

Science-1A Lab: Week-8, Wednesday, September 29, 2021

We will now continue to learn about the very strange laws of quantum mechanics that are essential to understanding atoms and photons, but are rarely noticeable on a large scale. This Lab Note is shorter because one of the videos is 50 minutes long. We start with the next Crash Course video:

Quantum Mechanics - Part 2 (CC 44) 9 min 7 s

https://www.youtube.com/watch?v=qO_W70VegbQ&list=PL8dPuuaLjXtN0ge7yDk_UA0ldZJdhwkoV

Just watch and listen knowing that you will **not** be tested on these specific ideas about matter waves and the Heisenberg Uncertainty Principle.

Last Friday, when talking about photons, I did not stress that, besides carrying energy, photons also have momentum $p_{\text{photon}} = E_{\text{photon}}/c = hf/c = h/\lambda_{\text{photon}}$ where $h = 6.63 \times 10^{-24} \text{ J}\cdot\text{s}$ is Planck's constant. (These are shown at the end of the Chapter 7 section of page 3 of your Equation Sheet.) Light momentum is observable and light sails have been seriously proposed that would be pushed through the vacuum of space by light bouncing off them.

I preferred to talk about the photon that Xzzypt and I might receive from a distant star than about Schrodinger's cat discussed here. Talking about a macroscopic object like a cat makes the physics seem less believable than talking about a photon wave that spreads out to give the probability of something getting the photon's energy. They both discuss the same idea – you can't really know something until it is "detected". My photon discussion, however, does not pretend to endanger cats and relates to measurements that can actually be demonstrated.

The discussion of an electron in a box is closer to the discussion of the photon probability wave heading out toward Xzzypt and me. It is also getting us closer to how atoms actually behave.

Recall that on page 4 of last Friday's lecture, I talked about interference of photons emitted one at a time. The discussion here about electron interference is the same except that electrons are being discussed instead of photons.

Disney Educational Video Our Friend, the Atom (1957) 49 min 47 s

<https://www.youtube.com/watch?v=QRz1wHc43I>

I watched this next video as a television program when I was 12 years old. It was perhaps my first introduction to science and I was fascinated. I absorbed the whole thing, but especially remember the demonstration with mouse traps. This is a great resource for 3rd graders and older (like college!).

Disney made propaganda films during WWII, and the end of this video has a touch of propaganda for the nuclear power industry. At that time, nuclear power plants were being constructed and many people were worried about such plants being "in their backyards". The atomic bombing of Japan that ended WWII was only 12 years earlier, and the Cold War with the Soviet Union was on everyone's mind. We will learn about nuclear power plant accidents at the end of the course when we cover nuclear physics.

This video prepares you for the chemistry half of the course and the nuclear physics part at the very end.

To earn credit for this lab, report that you have done the following:

1. Watched the Quantum Mechanics - Part 2 Crash Course video.
2. Watched all of "Our Friend the Atom".