Wave-particle dualism

Wave-Particle-Dualism

This article was checked by pedagogue

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The wave-particle duality is a theory of quantum physics, according to which all matter exhibits the attributes of waves and particles.

- Classical waves propagate in space. They weaken or strengthen by superposition and can act simultaneously at different locations with different strength.
- A classical particle can be present at a specific location only at one time. It acts only there but always with all it’s charge, energy, mass etc.

Both properties seem to contradict each other. Nevertheless, it was shown in several experiments that both properties are present. Therefore it is impossible to create a concrete image of the wave-particle duality, which is based on our classical perspectives. Depending on the type of measurement that is performed light can occur either as a wave or a particle, but never both at the same time.

The Double-Slit Experiment

Experiment setup The behavior of quantum objects is especially shown in the so-called double-slit experiment. Thomas Young was the first to demonstrate the wave nature of light with this experiment.

Experiment setup

Rays are sent out from a source, either electromagnetic waves or particles of matter, and meet a panel with two very fine, closely spaced slits ("double slit"). Behind the panel is a screen. The rays are passing through the double slit, apply to the screen and are registered there.

Behavior of classical waves

A characteristic interference pattern is observed, very similar to the pattern resulting from the interference of water waves.

Behavior of particles

Particles do not interfere, they either get through the left or right gap and then appear within a clearly defined area on the screen.

Bahavior of light

The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen— that would mean the particle is at two places at the same time, in superposition. To determine the location of the particle, a measurement takes place and the interference pattern disappears, the particle will be forced into a more localized state as given by the uncertainty principle. The double slit experiment shows that matter has properties of matter only when a measurement takes place. If there is no information about the particle, there is a propability of its stay. As long as we have no information through which slit the particle flies, the particle shows no matter property. Matter properties are observed only when information about the particles are present so it only behaves as a particle during observation. When position is relatively well defined, the wave has a very ill-defined wavelength (and thus momentum). And conversely, when momentum (and thus wavelength) is relatively well defined, the wave has a very ill-defined position. This leads to the conclusion that the observer changes the behavior of matter by his observation.

THIS ARTICLE DOES NOT EXPLAIN THE WAVE-PARTICLE DUALITY VERY WELL AND NEEDS QUITE A REVISION - ALTHOUGH TO BE FAIR TO THE AUTHOR IT'S A GOOD ATTEMPT AT A DIFFICULT SUBJECT