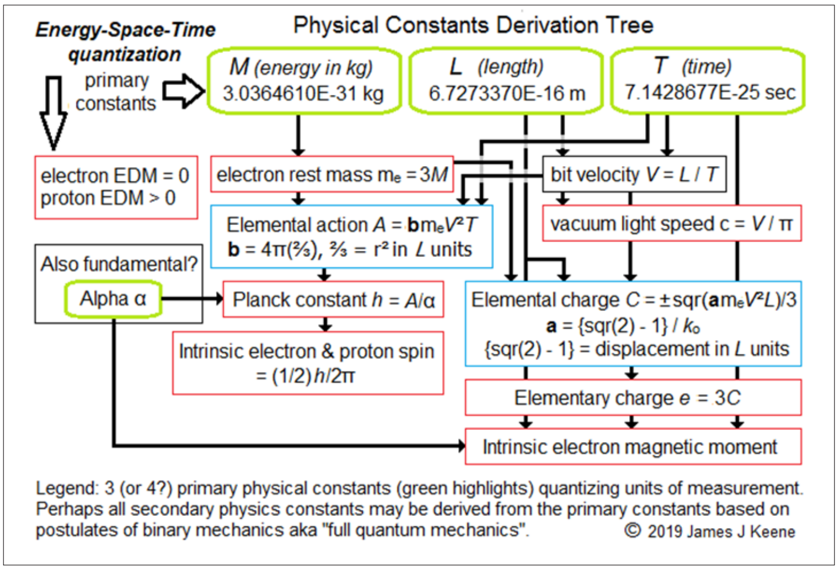
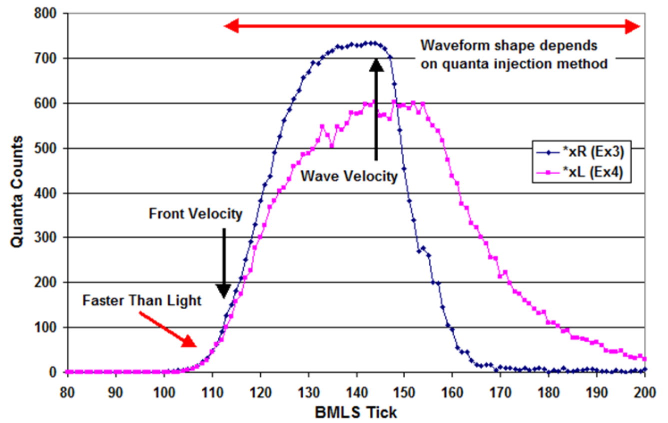


Figure 1: First-Ever Derivation of "Fundamental Constants" From First Principles

Methods and Results

A unidirectional light speed measurement demonstration (Figure 2) used the Binary Mechanics Lab Simulator (BMLS) v2.5.2 in a cubic 72x72x72 spot volume in Vacuum Mode with SUVF bit operations order, where S is scalar (electrostatic), U is unconditional, V is vector (magnetic) and F is strong [14].



Legend: Unidirectional light speed measurement demonstration. In experiment 3 (Ex3), the left gun injected quanta on the left side and sensors (*xR) counted quanta arriving on the right side of a cubic volume. In experiment 4 (Ex4), the right gun was used showing transmission in the opposite direction.

Figure 2: Unidirectional Light Speed Measurement

In Experiment 3, the quanta gun on the left side of the simulated volume, with respect to the **x** axis (horizontal in the BMLS display), injected energy quanta. Quanta sensors on the right side monitored arrival of injected quanta (the *xR variable in the *.csv output files). In the reverse direction in Experiment 4, quanta moving to the left from the right gun were counted by sensors on the left side (*xL).

The right and left guns at each side of the simulated volume each injected quanta in a centered, square area of X^2 spots where X is the volume dimension minus 16. Hence, with dimension = 72, the injection area is 56^2 = 3136 spots. In this area, each 2x2 spot face of a spot cube has 4 spots, two of which have spot units oriented in the injection direction [4]. One quanta was injected in one of these per BMLS Tick: an electron spot and an antimatter d quark spot (dbL) in experiments 3 and 4 respectively, selected to produce approximately similar peak intensity at the sensors. This difference in injection sites appears to be reflected in the waveform shape difference labelled "quanta injection method" in Fig. 2. In sum, with 1/4 of 3136 spots as injection locations, 784 quanta were injected per BMLS Tick.

