The Flaw in Quantum Mechanics revised

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Abstract

There is a flaw in The Born structure of Quantum Mechanics that has continuously caused conceptual problems. This error is the central problem of the double slit, the EPR Paradox and Bell's Inequality, and leads to what Einstein called the "spooky action at a distance." The phenomenon generally interpreted as quantum entanglement, is nonlocal and violates the Lorentz faster than light communications. There is an explanation that does not involve hidden variables, superluminal communications, or spooky action at a distance that is explored in this paper.

Introduction

When Born [1][2][3], was working on the statistical interpretation of ψ. He at first thought that ψ was a probability density for particles but then he noted on a cue from Einstein that the square of the optical wave amplitudes photons was a photon density. He subsequently decided that ψ is amplitude of probability (whatever that meant) and set the probability density of a particle or energy density to be the value of $\psi * \psi$.

For bound States $\psi * \psi$, it is asserted here that the square is not proper, but is the product of the probability density of two independent conjugate wavefunctions, thus it is the coincidence of the probability densities. It is postulated that this should properly be $\psi_1 \psi_2$ where ψ_1, and ψ_2 are independent conjugate particles.

If ψ_1 and ψ_2 are probability density of two density wavefunctions, then the probable coincidence location density of the of these two particles is just the product of the probabilities:

$$P = P_1 P_2 = \psi_1 \psi_2 \tag{1}$$

The integral over space of this product is a transient having no fixed value *unless* ψ_1, is the conjugate of $\psi_1* = \psi_2$. That is: opposite direction, and opposite phase.

In this case there is a rest frame and the presence of Lorentz invariant, energy density.

$$\int_0^\infty \psi_2 * \psi_2 \, d\tau = 1 \tag{2}$$

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If the wavefunctions are conjugates then in that space there is a Lorentz invariant quantity of energy, equivalent to a rest mass that is invariant under a velocity transformation. This can be illustrated by simply noting the product of the relativistic Doppler shifted product of two opposite going photons is an invariant whereas a single photon is not.

For an atomic system this is the bound steady state condition for quantized energy states of the Schrodinger equation. The Schrodinger equation is time symmetric and thus if ψ is a solution then the conjugate $\psi*$, is also a solution, and there exists for a bound state standing waves associated with that state [4]. As is well known the energy in a bound state constitutes a rest mass addition to the rest mass of a system and thus an occupied energy state is an invariant contribution to the mass

Photon

A distinction should be made between the bound state conjugate product of independent wavefunctions, and the conjugate square of the photon. The product of two conjugate wavefunctions is a Lorentz invariant whereas multiplying a wavefunction by its conjugate wavefunction does not make the wavefunction invariant.

For a free photon ψ is a probability density but there is no conjugate particle present. The product of $\psi * \psi$ is an energy or particle density, being analogous to squaring the velocity of a collection of particles and the wavefunction is not Lorentz invariant

Photon Atom Absorption

For a single photon, the probability density ψ is not a Lorentz invariant thus the space integral of $\psi^*\psi$ is a mathematical value of the kinetic energy density $\hbar\omega$ but does not represent the conversion to an invariant energy.

It is postulated that for an atomic system to absorb a photon, creating an allowed Schrodinger energy state there must be the coincidence presence of a photon and it's conjugate. The single photon wavefunction cannot split and cannot exist as a solution to the Schrodinger equation.

The single photon does not have a conjugate particle present ($\psi^*\psi$) and cannot be an energy solution to the Schrodinger equation thus it cannot be absorbed or re-radiated by spontaneous radiation in an atomic system. The photon can kinetically interact with an atomic system by the process of Compton scattering, transferring the energy to kinetic thermal.

Photon Double Slit

A screen on which there is a projection of double slits from a coherent source there is a flux of photons going through both slits. As a single photon hits a target and reflects (Fig.1), it becomes a conjugate of the following incident particle. At that point there exists the probability of transferring the photon energy $\hbar\omega$, Eq.**Error! Reference source not found.**, to an energy level of the reflecting particle inducing a full $\hbar\omega$ detection of the event. If it is a photon detector there would be an event or if it is an atomic system it could spontaneously reradiate

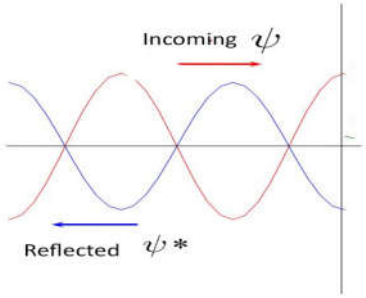


Fig. 1, Photon wave function reflecting

The probability of an energy exchange event will be proportional the phase of the conjugate photon wavefunctions. The pattern on the screen from the photons coming from two slits is then the familiar double slit pattern. The Born or Copenhagen view of this is the that the particle doesn't exist until it hits the screen and the single probability density wavefunction collapses, In this proposal there is a simple flux of photon probability densities arriving with differing phases that generate the interference pattern reflection and detection on the screen.

