

# Double Slit Experiment Explained

Contributed by Peter Harrison  
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In the double slit experiment a single photon is emitted from a transmitter. Between the transmitter and receiver devices there is a barrier with two small holes (or slits) through which the photon can travel. This experiment has been the one used traditionally to show the difficulty with classical interpretations of quantum behaviour.

The traditional approaches were for particles and waves. With particles you would expect photons arriving at a point to equal the number of particles that arrive when the first hole is open plus the number that arrive when the second hole is open. Since each individual photon has no opportunity to interact with other photons the number of photons detected should be simply the sum of the photons coming through each hole.

The trouble is that this is not what is observed. Instead each photon acts as if it 'smells' out both possible paths, even though it can only physically go through one of them. The wave theory of light would easily explain this, except for the fact that when we observe light we do actually see it come in discrete packets - photons. This is what is called the particle/wave duality of light.

Of course, there is a more logically consistent approach which does away with all this duality. While the following is not common sense I believe it is quite logical and consistent with what we know. First of all the known laws of physics are reversible. This means there should be no difference to the laws of physics if we were to reverse the motion of everything.

We also know that the laws of physics are not deterministic. By not deterministic we mean that the current state of the universe does not determine exactly the state of the universe at some later time. Of course that doesn't mean that a future state is random, it simply means that there are a large number of possible future states that are consistent with the current state.

Putting these concepts together we must come to the conclusion that not only are our future states uncertain - that there are many possible future states, so long as those states are consistent with the present, but there are also many possible past states that are also consistent with the present. To reiterate - there is not only one past, but many. As a concept this at first sounds rather intellectual and not terribly practical, but as you will see this sort out our whole double slit paradox quite well.

In normal life we expect to experience only one valid history. This expectation is built deeper into our psychology than an expectation of gravity. The idea that there could be many pasts - that the past is not just one single set of events - is counter intuitive. However the double slit experiment shows how we can show the many pasts in a practical way.

When a photon can get to a detector two ways, and the state that the universe ends up is identical - ie you can't tell from the current state of the universe which path was actually taken, the reality will be that both histories are consistent, and that there is no sense asking which hole the photon 'really' went through. There are in effect two histories, one in which the photon went through the first hole, and another separate reality in which it went through the second hole.

Some would be critical of this kind of thinking, as it is not a scientific theory, but more of a metaphysical idea that we can use to understand how Quantum Mechanics can really work. It also means we do obtain an abstract notion that is easier to work with than only using mathematics.