IOSR Journal of Polymer and Textile Engineering (IOSR-JPTE)
e-ISSN: 2348-019X, p-ISSN: 2348-0181, Volume 7, Issue 2 (Mar. - Apr. 2020), PP 16-21
www.iosrjournals.org

Photon Polarization and Entanglement Interpreted by Yangton and Yington Theory

Edward T. H. Wu

[Abstract]: *Antimatter Revolution and Rotation Spins (ARRS) model is proposed for the interpretation of the polarization and entanglement of photons based on Yangton and Yington Theory. Photon Polarization Transformation Diagram is developed to study the polarization transformation of photons. All entangled photon pairs loosing energies through polarization transformation process are no longer the same elements prior polarization transformation process, therefore the probability of distribution of the entangled photons observed via polarization transformation process doesn't have to follow Bell's Inequality and Einstein's Hidden Variables remains a reasonable solution of EPR paradox.*
[Keywords]: *Yangton and Yington, Wu's Pairs, Photon, Polarization, Photon Spin, Quantum Entanglement, Quantum Mechanics, Electron Spin, Hidden Variables, EPR Paradox, Bell's Inequality.*

Date of Submission: 25-05-2020 Date of Acceptance: 11-06-2020

I. Introduction

1. Yangton and Yington Theory

Yangton and Yington Theory [1] is a hypothetical theory of Yangton and Yington circulating particle pairs (Wu's Pairs) [1] with a build-in inter attractive force (Force of Creation) [1] that is proposed as the fundamental building blocks of all matter in the universe. All elementary subatomic particles [2] having string structures as proposed by the String Theory [3], are made of Wu's pairs by string force [4], the Yangton and Yington attractive force between two adjacent Wu's Pairs. Subject to the structures, the composite subatomic particles [2] are made of elementary subatomic particles by four basic forces including gravitational force, electromagnetic force, weak force and strong force. Yangton and Yington Theory can explain the formation of subatomic particles [4] in accordance to String Theory and Unified Field Theory [5], and also interpret the correlations between space, time, energy and matter [6].

2. Wu's Pair – The Building Block of the Universe

According to the 4th Principle, with the external energy generated from Big Bang explosion, a Yangton and Yington circulating pair with an inter-attractive Force of Creation named "Wu's Pair" (Fig. 1) can be formed so that Something can become a permanent matter. These Wu's Pairs are the fundamental building blocks (God's Particles) of all matter such as photons, quarks, electrons, positrons, neutrons, protons, etc.
From Something to a permanent Wu's Pair, the reaction process can be represented by the following formulas:

$$\text{Yangton } \Theta \text{ Yington} \rightarrow \text{Yangton } \Phi \text{ Yington} \quad \Delta E = E_{Circulation}$$

$$E_{Creation} + E_{Circulation} \leftrightarrow \text{Yangton } \Phi \text{ Yington}$$

Where "Yangton Θ Yington" represents Something – a temporary Yangton and Yington pair. "Yangton Φ Yington" represents Wu's Pair – a permanent Yangton and Yington circulating pair. $E_{Creation}$ is Energy of Creation which is used to generate Force of Creation. $E_{Circulation}$ is the circulation energy which includes both potential and kinetic energies of the circulation. The summation of $E_{Creation}$ and $E_{Circulation}$ is called "Wu's Pair Formation Energy" which can be generated either from Big Bang explosion [7].

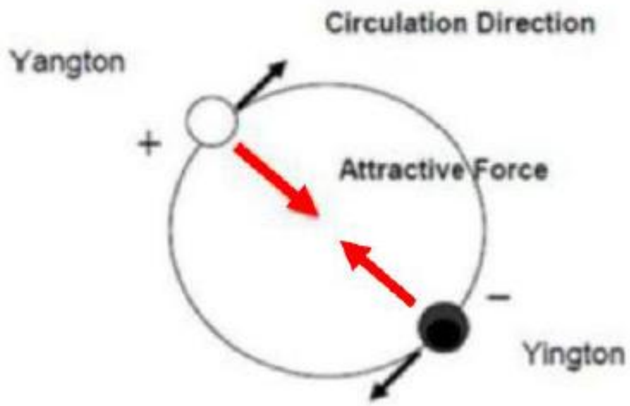

Fig. 1 Wu's Pair - a Yangton and Yington circulating pair.

