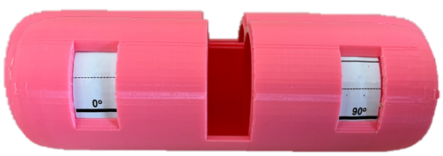
This object, the Quantoscope, showcases the phenomenon of **quantum superposition**. It creates a situation that classical physics alone does not explain.

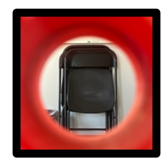
Light is made of photons ,small units of light. Each photon has a polarization that takes on an orientation (e.g. for 90˚, for 45˚, and for 0˚).

These photons can be filtered based on their orientations using a polarized filter, just like the ones in your sunglasses.

A photon at a 90˚ orientation will always pass through a 90˚ filter but never pass through a filter with a 0˚ or 180˚ polarization.



Because light is made of a lot of photons with all sorts of orientations, filtering only one orientation does not noticeably dim the brightness.

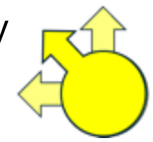


However, if you put a first filter at 90˚and a second at 0˚ then no photons polarized at 0˚ will pass through the first filter, therefore no photons whatsoever will pass through the second filter. All you will see is darkness. **Try it!**

Now **the surprising thing** is what happens when you add a 3rd filter in between these two filters. Classical physics would say: “Adding anything in-between won’t change the fact that after the first filter at 90˚ there are no photons with orientations 0˚ left.”.

This is similar to a standard filter, for instance let’s say a gold prospector first removes all rocks that are larger than a marble, and then removes all rocks smaller than a golf ball. No rocks will ever be left in the prospector’s bucket, no matter what extra rule you add inbetween the first two in the middle.

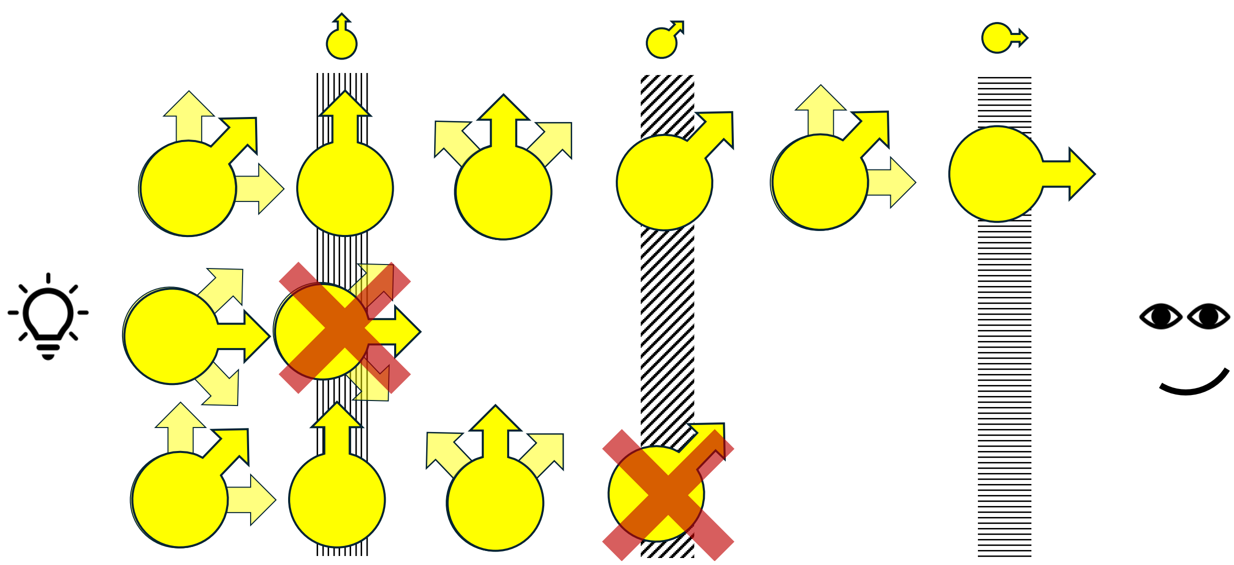
Well, I invite you to **try it for yourselve** and see what happens when you add a 3rd filter. *Make sure it matches the picture*. The 0˚ from the 1st filter and the 90˚ from the 3rd filter should align with the grey line between the 0˚ and 90˚ mark of the 2nd filter (the 45˚ mark). **Turn the page now!**



Surprising isn't it? Well that's because the photons actually exist in a quantum superpositon of orientations. Meaning that they do not have a singular orientation but also exist a little bit in nearby orientations.

Every time a photon hits a polarizer, its state gets observed or "collapsed" and if it does pass through the filter, its quantum state of orientation will re-center to the filter's polarization. As a result, photons that pass the first filter, even though they have no chance of passing the third, still have a chance for to pass the second. The photons who do, will then get repolarized to the second filter's orientation, unlocking a chance to now pass the third filter.

In the image below, the top photon is one of these lucky photons that will make it through all these filters. The bottom photon, although it starts in the same quantum state, is unlucky and gets absorbed by the second filter. The middle photon, because it was initially perpendicular to the first filter would never make it across the first filter.



More info here:

Video demonstration: