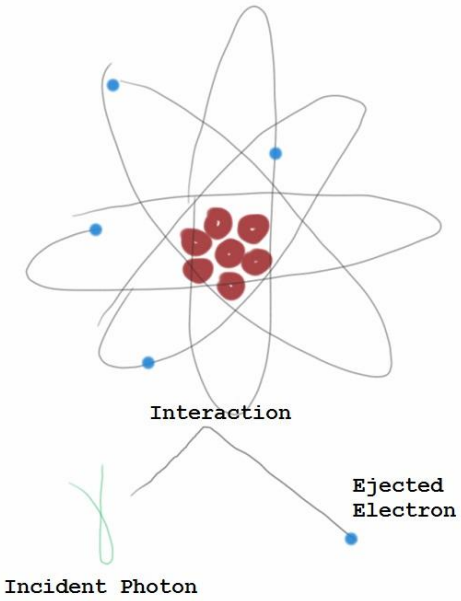
Photoelectric Effect

Amazingly, for all his contributions to science, the only Nobel Prize that Albert Einstein received was for the photoelectric effect.

The photoelectric effect is the process by which a photon of energy is absorbed by an electron bound to an atom and gives it enough energy to escape the atom and become a free electron.

To understand what is happening, you must have just a little background on quantum physics. Early in the 1900s, scientist began to realize that energy on the atomic level appeared to not be a continuum, but rather specific energy levels were present. Electrons couldn't just exist at any level. They could only exist at certain energy levels. These quanta (plural of quantum – meaning a specific energy level) started to explain a lot of what the scientist were seeing experimentally. When an electron was excited by photons, electrons were sent into higher orbits. They were unstable in these orbits and would fall back down giving off specific energy as they did. Planck had already made the discovery that the energy of a photon was proportional to its frequency. We could then see the frequency of this light emitted from the electron changing orbit and determine the quantum levels of the electron orbits. This unlocked the electronic structure of the atom.



But what if the photon were of sufficient energy to not just knock the electron into a higher orbit but could actually eject it from the atom? This is what is happening in the photoelectric effect. The electron leaves the confines of the atom and is free to interact with other matter and energy.

This process led to better understanding of the atom and the nature of light. Many of the early electronic devices took advantage of this effect. The photomultiplier tube was a "light magnifier" that used sensitive photoelectric material to give off initial electronics and then relied on high voltage grids to accelerate and multiply the number of electrons in the tube. With this, a very small amount of light could be detected.

Did you ever see pictures of the moon that look a little hazy? Light that strikes moon dust causes the photoelectric effect to leave the dust with a positive charge. The like charged dust repels itself and this causes a light cloud of dust to lift off the surface and engulf the moon.

Do you want to design spacecraft? Better make sure that you account for the photoelectric effect. The side of the craft that is exposed to the sun will have a large amount of photoelectric activity leaving the metal positively charged. This could start to cause current to flow in the metal of the spacecraft and could damage sensitive electronic components.

The photoelectric effect was a simple concept, brought to light by many different scientists and has revolutionized the way we look at the atom. Well done Albert!

