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Probability as a Field Theory

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Abstract

A review of quantum theory shows that quantum theory has substantially replaced all photon behaviour with wave equations. This therefore, has resulted in a quantum theory that does not have a mechanism to explain how Nature implements probabilities. The proposal for such a mechanism is divided into 3 parts of which this paper is the third. The papers [2] and [6] are the first and second parts. This paper proposes a basic field theory for probabilities, which is derived from a step by step analysis of the Point Spread Function of photon localizations. By deconstructing probabilities to separate out the wave modulation from the underlying probabilities it is possible to determine that the photon energy is the cause of the probability field that surrounds the photon. Further, the classical definition of probabilities is used to derive a physical definition of probabilities. From this is derived the correct or true mechanism of the probability field, that of location transfer or translocation, and some addition thoughts on Bell's Theorem.

Keywords: ***Airy Pattern; Bell's theorem; Electron shell; Photon localization; Photon probability; Photon propagation; Probability; Schrödinger wave function***

Introduction

Quantum theoretic approach

Quantum theory [1] describes both mass-based particles and massless particles as wave functions only, to the extent that all photon behaviour are expressed as wave functions. Even probabilistic properties are expressed as wave functions. Solomon and Beckwith [2], however, showed that an alternate probabilistic description is feasible. The point spread function (PSF), here termed Airy Pattern, of photons projected through a pin hole to a screen, is the basis of this alternate probabilistic description.

Further, there is in physics research, what is known as the pilot model [3], which has a specific re-interpretation of probability, and not just on the basis of wave interference. "The Copenhagen interpretation is essentially the assertion that in the quantum realm, there is no description deeper than the statistical one. When a measurement is made on a quantum particle, and the wave form collapses, the determinate state that the particle assumes is totally random. According to the Copenhagen interpretation, the statistics don't just describe the reality; they are the reality" [4].

The research in this paper is to determine another layer of statistical inference, as an alternative to the Copenhagen interpretation, and that is what the offered aim of this paper is.

Deconstructing probability without wave modulation

For the sake of clarity and ease of reading this paper, this section is taken from §3 of Solomon and Beckwith [5]. Roychoudhuri [6] points out that quantum electrodynamics assigns rich properties to "vacuum" and yet relativity and quantum physics do not explicitly recognize space as a real physical medium. Solomon and Beckwith [2] had proposed that subspace (x, y, z) is how Nature implements probabilities. It was proposed [2,7,8] that electric and magnetic field energies are transferred to subspace as these field energies not conserved within the transverse wave. Just as gravitational fields have a time invariant potential energy structure in spacetime, observed as spacetime curvature, the transverse wave's electric and magnetic field energies transform the structure of subspace curvature to exhibit probability density per C (3).

Gravitational fields have several important properties, (i) a source, or mass and (ii) a field structure, or curvature, (iii) the field effect, gravitational acceleration, is due to field curvature (iv) total field strength, and (v) the total field energy dependent upon the amount of the gravitating mass [9,10].

Using this gravitational model as an analogy, this paper proposes (i) the source of a photon's probability density is the transverse wave's electric and magnetic field energies, (ii) the observed subspace curvature is the inverse radial function per C(3), (iii) the field effect, probabilities, is due to the subspace curvature, (iv) the total field strength is the total probability density function $P_{\psi P}$ per C(5), and (v) the total probability density is dependent upon the total electric and magnetic field energy.

Per (i), using the electric field energy ${}_{T}\eta_{E}$, to keep it simple,

$${}_{T}\eta_{E} = \left(\frac{\varepsilon E_A^2}{2}\right) \qquad (1)$$

Per (ii), from C (3),

$$\varphi_P = \left(\frac{1}{k_P r_P}\right) \qquad (2)$$

Per (iii), from C (4),

$$P_P = \frac{1}{2}\sqrt{\frac{\lambda_P}{\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\,sin\left(\pi\sqrt{\frac{\sqrt{\varepsilon}E_A}{\lambda_P}}r_P\right) \tag{3}$$

In the absence of the transverse wave's modulation of the probabilities,

$$P_P = \frac{1}{2}\sqrt{\frac{\lambda_P}{\sqrt{\varepsilon}E_A}}\frac{1}{r_P} \tag{4}$$

