A New Variant on Young's Double-slit Experiment and Wheeler's Delayed Choice Experiment

Yuan Kai
Hongda Cultural Research Co,ltd. Changsha Hunan China
Email: yuan-kai@hotmail.com

Abstract

Based on the basic version of the Double-slit experiment, a coherent light source, such as a laser beam, illuminates a plate pierced by two parallel slits, and the light passing through the slits is observed on a screen behind the plate.The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen — a result that would not be expected if light consisted of classical particles. Our new variant is as below: We shut one of the two parallel slits once the light passed the slits. Or we keep the two slits shutting and opening randomly in high speed. We believe this variant experiment could lead to a farther fundamental understanding of the Quantum Mechanics.

Keywords

Double-slit experiment Delayed Choice Experiment new variant

Subject Areas

1.Young's Double-slit Experiment

In the basic version of this experiment, a coherent light source, such as a laser beam, illuminates a plate pierced by two parallel slits, and the light passing through the slits is observed on a screen behind the plate. The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen — a result that would not be expected if light consisted of classical particles. However, the light is always found to be absorbed at the screen at discrete points, as individual particles (not waves), the interference pattern appearing via the varying density of these particle hits on the screen. Furthermore, versions of the experiment that include detectors at the slits find that each detected photon passes through one slit (as would a classical particle), and not through both slits (as would a wave). However, such experiments demonstrate that particles do not form the interference pattern if one detects which slit they pass through. These results demonstrate the principle of wave–particle duality.

2.Wheeler's Basic Delayed Choice Experiment

"Wheeler's delayed choice experiment" refers to a series of thought experiments in quantum physics, the first being proposed by him in 1978. Another prominent version was proposed in 1983. All of these experiments try to get at the same fundamental issues in quantum physics. Many of them are discussed in Wheeler's 1978 article, "The 'Past' and the 'Delayed-Choice' Double-Slit Experiment", which has been reproduced in A. R. Marlow's Mathematical Foundations of Quantum Theory, pp. 9–48.These experiments are attempts to decide whether light somehow "senses" the experimental apparatus in the double-slit experiment it will travel through and adjusts its behavior to fit by assuming the appropriate determinate state for it, or whether light remains in an indeterminate state, neither wave nor particle, and responds to the "questions" asked of it by responding in either a wave-consistent manner or a particle-consistent manner depending on the experimental arrangements that ask these "questions".Wheeler's version of the double-slit experiment is arranged so that the same photon that emerges from two slits can be detected in two ways. The first way lets the two paths

come together, lets the two copies of the wavefunction overlap, and shows interference. The second way moves farther away from the photon source to a position where the distance between the two copies of the wavefunction is too great to show interference effects. The technical problem in the laboratory is how to insert a detector screen at a point appropriate to observe interference effects or to remove that screen to reveal the photon detectors that can be restricted to receiving photons from the narrow regions of space where the slits are found. One way to accomplish that task would be to use the recently developed electrically switchable mirrors and simply change directions of the two paths from the slits by switching a mirror on or off. As of early 2014 no such experiment has been announced.

3.The new Variant on Young's Double-slit Experiment and Wheeler's Delayed Choice Experiment

As we mentioned above, in the basic version of this experiment, a coherent light source, such as a laser beam, illuminates a plate pierced by two parallel slits, and the light passing through the slits is observed on a screen behind the plate.The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen — a result that would not be expected if light consisted of classical particles. Our new variant is as below: We shut one of the two parallel slits once the light passed the slits. Or we keep the two slits shutting and opening randomly in high speed. By this experiment we believe we could lead to a farther fundamental understanding of the Quantum Mechanics intrinsically.

References

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