3. Photon – A Free Wu's Pair
When Wu's Pair is released from a substance, it becomes a free particle known as "Photon". Photon travels in space at a constant Absolute Light Speed $3x10^8$ m/s [8] while observed at the light source. The reaction process can be represented as follows:

Yangton Φ Yington → Photon $\Delta E = h\nu$

Where "Yangton Φ Yington" is Wu's Pair and hν is photon's kinetic energy.

II. Quantum Entanglement

Quantum entanglement is the physical phenomenon that occurs when a pair or group of particles is generated at the same time, they interact or share spatial proximity in a way such that the quantum state of each particle of the pair or group cannot be described independently of the state of the others, even when the particles are separated by a large distance.

Measurements of physical properties such as position, momentum, spin and polarization performed on entangled particles are found to be perfectly correlated. For example, if a pair of entangled particles is generated such that their total spin is known to be zero, and one particle is found to have clockwise spin on a first axis, then the spin of the other particle, measured on the same axis, even instantly will be found to be counterclockwise. However, this behavior gives rise to paradoxical effects: any measurement of a property of an entangled particle results in an irreversible wave function collapse of that particle which can cause interruption of the entanglement and subsequently a random state of the other particle can be measured.

In 1935, Albert Einstein, Boris Podolsky, and Nathan Rosen [8] brought up EPR paradox, in which Einstein and others considered such behavior to be impossible unless instant communication can be fulfilled for an infinite distance. It violates the local realism view of causality (Einstein referring to it as "spooky action at a distance") [9] and argued that the accepted formulation of quantum mechanics must therefore be incomplete. The weak point in EPR's argument was not discovered until 1964, when John Stewart Bell proved by his inequality that the Hidden Variables interpretation hoped for by EPR, was mathematically inconsistent with the predictions of quantum theory.

III. Paradox

The paradox is stated as follows: A measurement made on either of the particles apparently collapses the state of the entire entangled system instantaneously before any information about the measurement result could have been communicated to the other particle. According to quantum theory, the outcome of the measurement of the other part of the entangled pair must be taken to be random, with each possibility having a probability of 50%. However, if both spins are measured along the same axis, they are found always to be anti-correlated.

IV. Hidden Variables

Despite the impossible solution that the communication between two particles can be so fast even more than light speed, a possible resolution to the paradox is to assume that quantum theory is incomplete, and the result of measurements depends on predetermined "hidden variables" [10]. The state of the particles being measured contains some hidden variables, whose values effectively determine, right from the moment of separation, what the outcomes of the spin measurements are going to be. This would mean that each particle carries all the required information with it and nothing needs to be transmitted from one particle to the other at the time of measurement. Einstein and others originally believed this was the only way out of the paradox, and the accepted quantum mechanical description with a random measurement outcome must be incomplete.

The hidden variables theory fails, however, when measurements of the spin of entangled particles along different axes. If a large number of pairs of such measurements are made (on a large number of pairs of entangled particles), then statistically, if the hidden variables view were correct, the results would always satisfy Bell's inequality [10]. Since a number of experiments have shown in practice that Bell's inequality is not satisfied, therefore hidden variables cannot be true.

V. Photon Entanglement Interpreted by Yangton and Yington Theory

1. Antimatter Revolution and Rotation Spins (ARRS)

According to Yangton and Yington Theory, photon has a disc structure (Fig. 1) which is composed of two anti particles, Yangton and Yington circulating on the same orbit. It is proposed while Yangton and Yington circulating the orbit – revolution spin (photon spin), they can also rotate by them self (Yangton spin and Yington spin). This phenomenon is named "Antimatter Revolution and Rotation Spins" (ARRS). In ARRS, there are two major spin categories: "Up Spin" – photon spins in up direction and "Down Spin" – photon spins in the down direction. In addition, there are two minor spin categories: "Parallel Spin" – Yangton and Yington spin in the same direction as photon and "Anti Parallel Spin" – Yangton and Yington spin in the opposite directions. Together, there are a total of four spin modes: Up-Parallel (U_p) and Up-Anti Parallel (U_a) modes for Up Spin; and Down-Parallel (D_p) and Down-Anti Parallel (D_a) modes for Down Spin (Fig. 2).