Per (iv), from C (5) and C (4),

$$P_{\psi P} = \frac{r_P}{k_P} = r_\psi = \frac{1}{2\pi}\frac{\lambda_P}{\sqrt{\varepsilon}E_A} \tag{5}$$

And from (12) and C (19),

$$P_P = \sqrt{\frac{\pi P_{\psi P}}{2}}\frac{1}{r_P} = \frac{1}{r_P} \tag{6}$$

That is, in the absence of any wave modulation, photon probability is purely an inverse function of the radial distance r_P from axis of motion. That is, per Solomon and Beckwith [11-15], just as wave equations and probabilities are different phenomena, given a consistent particle structure, it is possible to define probabilities in terms of the wave equations.

Per (v), the relationship (1) between source and field is proposed by equating the total electric field energy (electric field energy density $_T\eta_E$ x volume V_E occupied by this electric field) to probability density $P_{\psi P}$ (because the electric field is that of the transverse wave, the probability density $P_{\psi P}$ in the plane of this transverse wave is the equivalent). However, by C (19) and (5)

$$P_{\psi P} = \frac{1}{2\pi}\frac{\lambda_P}{\sqrt{\varepsilon}E_A} = \frac{2}{\pi} \tag{7}$$

Or

$$\lambda_P = 4\sqrt{\varepsilon}E_A \tag{8}$$

Or

$$E_A = \frac{\lambda_P}{4\sqrt{\varepsilon}} \tag{9}$$

Thus, the electric field strength E_A, of the transverse wave is purely a function of it wavelength and the electric permittivity of the environment, and as the photon's wavelength λ_P increases it electric field strength E_A also increases. That is, there is no standard electric field strength E_A for the photon.

Rewriting, gives, the electric energy density η_E in terms of the photon wavelength λ_P, and photon energy E_P,

$$\eta_E = \frac{1}{2}\varepsilon E_A^2 = \left(\frac{\lambda_P}{4\sqrt{2}}\right)^2 \tag{10}$$

$$E_P^2\eta_E = \left(\frac{hc}{4\sqrt{2}}\right)^2 \tag{11}$$

The electric field energy density η_E is a function of the square of the photon's wavelength λ_P. As the right had side of (11) is a constant, one infers that the electric field energy density is like a store, transmuting into photon energy E_P per (11), and it is independent of photon wavelength λ_P.

Thus, (a) photons total probability density functions $P_{\psi P}$ C(9) and $D_{\psi P}$ C(10) evaluate to a constant and is independent of its wavelength λ_P (b) their electric field energy densities and photon energies are interchangeable and governed by (11), (c) as $E_P \rightarrow \infty$, $\eta_E \rightarrow 0$ and photons lose their wave characteristics and appear to be point-like particles, (d) at this stage it is not possible to equate the photon probability density functions to their energies as (7) shows how electric field and wavelength compensate for each other, (e) this section forms the basis of a field theory approach to how probabilities are implemented in Nature.
From C (21) and (8), the photon probability in the absence of any other external factors, can be rewritten as,

$$P_P = \frac{1}{2}\sqrt{\frac{\lambda_P}{\sqrt{\varepsilon}E_A}}\frac{1}{r_P}sin\left(\pi\sqrt{\frac{\sqrt{\varepsilon}E_A}{\lambda_P}}r_P\right) = \frac{1}{r_P}sin\left(\frac{\pi}{4}r_P\right) \tag{12}$$

Therefore, the non-modulated, without the effect of the space wave, probability P_N takes the form,

$$P_N = \frac{k_N}{r_P} \tag{13}$$

Where k_N is some constant. That is one now has a probability function (13) that is deconstructed from the modulated probability function (12). Note that (6) informs the shape of the probability function at any distance r_P, while C (9) or $P_{\psi P}$ and

C (10) $D_{\psi P}$, provide the total value of the respective photon probability density functions, but not their shapes. Therefore, to develop a probability field theory, the next step is to answer the question, what is the shape of the photon's non-modulated probability density function ψ_N given its probability function P_N?

