Nobody really understands quantum mechanics

As promised in the previous chapter, let's get some examples of weird behaviors that can be found in quantum world!

Quantization

Quantization consists in approaching a value (or a signal) as best as possible but only using discrete values.

Look at the following picture:

This is a atom with a nucleus (represented here in green and red) and electrons (in blue).
Electrons are arranged in “layers of energy” named quantum shells: shell K, shell L, shell M, …
Well: it is possible to “move” electrons from one layer to another **but** there is no intermediate possibility between shells.

That is to say: electron will be on shell K or shell L but never between. The electron will “jump” from K to L with no intermediate state of energy. This is amazing isn't it ?

It's like climbing a ladder: imagine your feet does not move between rungs: it “jumps” from one rung to another.

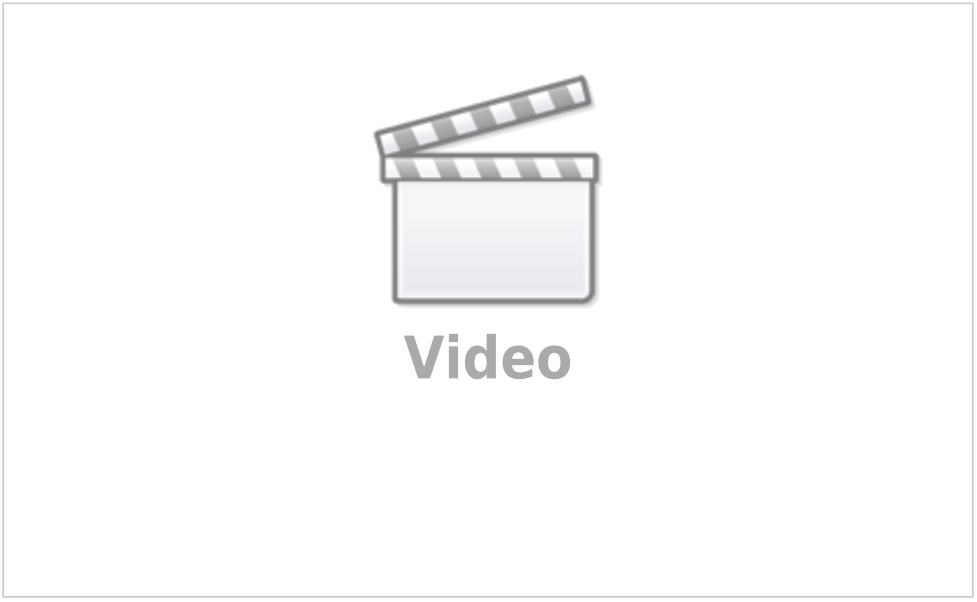
Wave-particle duality

By the end of 17st century, two guys were fighting: Isaac Newton with the idea of “light is particles” (grains of lights); and Christian Huygens with another idea: light is waves.

Both of them with their experiences strengthen their beliefs in each theorie.

In 1801 - one century after - Thomas Young wanted to close the debate, and he discovered that light is both waves and particles! Light is neither wave nor particles: it is both…
Since then scientists renewed the same experience with more accuracy, but the result remains the same: in the quantum world particles behaves both as waves and particles.

Young's “double-slit experiment” is famous and unbelievable! I would like to describe you in details but someone else did it better than me. I warmly invite you to discover this experiment with the following video (originally created in french but help yourself with subtitles):



Partial reflection

For the last example of strange behavior in quantum world, let's consider the following experiment. This experience is fully described in the book of Richard Feynman “The strange theory of light and matter”.

As you can see in the right image, we have a source of light and 2 light sensors A and B.
The source emits photons (grains of light) one by one in the direction of a glass sheet. Like any other glass, it reflect a part of the light and absorbs the other part.

Thus when the source sends 100 photons, sensor B receives 96 while sensor A receives 4.

You may wonder “yeah, but what is amazing in that ?”. Well in my world the same cause has the same consequence. Always. I mean: if I throw a ball against a wall 100 times, it will bounce 100 times, and cross the wall 0 times.

This is not obvious in quantum world. When the source emits 100 photons, 96 crosses the glass and 4 are reflected. Yet nothing changes during the experiment: all produced photos are the same kind, going in the same direction, and the glass does not move.

This is the first thing to learn about quantum world: **all is random**.

Hence, quantum world is very different than the world we know. Laws are different therefore behaviors are different. So different comparing to our own world that we cannot *understand* it. We cannot because we never experienced anything like what happens at quantum scale.

I believe that all of that is summarized with this sentence of Richard Feynman:

I think I can safely say that nobody really understands quantum mechanics.

Richard Feynman

Richard Feynman, him again? Yes, a superstar of quantum mechanics. Nobel prize in Physics in 1965, he is the first one having the idea to use quantum mechanics for calculations. He is the father of quantum computation.

Feynman has been good to popularize quantum mechanics and if you like this science you will learn a lot by reading his book:

Before him, some guys tried to transpose quantum behaviors to something we can understand. You probably heard about a famous one: mister Schrodinger and his cat !
Next: The Schrodinger's cat