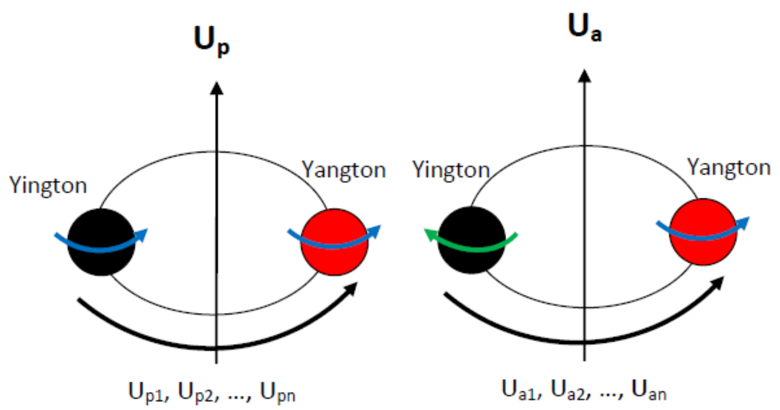

Fig. 2 Photon Spin contains Four Modes: (1) Up Spin: Up-Parallel (U_p) and Up-Anti Parallel (U_a) modes, (2) Down Spin: Down-Parallel (D_p) and Dow-Anti Parallel (D_a) modes. Each mode contains equal amount of energy states.

2. Quantum States and Entanglement

Subject to the difference of the angular momentums between Yington and Yangton, there are a number of quantum states in each of the spin modes. Each quantum state can be represented by a composite code, for example U_p5 means the 5th energy level of Up-Parallel (U_p) Mode. According to Pauli Exclusion Principle [11], a photon can only occupy one quantum state at a time, therefore a pair of entangled photons should have quantum states of the same energy but opposite spin modes such as U_p5 and D_p5. Also all spin modes have equal amounts of quantum states. Furthermore, it is proposed that Anti Parallel spin U_a has higher energy than that of Parallel spin U_p (as is D_a to D_p). In addition, all photons prefer to stay in the low energy quantum states rather than the high energy quantum states.

3. Polarization Transformation

When photons transform between two polarization directions, they need to overcome an energy barrier. Fig 3 shows a photon transformation between two polarization directions, where B_1 is the magnetic field of the photon in the original polarization direction, B_2 is the magnetic field of the new polarization direction and ϴ is the angel between B_1 and B_2.

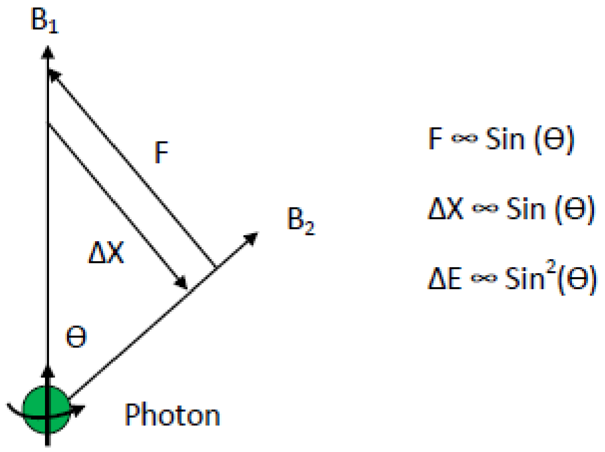

Fig. 3 Force and energy applied from a photon to change its original spin direction to a new polarization direction.

Because
$F \infty \text{Sin}(\Theta)$
$\Delta X \infty \text{Sin}(\Theta)$
$\Delta E \infty \text{Sin}^2(\Theta)$
Because only photons in Up molds (U_p and U_a modes) having higher energy than ΔE (energy barrier) can be transformed to the same Up modes (U_p and U_a modes) in the new polarization direction, therefore,

$$E_m(\Theta) = \Delta E(\Theta)$$

$$E_m(\Theta) = K\,\text{Sin}^2(\Theta)$$

Where $E_m(\Theta)$ is the minimum energy quantum state that can be transformed to the new polarization direction and $\Delta E(\Theta)$ is the energy barrier at angle Θ.