Interpretation and definitions of probability and probability density

Starting with the premise that the photon probability modulation is due to the space wave χ_P C (2), it is necessary to determine the true relationship of probabilities in the absence of this modulation. Rewriting B (13) and C (10) in the form of a straight line (14),

$$y = mx + c \tag{14}$$

one gets,

$$P_A = \left(\frac{1}{P_{\psi A}}\right)\psi_A + 0 \tag{15}$$

$$P_P = \left(\frac{1}{P_{\psi P}}\right)\psi_P + 0 \tag{16}$$

That is, conceptually probability relationships can be structured into three parts, (i) probability P_A or P_P is the y effect function, (ii) caused by the probability density ψ_A or ψ_P, the x-source function (iii) whose effects is modified by the total probability density $1/P_{\psi A}$ or $1/P_{\psi P}$ the m gradient function or in general using a generic process D,

$$P_D = \left(\frac{1}{P_{\psi D}}\right)\psi_D + 0 \tag{17}$$

One can now define probabilities in terms of spatial properties. The classical definition of probabilities is that, for a given process, probability is the ratio of the number of outcomes of a specific event over the total number of outcomes of all possible events. From this classical definition one can now propose a physical definition of probability.

The physical probability P_F field is defined as the field in which is evidenced latent or real localization events caused by the localization probability density function ψ_D. Such that, the probability P_D at a point S_D from a reference point S_R is the occurrence of localization events at S_D over the total number of localization events caused by the total localization probability density function $P_{\psi D}$ from that same reference point S_R within range defined by its range of upper point S_U and lower point S_L, in a time invariant manner.

$$P_D = \frac{\psi_D\left(S_D|S_R\right)}{P_{\psi D}\left(\left(S_U - S_L\right)|S_R\right)} = \frac{\psi_D\left(S_R - S_D\right)}{P_{\psi D}\left(S_U - S_L\right)} \quad (18)$$

In terms of (18), (15) and (16), are rewritten as (19) and (20), respectively,

$$P_A = \frac{\psi_A\left(r_A\right)}{P_{\psi A}\left(r_{AU} - r_{AL}\right)} = \frac{\psi_A\left(r_A\right)}{P_{\psi A}\left(r_{AU}\right)} \quad \text{as } r_{AL} \approx 0 \quad (19)$$

$$P_P = \frac{\psi_P\left(r_P\right)}{P_{\psi P}\left(r_{PU} - r_{PL}\right)} = \frac{\psi_P\left(r_P\right)}{P_{\psi P}\left(r_{PU}\right)} \quad \text{as } r_{PL} \approx 0 \quad (20)$$

Therefore, the non-modulated photon probability P_N is the direct effect of the photon's non-modulated probability density function ψ_N,

$$\psi_N = \left(\frac{1}{P_{\psi N}}\right) P_N + 0 \quad (21)$$

Since, the range of r_P determines the photon's probability range C (13), and by C(21) that the oscillating electric field E_A (22) alters the photon's probability,

$$P_P = \frac{1}{\sqrt{\sqrt{\varepsilon} E_A}} \left(\frac{\sqrt{\lambda_P}}{2r_P}\right) sin\left(\sqrt{\sqrt{\varepsilon} E_A}\left(\frac{\pi}{\sqrt{\lambda_P}} r_P\right)\right) \quad (22)$$

As probabilities, cannot be negative, the magnitude of the photon probability due to the oscillations is,

$$0 \le P_N \le + \frac{1}{\sqrt{\sqrt{\varepsilon} E_A}} \left(\frac{\sqrt{\lambda_P}}{2r_P}\right) \quad (23)$$

And therefore, the governing relationship with the maximum electric field amplitude E_A is,

(24)

Since, the wavelength λ_P is a constant for a given photon,

$$k_N = \frac{\sqrt{\lambda_P}}{2} \quad (25)$$

And,

$$P_N^2 \sqrt{\varepsilon} E_A = \left(\frac{k_N}{r_P} \right)^2 \tag{26}$$

Or,

$$P_N = \left(\frac{k_N}{r_P} \right) \frac{1}{\sqrt{\sqrt{\varepsilon} E_A}} \tag{27}$$

