

General Research Notes

Math Expressions

$$\sqrt{\frac{1}{2}}$$

Blocks

Code Block

Electrons Wave-Particle Duality and Superposition

- The electron itself is a particle but it moves like a wave.
- Because of superposition, the electron and its wave are in multiple positions at the same time.
- This is why when only one electron is shot through the double slits, two electrons end up going through the slits, one per slit, at the same time (because of superposition).
- Since two electrons are going through the slit at the same time, and electrons also act as a wave, both deconstructive and constructive interference happens which forms a pattern on the screen.
- Almost anything can be in a superposition of states. This includes, neutrons, protons, quarks, and even cats! Although in order for a cat to be in a superposition of states, we would have to observe it at a microscopic level (aka. shrink the cat to the size of an electron and view it).
- It was the double slit experiment with electrons that proved that electrons are both waves and particles. This experiment also proved superposition because the electron didn't go just through one slit, instead, it went through both. (the electron's superposition were in front of the other slit)

Einstein and the Photoelectric Effect

- Einstein's photoelectric effect is the idea that light can eject electrons from a metal surface.
- The brightness and color of the light determines the amount of electrons ejected.
- $E = hf$ where E is the energy of the light, h is Planck's constant, and f is the frequency of the light.
- Different light colors have different frequencies. Violet being the highest, red being the lowest.
- Photons are light's particles. The energy of a light wave is dependent on how many photons are being transmitted. The more photons, the more energy. Dim light has less photons and less energy. Bright light has more photons and more energy.
- The light's brightness is dependent on the number of flicks per second. The more flicks per second, the brighter the light. The less flicks per second, the dimmer the light.
- Einstein used colored light to power a lightbulb. He did this because light has photons.
- My new bestfriend: $W = \Delta E$ and $F\Delta d = \Delta E$
- $E_{\text{light}} = W + E_k$
- **X-Rays** (A type of an electromagnetic wave) have high energy because their frequencies are much more compact.
- **Ultrasounds** have low energy because their frequencies are much more spread out.

- In order to produce a high frequency, you need more energy. In order to produce a low frequency, you need less energy.
- A photon is a little packet of waves that behave like particles.
- Compton confirmed Einstein's photoelectric effect with his "Compton Scattering" which utilized the Bohr-Rutherford diagram.
- Light waves always travel at a constant speed. (c)
- A photon clock defines time dilation
- Twin paradox