The mechanism of photon energy transfer in this proposal is that; two photons arriving simultaneously at a point producing an energy probability density proportional to their phase that can deliver energy to the target. Each travels separate paths, with a probability of arrival defined by Feynman path integrals, [5] and the Heisenberg uncertainty relations [6].

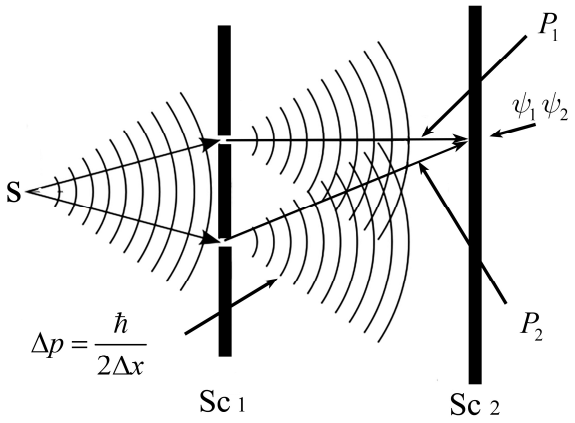


Fig. 2, Interference of two photon fluxes of target screen

Particle Counting, Single Particle Flux Interference

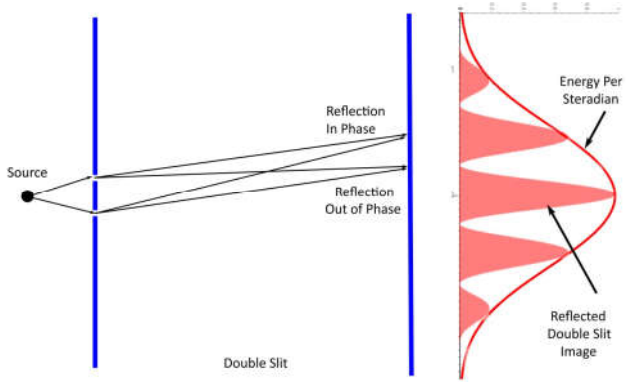
In this interpretation, the number of events detected is the number of two particle coincidence events. The photon flux necessary to trigger detection is the flux necessary produce coincidences. Since the only measurable is the detection rate, the actual number of photons passing through each of the slits cannot be determined.

Conservation of energy

The transfer of energy from two coincident photons is most efficient when the detected photons are exact conjugates as in a laser beam and thus can deliver energy of $E = \hbar\omega$. Most photon encounters are not of conjugate photons, but are of only the Compton scattering which converts the photon energy to heat.

Although the out of phase photons are not visible in the double slit pattern the number of photons in the flux per steradian is the same at the minimum as the maximum. If the flux of a double slit radiation pattern is measured with a blackbody thermopile pyrometer accounting for all the energy, the energy at the peaks and nulls should have the same energy flux.

Double Slit Experiment



If the conjecture is correct, the energy per steradian at the target is primarily determined by the single slit as the result of the Heisenberg uncertainty relation, and should be independent of the double slit interference pattern.

Spooky Effect Explanation

Bells Inequality

The most notable experiment of QM, confirming the nonlocal aspects of QM is the EPR conjecture [7]. Measurements over the past 50 years associated with Bell's inequality have virtually confirmed that Einstein's "spooky action at a distance" is real, and somehow instantaneous communication over vast distances between measurements happens [8]. This is an illogical aspect of QM, and this alternate interpretation offers a simple explanation.

For those familiar with the measurements of Bell's Inequality test by polarization of entangle photons, the probable coincidence match between two polarizers that are set an angles $\theta_1 = 0 + \theta_0$, and $\theta_2 = 0 - \theta_0$ should logically be, for a 60^0 angle:

$$P_m = \cos(\theta_1 - \theta_2), \quad @ \ 60^0 \quad = \ .5 \tag{3}$$

Whereas the actual measurement and predictions of QM and is;

$$P_{QM} = \cos^2(\theta_1 - \theta_2), \quad @ \ 60^0 \ = \ .25 \tag{4}$$

Our postulate is that a photon detection has to be the result of two photons arriving at the detection point at the same time.

If detection is only possible when two photons from the same source are coincident at the detector, then the probability of coincident is the product of the probabilities:

$$P_m = \cos(\theta_1 - \theta_2) \times \cos(\theta_1 - \theta_2) \qquad @ \ 60 = \ .25 \tag{5}$$

This yields the same results as QM without the necessity of postulating superluminal communication at a distance.

The measurements are in agreement standard QM, and with Bells expected values and thus there is no discrepancy

Conclusion

An alternate interpretation of the nature of photons and quantum mechanics has been presented that is physically mimics standard QM but explains some of the more puzzling aspects without non-local effects, hidden variables [9], or require superluminal communications. It does in some way contradicts Dirac's statement that "each photon then interferes only with itself," [10] with the double slit phenomena being an interference of two photons.

A simple experimental test using a blackbody thermopile pyrometer that can measure the energy flux across the image of a double slit pattern should be able to distinguish the physical results of this proposal, from the results expected of standard QM. This experiment is discussed in "Testing the Flaw in Quantum Mechanics"[11]

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