Or because $P_{\psi N}$ is a constant, grouping all the constant terms, by (21) one can propose that,

$$P_{\psi N} = \sqrt{\frac{2\sqrt{\varepsilon} E_A}{\lambda_P}} \tag{28}$$

And,

$$\psi_N = \left(\frac{1}{r_P} \right) \tag{29}$$

Thus, the total probability density function $P_{\psi N}$ is a function of the photon's electric field and its energy. (29) informs of the shape of the non-modulated probability density function ψ_N. The non-modulated probability P_N is given by,

$$P_N = \left(\frac{1}{P_{\psi N}} \right) \psi_N = \left(\frac{k_N}{\sqrt{\sqrt{\varepsilon} E_A}} \right) \frac{1}{r_P} = \sqrt{\frac{hc}{4\sqrt{\varepsilon} E_A} \frac{1}{E_P}} \frac{1}{r_P} = \frac{k_{\lambda N}}{r_P} = \frac{k_{EP}}{r_P \sqrt{E_P}} \tag{30}$$

And $k_{\lambda N}$ and k_{EP} are some constants as r_P is the only variable for a specific photon wavelength λ_P.

Probability as an energy deformation of space

With this information and noting that the probability field is a disc (x-y axes) orthogonal to the field of motion (z-axis), (30) can be rewritten along the x-axis as,

$$\delta P_N = k_{\lambda N} \psi_N \left(\delta x \right) = k_{\lambda N} \delta \psi_N \left(x \right) \tag{31}$$

$$\frac{\delta P_N}{\delta \psi_N \left(x \right)} = k_{\lambda N} \tag{32}$$

Or in the limit as x→0,

$$\frac{dP_N}{d\psi_N(x)} = k_{\lambda N} = \frac{dP_N}{dx}\frac{dx}{d\psi_N(x)} \tag{33}$$

$$\frac{dP_N}{dx} = k_{\lambda N}\frac{d\psi_N(x)}{dx} \tag{34}$$

Similarly, along the y-axis,

$$\frac{dP_N}{dy} = k_{\lambda N}\frac{d\psi_N(y)}{dy} \tag{35}$$

Developing the probability field P_F theory with reference to Appendix C, it is noted that the probability field does not cause localizations [2]. Localizations are due to the spacetime-subspace αβ joins. A probability field on the other hand is a region of space (not spacetime as the probability field is time invariant) that determines how likely a localization event $L(r_P)$ a distance r_P from the reference point S_R (in this case the axis of the photon motion) is likely to occur given a spacetime-subspace αβ join is present at r_P. Note, there may be more than one spacetime-subspace αβ joins present within the probability field P_F.

Using (30), the total probability P_T, with radius r_P set at its maximum value r_{PL} over the photon's probability disc must be 1, from C (4) and C (17),

$$P_T = \int_0^{2\pi} \pi P_N^2 = \left(\frac{k_N}{\sqrt{\sqrt{\varepsilon}E_A}}\right)\frac{1}{r_{PU}}\left[2\pi - 0\right] = \left(\frac{k_N}{\sqrt{\sqrt{\varepsilon}E_A}}\right)\frac{2\pi}{r_{PU}} \tag{36}$$

$$P_T = \left(\frac{k_N}{\sqrt{\sqrt{\varepsilon}E_A}}\right)\frac{2\pi}{r_{PU}} = \lambda_P \frac{\pi}{2\sqrt{\varepsilon}E_A} = 1 \tag{37}$$

Or for the total probability disc, as opposed to the radial probability, the relationship between wavelength and electric field strength is given by,

$$\lambda_P = \frac{2}{\pi}\sqrt{\varepsilon}E_A \qquad \text{for total disc probability } P_T \tag{38}$$

But from (8),

$$\lambda_P = 4\sqrt{\varepsilon}E_A \qquad \text{for total radial probability } P_N \tag{39}$$

One would have thought that the relationship between wavelength and electric field would have been the same. It is suggested that (39) be used when determining the electric field amplitude of a single photon and (38) be used when modifying the photon's total probability field.

