How Mass is Formed from Light

Step-by-step Calculations from the Photon to the Standard Model

M. J. Lindeman

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2. Modeling Light and Darkness

Digging into the old original writings of Nobel Laureates in Physics has been very useful. My first book on Interval-Dynamics Theory, *The Force that Controls Our Universe,* recovered Einstein's 1905 equation for finite volumes. (From Stachel, 1998, pp. 135, 160 [Footnote 3])

Consequently, a basic-arithmetic equation calculated the same orbital precession and photon deflection values as Einstein's advanced math in general relativity. Interval-Dynamics Theory (IDT) models volumes with Euclidean geometry rather than the geometry of curved surfaces.

This book reports the results of applying a similar cognitive-psychology analysis to Schrödinger's original "wave" theory of vibrating strings. Like Einstein's 1905 electromagnetic model of space and time, Schrödinger's electromagnetic model of quantum strings was buried in the dustbins of history.

Interval Dynamics uses pairs of Maxwell's six fields to define three descriptive levels of reality: (1) quantum, (2) electromagnetic, and (3) physical objects.

Thus it strongly supports mainstream physics with an alternative point of view based in human perception. Any Einsteinian electromagnetic volume is defined by a light wave traveling along the volume's diagonal. It connects two opposite corner points: P1 as the point of emission, and P2 as the point of absorption.

This visualizes Maxwell's description of how light is formed. (1954, Volume 2, Chapter XX) A light wave is the sum of a pair of opposing helical components in the *A* field of the magnetic vector potential.

De Broglie later rediscovered the *A*-field components as quantum "spinners", and Schrödinger used them in his quantum-wave equation. Figure 1 visualizes Einstein's electromagnetic unit volume defined by two unit spinners.
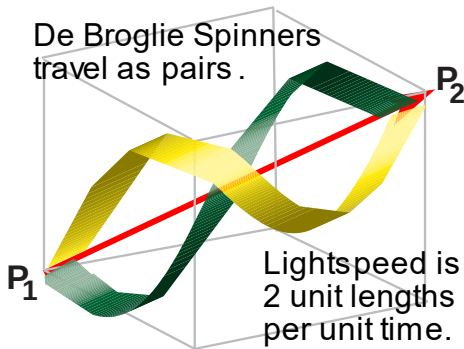

Figure 1. Maxwell's A-field spinner components of a light wave.

However, a light wave is only one solution to Einstein's equation. Its summary form factors into two solutions, each one a symmetrical pair of spinners.

In other words, the recovered Einstein's equation requires four spinners with a perfect symmetry that sums to darkness. The darkness vector is also the arrow of time.

Einstein's equation and its summary statement are part of Equation 1. The summary form of the equation factors into two symmetrical pairs of *A*-field spinners.

Equation 1. Einstein's 1905 equation and its factoring into two symmetrical pairs of A-field spinners. Each solution is a light wave.

Einstein's 1905 Electromagnetic (Null) Interval

The equation defines everyday volumes with the spatial terms as the edges and ct as the diagonal.

$$(x_1 - x_0)^2 + (y_1 - y_0)^2 + (z_1 - z_0)^2 - (ct)^2 = 0$$

The zero interval defines **two equal diagonals:** the spatial S diagonal & light-time ct diagonal.

$$S = \sqrt{\sum_1^3 s_i^2} \qquad \text{equals} \qquad ct = \sqrt{(ct)^2}$$

Summary form:

$$\sum_1^3 s_i^2 - (ct)^2 = 0 \quad \textit{Therefore, } \ S^2 - (ct)^2 = 0$$

**Factors into two solutions, and
each solution a pair of spinners.**
Positive (+S) solution: **(+S+ct)(+S-ct)**
Negative (−S) solution: **(-S+ct)(-S-ct)**

Figure 2 provides the front, side, and angle views of an example spinner. Figure 3 illustrates the two solutions as four helical paths that define one cylindrical volume. The four spinners have the same central axis of rotation.

In this visualization, the S value identifies the location of zero phase as the top (+S) or the bottom (-S) of the cylindrical volume. Positive spin (+ct) is left-handed and negative spin (-ct) is right-handed. (There is inconsistency in the literature about assignments of signs to rotations.)

Action-wave Example Spinner: (+S–ct)

Front View

y axis

x axis

S defines the starting position
Top (+S) or Bottom (-S).
ct defines the direction of spin
Right-hand (-ct) or left-hand (+ct).