Programmed experiments 3 and 4 inject quanta from active right or left guns for the first X BMLS Ticks where X = simulated volume dimension = 72. Hence, in each experiment, 72 x 784 = 56448 quanta were injected.

The initial state was a saved *.mat file from a previous study, where the initial randomly-seeded quanta (1-state bit) energy density was 0.25 of maximum, which was reduced, after cooling to zero Kelvin, to 0.2281 in the final state in the saved file [15]. In this zero Kelvin state, the lost quanta were thought to represent "kinetic energy" (electromagnetic radiation and particle motion) which might interfere or contribute to error in the present light speed demonstration. Of course, quanta injected by the guns would be expected to raise temperature which would then decease as quanta exit the simulated volume.

As presented previously, about 88% of the zero Kelvin final state quanta were perfect vacuum energy content, with the rest representing particles -- protons, neutrons and electrons [15].

Recall that a quanta may move only distance L in a time interval T where L and T are the quantized primary length and time constants respectively [3]. Hence, during a single **tick** T, there are only two possible quanta velocities: bit velocity $V = L / T$ if a quanta moves or zero (Fig. 1).

With cubic volume size equal to 72 spots and spot size equal to $2L$, transit distance may be estimated as 72 x $2L + L = 145L$ where L is added to the product as the nominal distance from the quanta gun into the first bit loci in the simulated volume [4].

A BMLS Tick is the duration of one cycle of the four bit operations assumed to equal $4T$. The observed **front velocity** defined by the initial high slope rise in quanta counts in Figure 2 was near BMLS Ticks 113 and 114. Using an observed BMLS Tick value of 113.5, the elapsed transmission time would be 4 x 113.5 = $454T$.

With calculated light speed $c = V / \pi$ (Fig. 1), the measured velocity of the light signal may be expressed in bit velocity units or $1 / \pi$.

Finally, in bit velocity units, light front velocity was $145L / 454T$ = approx. 0.319 or within about 0.3% of $1 / \pi$ in bit velocity V units.

A small number of quanta exhibit faster than light transmission in Fig. 2, confirming previous reports and description of its mechanism [1, 16]. Also, the two directions of light transmission show similar values for what might be deemed "wave velocity" in the present context.

Discussion

In the long history of measurement of light speed and given its importance in many branches of physics, **light speed has been an unexplained observation wrongly characterized as a "fundamental physical constant" in physics literature**. In this context, the present and previous reports deriving light speed for the first time from first principles, using three different measurement methods, may represent a remarkable, even stunning, development in this story that merits careful examination. All three measurement methods produced light speed values very close to V / π, where V is bit velocity (Figure 1).

A number of methodological issues require attention:
The addition of one L unit to the signal transit distance was a "best guess".

Both the injection of quanta to create a signal at one location and the sensor counts detecting signal arrival at another location are based only on the unconditional bit operation (U) in the SUVF bit operation cycle comprising a BMLS Tick ($4T$). That is, the unconditional bit operation "shifts" a quanta from a gun into the simulated volume to create a signal and from the simulated volume into the sensors to detect a signal. This may imply that the signal transit time used to measure light speed is correct since the unconditional operation occurs at the same position in the cycle sequence in both cases. But one may ask if the duration of each of the four bit operations in the cycle is in fact the same (T).

The present demonstration used an initial state that was not perfect vacuum. Thus, the data presented does not distinguish between "vacuum light speed" and possible refraction effects due to the presence of atoms from the particle content. One solution might be to use a range of initial state files saved from the "Vacuum Composition" study, in which lower quanta densities have very few particles and greater quanta densities contain more particles [15]. Even better would be added features to BMLS software to create perfect vacuum initial states at zero Kelvin with the option to add specific numbers of particular atoms or molecules.

In an optimistic perspective, resolution of methodological issues such as the foregoing items might not substantially change the observed light speed measurement as approximately 1 / π in bit velocity units. This light speed resulted from the time-development laws as expressed by the four bit operations. Hence, the present demonstration illustrates derivation of a physical constant merely by running the BMLS with an appropriate initial state setup.

This article supports two conclusions. First, light speed has changed status from unexplained data to derived physical constant. Second, the light speed derivation favors increased credibility of both the veracity and utility of binary mechanical postulates.

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