Using (34) and (35) one can now rewrite subspace deformation in terms of this photon energy. Considering a 1-dimensional formulation, along the orthogonal x-axis,

$$\frac{dP_N}{dx} = \frac{dP_N}{dE_P}\frac{dE_P}{dx} \tag{40}$$

$$\frac{dE_P}{dx} = \frac{dP_N}{dE_P}\frac{dx}{dP_N} \tag{41}$$

From (30), for a specific photon wavelength,

$$\frac{dP_N}{dx} = -\frac{k_{\lambda N}}{x^2} = -\left(\frac{\sqrt{\lambda_P}}{2\sqrt{\sqrt{\varepsilon}E_A}}\right)\frac{1}{x^2} \tag{42}$$

$$\frac{dP_N}{dE_P} = -\left(\frac{k_{EP}}{2x}\right)\left(\frac{1}{E_P^{\frac{3}{2}}}\right) \tag{43}$$

Therefore, the subspace gradient of the photon energy in 1-dimension is given by,

$$\frac{dE_P}{dx} = \left(\frac{k_{EP}}{2x}\right)\left(\frac{1}{E_P^{\frac{3}{2}}}\right)\frac{x^2}{k_{\lambda N}} = \left(\frac{1}{4\sqrt[4]{2}}\right)\left(\frac{1}{E_P^2}\right)x \tag{44}$$

Or, the 1-dimensional deformation of subspace by this photon energy is given by,

$$\frac{dx}{dE_P} = 4\sqrt[4]{2}E_P^2\left(\frac{1}{x}\right) \tag{45}$$

Note, however, this is not a useful approach as (44) is the spatial photon energy gradient along a radial axis, and does not provide how photon energy stresses the space. To do that one needs to consider the change in probabilities as a result of a change in the photon energy. From (30), given two photons 1 and 2 with E_{P1} and E_{P2} energies, probabilities P_{N1} and P_{N2} and maximum electric field amplitudes E_{A1} and E_{A2} respectively, at a distance r_P from the z-axis are given by,

$$P_{N1} = \sqrt{\frac{hc}{4\sqrt{\varepsilon}E_{A1}}}\sqrt{\frac{1}{E_{P1}}}\frac{1}{r_P} \tag{46}$$

$$P_{N2} = \sqrt{\frac{hc}{4\sqrt{\varepsilon}E_{A2}}}\sqrt{\frac{1}{E_{P2}}}\frac{1}{r_P} \tag{47}$$

Assuming that $E_{A1} \approx E_{A2}$ for simplicity,

$$\delta P_N = P_{N1} - P_{N2} = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\right)\left(\frac{1}{\sqrt{E_{P1}}} - \frac{1}{\sqrt{E_{P2}}}\right) = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\right)\left(\frac{\sqrt{E_{P2}} - \sqrt{E_{P1}}}{\sqrt{E_{P1}E_{P2}}}\right) \tag{48}$$

And as $E_{P2} \to E_{P1}$, $E_{P2} \to E_{P1} + \delta E_P$ thus,

$$\delta P_N = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\right)\left(\frac{\sqrt{E_{P1}+\delta E_P} - \sqrt{E_{P1}}}{\sqrt{E_{P1}\left(E_{P1}+\delta E_P\right)}}\right) = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\right)\left(\frac{\sqrt{E_{P1}+\delta E_P} - \sqrt{E_{P1}}}{\sqrt{E_{P1}\left(E_{P1}+\delta E_P\right)}}\right) \tag{49}$$

Using two simplifying assumptions,

$$As\,\delta E_P \to 0, \sqrt{E_{P1}+\delta E_P} - \sqrt{E_{P1}} \to \delta E_P \tag{50}$$

$$As\,\delta E_P \to 0, \sqrt{E_{P1}E_{P1}+E_{P1}\delta E_P} \to E_{P1} \tag{51}$$

$$\delta P_N = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\right)\left(\frac{\delta E_P}{E_{P1}}\right) \quad (52)$$

Or,

$$\frac{dP_N}{dE_P} = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\frac{1}{r_P}\right)\left(\frac{1}{E_P}\right) \quad (53)$$

(53) is the probability energy gradient, or how probabilities change if the photon energy is changed. Therefore, integrating (53) with respect to E_P gives,

$$P_N = \left(\sqrt{\frac{hc}{4\sqrt{\varepsilon}E_A}}\right)\frac{ln\left(E_P\right)}{r_P} \quad (54)$$

(54) is the relationship between probabilities and photon energy, or the physical manifestation of the probability field P_F is the spread of photon energy across the disc such that the amount of photon energy present at a spacetime-subspace αβ joins is equivalent to its probability P_N. Therefore, photons do not mysteriously localize at a point orthogonal to their motion. Their energy is spread over the disc and therefore, some portion of the photon is already present at the point where they localize.