Side View

0π   2π   4π   6π

Time's Arrow (Vector)

1π   3π   5π

+S

−ct

2π   4π   6π

Time's Arrow (Vector)   Phasor

−S 1π

3π

5π

Quantized: Count half-cycles or cycles
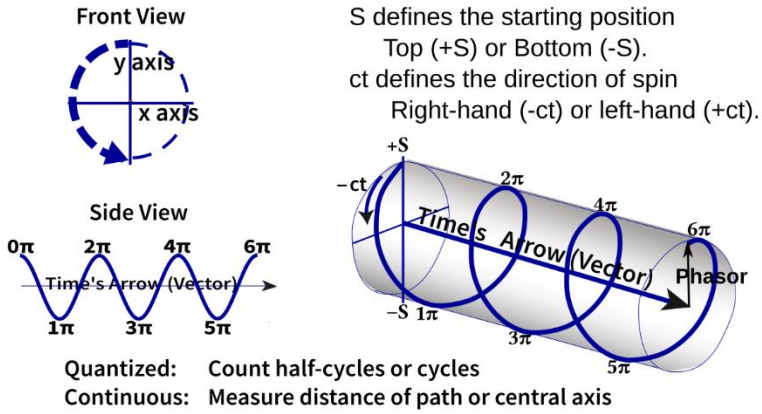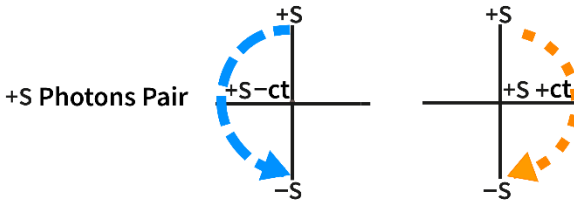**Continuous:** Measure distance of path or central axis

Figure 2. The front, side, and angle view of an action spinner, an electromagnetic string. It carries integer multiples of action hbar.

Column Pair:
Magnetic Monopole

+S Photons Pair

+S

+S−ct

−S

+S

+S +ct

−S

Row Pair:
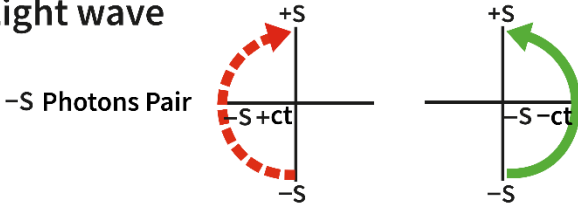## Light wave

−S Photons Pair

+S

−S +ct

−S

+S

−S −ct

−S

Figure 3. The four spinner types create all light (row pairs) and matter (column pairs). The diagonal pairs create the quantum of action hbar. (Assignments of locations and directions are arbitrary.)

When the four spinners are summed together, they define a filament of darkness, the dark arrow in Figure 4. It is a tube of energy and momentum that cannot be observed because an observation breaks its perfect symmetry. Only a volume's gravitational effects can be measured.
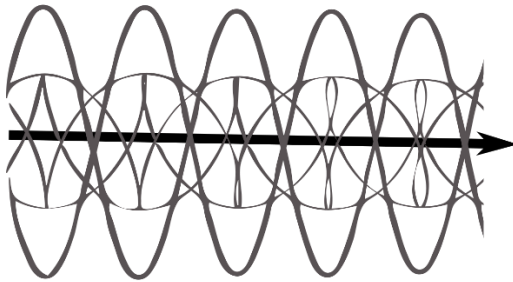

Figure 4. The side view of the four spinners traveling together along an arrow of time. Darkness cannot be observed because any exchange of energy breaks the perfect symmetry.

This agrees with Einstein's directional model for light waves. (1997, p. 224 [Doc. 38]) Spherical waves occur only when many photons are emitted in random directions.

These filaments of darkness are the unobservable structure of our Universe. When any one of the four waves absorbs energy, it breaks its filament's perfect symmetry and creates real particles.

These volumes filled with darkness are the dark matter and energy that cannot be observed. They were created in the 'Big Bang' origin of the Universe. Their volumes continually expand as their arrows of time gets longer.

3. Modeling Photons and Magnetism

The *A*-field's variations in space furnish magnetic force *H*, and the *A*-field's variations in time (sometimes with the voltage scalar potential) furnish electrical force *E*. (Heaviside, 1894, p. 491)

Photons and the poles of the magnetic vector potential are created when two spinners cross paths. Only then is there enough energy density to create a virtual particle. Physical particles require breaking the perfect symmetry.

Figure 5 visualizes the two solutions of Einstein's equation. A unit photon is created at each crossing of a solution pair. One pair of photons flickers each half-cycle.

Figure 6 visualizes the crossings of non-solution pairs. This also happens twice per cycle, and it creates a virtual magnet that flips positions each half-cycle (Figure 7). The sign of a virtual pole corresponds to the signed middle term of the spinners' product (Equation 2).

