

Peer Review

Review of: "Aristotle, Heisenberg, and the Non-Locality and Non-Temporality of a Single Photon"

Andrew Das Arulsamy¹

1. Independent researcher

"The author presents an analysis of the exchange of energy by photons." How does one photon exchange energy with another photon? Photons do not interact with another photon because they are massless and chargeless.

Philosophical framework can be used to further understand the properly interpreted QM, but I am not convinced that such a framework can be used to construct the interpretation. What are your arguments justifying your approach?

What do you mean by photons exhibit the strongest quantum? Electrons are not giving enough evidence that the latter are also exhibiting the strongest quantum? They are two different categories of the strongest quantum (bosons and fermions).

Yes, HUP points to our insufficient knowledge such that we cannot isolate (foundationally, mathematically, physically, nor mechanically) the particle nature from the wave nature of a photon or an electron. But this does not imply we have to start or need a philosophical framework nor the assumption that photons have the strongest quantum.

The author attempts to show "non-local and non-temporal correlations occur in the trajectory of a single photon." This makes sense because being solely non-local means constant-speed-of-light violation, hence, the additional notion of being non-temporal. Here, the author has to be super-careful with whose frame of reference the author is referring to. For photons, of course, they are non-local and non-temporal because time does not exist for photons and therefore space does not exist either, hence non-local. Thus, in this respect, it makes sense to me, but the catch here---whose frame of reference? This means that the

so-called “Aristotelian approach, the trajectory of any movement is considered a whole” has got nothing to do with the quantum particle’s whole trajectory.

But never mind, let us go on. A light pulse of a certain size travels from A to B and is detected at B with another size. The notion of collapse of the wavefunction is an assumption here invoked randomly. Next, it is true that we cannot measure the trajectory without disturbing the light pulse. There must be at least a weak disturbance with a weak measurement technique. OK, this is fine. Then there is no which-way information. This no which-way is only true for a given photon in a double-slit experiment. Moreover, we definitely know the photons are taking one of the slits (there is no magic here); we just do not know which photon is taking which slit. In the light pulse stated by the author, we do not need to talk about which-way information because it is irrelevant here. Thus, the which-way notion is invoked randomly here. The light pulse trajectory has a particular path or trajectory. Use visible laser light. While driving at night, you see the road because of the headlight. Do you know why? Let me be specific. Does the light bend and reach your eyes, and is this a valid photon trajectory?

Maxwell’s equations are designed for the wave-like nature of photons. They are not for the particle-like nature of a single photon nor for many particle-like photons. You claim: “Photons show particle properties different from those of macroscopic objects,” which is correct, but this has got nothing to do with or does not imply “Dirac’s assumption: *photons interfere with themselves.*” Another randomly invoked notion.

As anticipated, you now claim physically unacceptable notions: “Non-locality means...faster than light correlations are involved or action at a distance” and “Non-temporality means that events in the future light cone have a certain influence on the present state of the origin.” We need an interpretation that does not violate established experiments and physical reality. Your ideas violate physical reality maximally. See my conclusions.

By writing (coherence length) = (speed of light) X (uncertainty in time), you are unknowingly implying that the photon’s position uncertainty in spacetime is the same as the uncertainty of the photon frequency at a given position in spacetime. In other words, the kinetic energy of a photon, which determines its position, has got nothing to do with the frequency of that photon. This confusion is common among physicists. But never mind. The position of the Sun is meaningless if you are referring to its energy.

Your (I) to (iii) properties of the coherence length are acceptable because they are not wrong if the trajectory is in a vacuum (before the detection and after the emission). The FACTS below are also true for

photons that travel in a fiber-optics cable (the situation is complicated due to interaction with optical matter). The coherence length defined by the author, of course, cannot be a fixed value for photons traveling in a fiber optic cable or with non-constant spacetime.

(FACTS) Yes, a photon is a real physical object. What connection is there between the emitter and the detector? The detector cannot influence the photons emitted. The detected photons do not, non-locally nor non-temporally, be connected to the detector (fwd or bwd in time) to the emitter such that the detector spreads information to the emitter. This is not true for a single photon and for a light beam (many photons). Anyone who does not agree with these facts violates physical reality and the established experiments.

The experimental analysis provided by the author supports and proves the facts stated in (FACTS), but does not support non-local and non-temporal notions proposed by the author. Hence, there is no valid science here, even though the author's idea is new, but it is physically false (as shown above) because it clearly violates physical reality (see the FACTS above). Moreover, as expected, the author invokes hidden variable theory when the photons have large changes to their frequency or when their frequencies are spread satisfying a particular distribution during the travel. All problems from HUP are swept under the hidden variable carpet. Another randomly invoked concept. There are three escape statements (unrelated statements that are invoked to save his arguments without proper justifications), namely, Dirac's self-interaction, wavefunction collapse, and hidden variable theory. We can now conclude that the coherence length defined by the author does not provide any new physics other than what is already known from the above FACTS (see below for more details).

In conclusion, the author used HUP in writing his coherence length equation to justify non-local and non-temporal notions. However, the changes due to photons' frequencies and positions do not require such notions. We cannot accept any interpretation that violates physical reality and/or established experiments. Even though backward causality is denied by the author, the author's proposal of non-temporal implies that the emitted photons need to know the whole trajectory, and therefore backward causality exists, and we cannot deny its existence by assuming it does not exist. Mathematically, we can always allow such causality because we need to know the initial and final conditions, but when we interpret the physics, it always reads---the emitted photons follow a trajectory that satisfies the least action principle as determined by the spacetime and light-matter interaction (if any). I think the author is confused between the conditions required for mathematical derivation and mathematical solution and

the physical interpretation from the derivation and solution. This confusion is too common among physicists.

(1) The double slit experimental results can be explained with physics that does not violate physical reality [see [Results in Optics Volume 15](#), May 2024, 100638]. Hence, any proposition that needs to invoke non-local and non-temporal is not needed.

(2) You cannot construct experiments to violate physical reality because it is simply not allowed; hence, we cannot prove or disprove the authors' proposal with experiments, but we can disprove it by using physics and logical arguments as we did above.

The use of HUP and coherence length is misleading because HUP has got nothing to do with the uncertainty of photons' trajectories. HUP refers to the position of a particular photon at a given time.

Declarations

Potential competing interests: No potential competing interests to declare.