Because at $\Theta = 90^o$, all photons in the Up mode are blocked by the polarizer and no light can be transformed to the new polarization direction (pass through the polarizer), therefore,

$E_m(90^o) = E_{Ua}n$

$K\,\text{Sin}^2(90^o) = E_{Ua}n$

$$K = E_{Ua}n$$

Because

$E_m(\Theta) = K\,\text{Sin}^2(\Theta)$

Therefore,

$$E_m(\Theta)/ E_{Ua}n = \text{Sin}^2(\Theta)$$

Where $E_{Ua}n$ is the highest quantum energy state in U_a mode.

Because all photons with quantum states above $\text{Sin}^2(\Theta)\,E_{Ua}n$ can be transferred to the new polarization direction, therefore, the overall possibility to find the photons in the polarization direction (Θ) can be represented as:

$$P(\Theta) = \text{Cos}^2(\Theta)$$

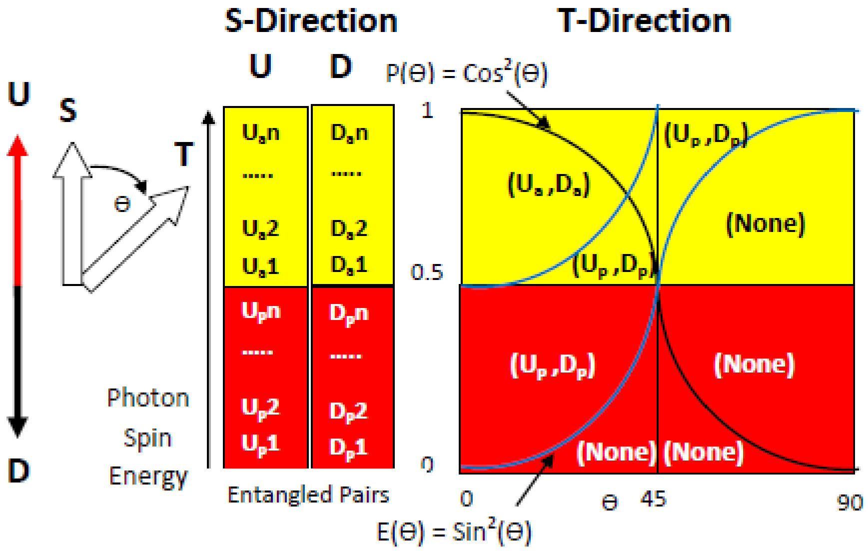

Fig. 4 Photon Polarization Transformation Diagram: The Transformation Diagram of Entangled Photon pairs from S direction to T direction.

Fig. 4 shows a detailed diagram of photon polarization transformation at a polarization angle from 0^o to 90^o. For those entangled photons (U_a, D_a) and (U_p, D_p), their quantum energy states are higher than the polarization transformation energy barrier $\Delta E(\Theta) = Sin^2(\Theta)\ E_{Ua}n$, they can overcome the energy barrier and transform to the lower quantum energy states (U_a, D_a) and (U_p, D_p) in the new polarization direction. Otherwise they will be blocked by the energy barrier if they are at lower quantum energy states. The probability of polarization transformation is equal to $P(\Theta\ ) = COS^2(\Theta)$. This diagram is named "Photon Polarization Transformation Diagram".

Similar to entangled electrons [12], however instead of gaining energy through measurement, the predetermined photon quantum states before photon polarization transformation, known as "Hidden Variables", can be changed by spending the internal energy to overcome the polarization energy barrier and then transformed to the new corresponding entangled quantum states through polarization process. Because all entangled photon pairs loose energy through polarization transformation process, they are no longer the same elements prior polarization transformation process, therefore the probability of distribution of the entangled photons observed via polarization transformation process doesn't have to follow Bell's Inequality and Einstein's Hidden Variables remains a reasonable solution of EPR paradox.

VI. Conclusion

Antimatter Revolution and Rotation Spins (ARRS) model is proposed for the interpretation of the polarization and entanglement of photons based on Yangton and Yington Theory. Photon Polarization Transformation Diagram is developed to study the polarization transformation of photons. All entangled photon pairs loosing energies through polarization transformation process are no longer the same elements prior polarization transformation process, therefore the probability of distribution of the entangled photons observed via polarization transformation process doesn't have to follow Bell's Inequality and Einstein's Hidden Variables remains a reasonable solution of EPR paradox.

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