Equation 2. The four possible spinner-pair products from Einstein's equation. Solutions form photons, and non-solutions form poles.
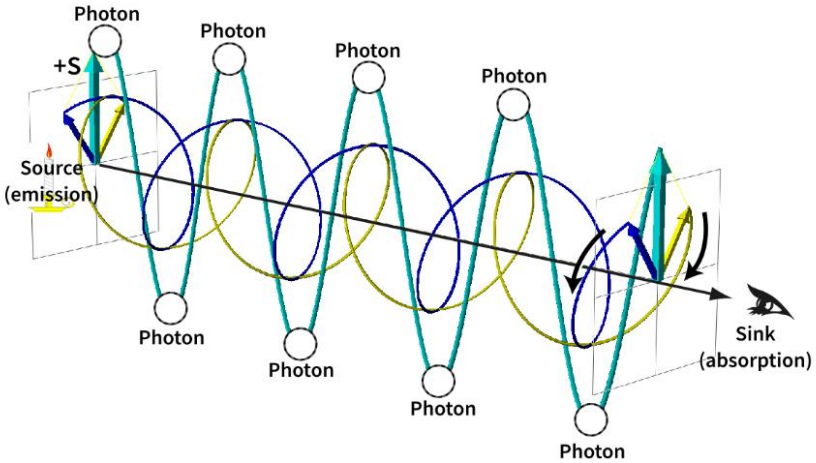
Solution photon 1 (+S+ct)(+S−ct) = +S²   −c²t²

Solution photon 2 (−S−ct)(−S+ct) = +S²   −c²t²

Magnetic pole +   (−S+ct)(+S−ct) = −S² $\boxed{+2\ Sct}$ −c²t²

Magnetic pole −   (−S−ct)(+S+ct) = −S² $\boxed{−2\ Sct}$ −c²t²

(a) The zigzag creation of (+S -ct)(+S +ct) photon.

Photon

Photon

+S

Photon

Photon

Source
(emission)

Photon

Photon

Photon

Photon

Sink
(absorption)

(b) Opposing creation of (−S +ct)(−S −ct) photon.

Photon

Assignment of signs is at
absorption, not emission.

Photon

Photon

Photon

Source
(emission)

−S

−ct vector
travels
counter
clockwise

Photon

Photon

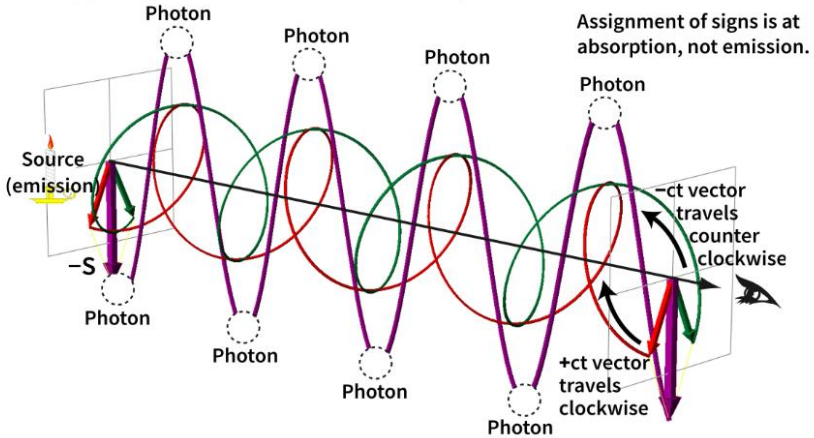+ct vector
travels
clockwise

Photon

Photon

Figure 5. Each row pair in Figure 3 (previous chapter) is a solution to Einstein's equation. The members of a row pair create a photon at each crossing, which occurs twice per cycle. The light waves created by the two row pairs cancel each other and sum to an arrow of darkness.

$$(-S+ct)(+S-ct) = -S^2 \boxed{+2\,Sct} -c^2t^2$$

Positive sign

+S−ct

−S+ct

−S+ct

+S−ct

One wave from each solution:
Red (-S+ct) and Blue (+S-ct)