What is the probability field P_F?

To develop a field theory for probabilities requires an understanding of what the probability field P_F is? Both the classical and physical definitions of probabilities provide descriptions of, but do not answer this question. From the physical description, one notes that the probability field P_F is a mechanism to relocate a photon's position, given localization events. Thus, this probability field P_F is a location transfer or translocation mechanism. This translocation is instantaneous as the field is time invariant, and therefore not related to motion or Lorentz-FitzGerald Transformations (LFT). The instantaneous nature of the P_F probability field's translocation mechanism points to a photon energy that is rich or sophisticated [16].

Rewriting (30) from the perspective of translocation gives,

$$r_P = \frac{k_{\lambda N}}{P_N} \quad (55)$$

That is, the radial distance translocated is inversely proportional to its probability. Noting that the photon's disc (see Appendix C) has a range per (56),

$$k_P r_\psi = r_{PL} \le r_P \le r_{PU} = \frac{1}{k_P r_\psi} \tag{56}$$

Integrating (44), gives

$$E_P = \left(\frac{1}{8\sqrt[4]{2}}\right) r_P^{2/3} \tag{57}$$

Therefore, the total photon energy E_{Pr} within the disc formed by the radius r_P is,

$$E_{Pr} = \left(\frac{1}{8\sqrt[4]{2}}\right) \int r_P^{2/3} dr_P = \left(\frac{3}{40\sqrt[4]{2}}\right) r_P^{5/3} \tag{58}$$

(58) determines the cumulative photon energy at the radius r_P. There is a monotonic relationship between the translocation distance r_P and the photon energy E_P to get to that distance. Or, the greater the proportion of the photon energy E_P within a radius r_P the greater is the translocation distance r_P.

Is the gravitational field mechanism the same as that of the probability field? No. The gravitational field is constrained by the Lorentz-FitzGerald Transformation (LFT) while the probability field is not.

What about Bell's theorem?

Khrennikov [17] stated "Bell's theorem rejects only local hidden variable models, i.e., models preventing faster than light communications." Bell's theorem is limited to spacetime. However, as shown [2], the conservation of energy within the electromagnetic transverse wave requires both the existence of the spacetime (*x*,*y*,*z*,*t*) and subspace (*x*,*y*,*z*). Subspace does not have the time dimension. In this light Bell's theorem in a richer spacetime (per Roychoudhri's critique [5]) is inapplicable for two reasons,

- Bell's theorem assumes that spacetime is not rich. Therefore, the disproof of hidden variables only disproves traveling hidden variables. The implicit assumption in Bell's theorem is that velocity is the only mechanism for the conveyance of signals between entangled photons.
- In a rich spacetime, other mechanisms for the conveyance of signals are possible. Solomon and Beckwith [6] proposed an experimental test that could determine if entanglement could either be due to probabilities or due to subspace itself. Therefore, there are two more signal conveyance mechanisms,
- Probabilities as subspace structures do not travel but are photon energy structures that exists over a large radius, and therefore a possible mechanism for probabilistic hidden variables.
- Subspace itself could be another mechanism as it does not have the time dimension, and therefore the conveyance mechanism would be space hidden variables.

Therefore, this exploration of how probabilities are implemented in Nature, partially invalidates Bell's Theorem.

Conclusion

This paper has laid the foundations of a field theory for probabilities, by starting with the premise that photon energy within the transverse electromagnetic wave must be conserved at any and every instance within this wave. This requires the existence of a subspace that is time invariant and therefore a suitable candidate for how Nature implements probabilities. In developing a field theory for probabilities this paper proposed that there isn't a standard electric field strength associated with the electromagnetic wave. By proposing a rich 4-dimensional spacetime (x, y, z, t) it is possible to derive a basic field theory for photon probabilities that is dependent upon photon energy. This leads to the inference that probability is a location transfer or translocation mechanism.

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