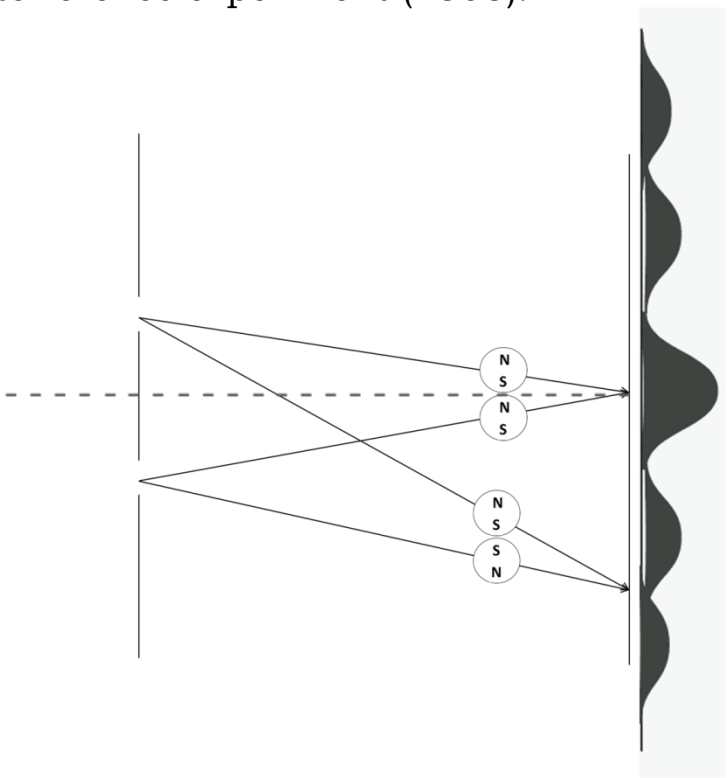
Two Slit Interference, Graphical Representation

Abstract

Thomas Young's interference experiment (1803) is very simple to perform but, even after more than 200 years is one of the most difficult to understand. Quantum physics offers a mathematical model for the observed wave-particle dualism. This article gives a physical model for the wave-particle duality nature of photons.

"If I can't picture it, I can't understand it." Albert Einstein.

In a double slit interference experiment, coherent photons after being diffracted and traveling from the two slits towards the screen, along two convergent rays of light; if on arrival at a point on the screen, are out of phase by 180 degrees, will repel each other and get deflected to neighboring areas, thereby creating a dark band between two bright neighboring bands. This explains Thomas Young's interference experiment (1803).



In the Figure above, along the dotted center-line of the screen, there is a high photon intensity region as the 2 photons are in phase and attract each other. Whereas, in the lower part of the screen the 2 photons are out of phase by 180 degrees and so repel each other and get deposited in neighboring areas, thereby resulting in a dark or very low photon intensity region between two neighboring bright or higher photon intensity regions [1].

HANBURY-BROWN & TWISS (HBT) EXPERIMENT

It is reported that two-slit interference occurs even when the intensity is reduced so much that only one photon or electron traverses the apparatus at a time.

However, Robert Hanbury-Brown and Richard Q. Twiss have observed in their experiment (1956) that photons, in a coherent beam, are not emitted one at a time at equal intervals. *Photons or electrons in a coherent beam, travel in bunches or groups and not as separate individual particles at equal intervals***.** The HBT experiment has been well explained by Akira Tonomura [2].

Two interference patterns (formed by a low intensity beam and a high intensity beam) will be identical for an equal number of photons. The time taken to form will be different. The interference pattern is related to the number of photons striking the screen. The basic requirement for interference is a coherent beam of photons or electrons. *Coherence is the defining criterion for interference*.

REFERENCES

[1] Rajpal K L, Wave Particle Paradox and Evans Photomagneton, 2013. http://www.physicsphotons.org/Wave_Particle19.pdf

[2] Tonomura Akira, The Quantum World Unveiled by Electron Waves, World Scientific, Singapore, 1998.

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