$$(-S-ct)(+S+ct) = -S^2 \boxed{-2Sct} -c^2t^2$$

Negative sign

−S−ct

+S+ct

−S−ct

+S+ct

One wave from each solution:
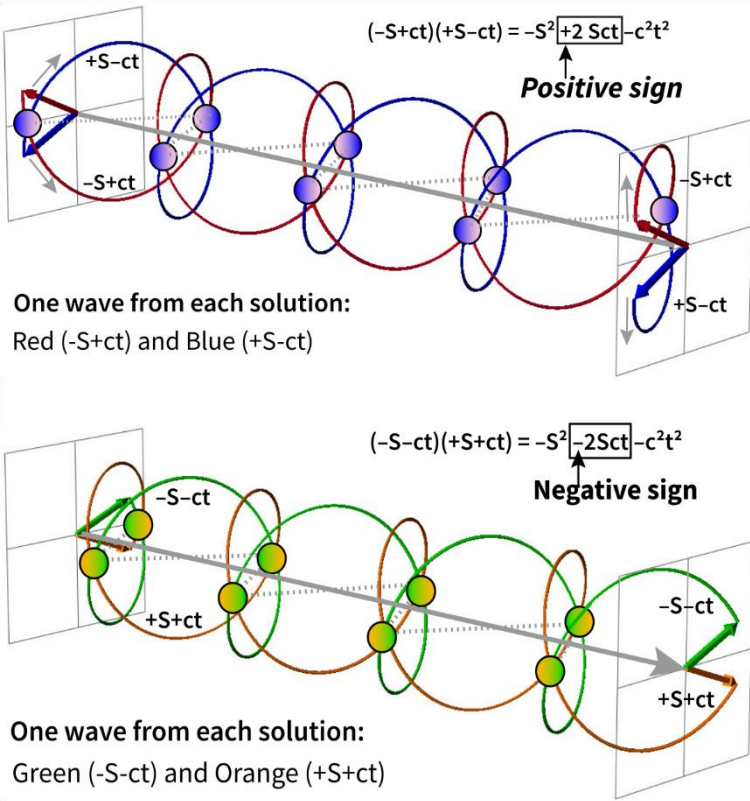Green (-S-ct) and Orange (+S+ct)

Figure 6. Together the two non-solutions create the signed poles of the magnetic vector potential. This happens each half-cycle, so the virtual magnet they create flips directions each half-cycle.
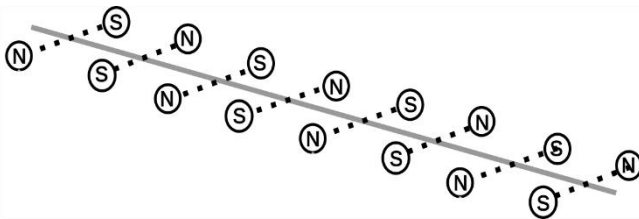
Figure 7. The dotted lines show the simultaneous pairs of virtual particles that create the magnetic vector potential as it travels.

Figure 8 shows the front view of all the pair crossings during one cycle. There are two crossings each quarter-cycle. The created pair of virtual particles alternates between photons and the poles of the magnetic vector potential.
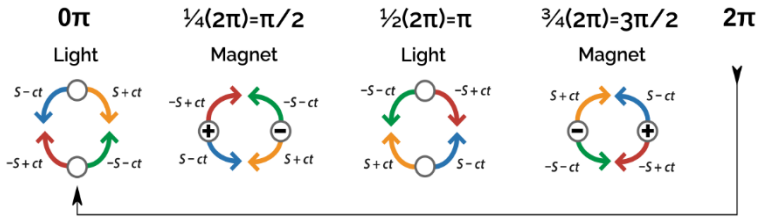

Figure 8. A pair of virtual particles is created each quarter-cycle of the unit interval. Follow a wave around the circle for motion in time.

Notice the photons seem indistinguishable, but the magnetic potential is directional. That is why the photon is a "boson" particle and the electron is a "fermion" particle.

The creation of a virtual magnet by the spinning pairs opens the door to a new paradigm for understanding electromagnetism. Maxwell wrote: (1954, Vol. 2, Article 637)

[S]ince we cannot explain electric currents by means of magnets, we must adopt the other alternative, and explain magnets by means of molecular electric currents.

Consequently, the motion of electrons became the traditional explanation of magnetism. However, the *A-*

field's magnetic vector potential is fundamental, and physical charge is created by breaking its symmetry.

The results of this symmetry breaking are why there are no magnetic monopoles in physical reality---they appear as electrical charges. This is explained in Chapter 5.

Chapters 4 through 8 provide the step-by-step calculations for rest-mass values. The equation sequence starts with the energy of the unit photon to define unit mass and the electron's mass is calculated from the unit mass.

Einstein's forgotten 1919 equation and the general-relativity equation for gravitational mass are combined to calculate the masses of the generations of the Standard Model. The interactions of the *A* field also are used to visualize the particles attributed to the Higgs field.

The next chapter provides three different ways of calculating the unit mass, and each of the three equations uses a different set of physical constants. This is the foundation for the unified view of physics and reality called Interval-Dynamics Theory (IDT).

All light and matter emerge from Maxwell's fundamental field, the *A* field that creates the magnetic vector potential and the photon. That is why the *A* field was designated as fundamental in both electrodynamics (Maxwell, 1954, pp. 187, 267) and quantum theory (Feynman, 1964, Section 15-5).

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