The Photoelectric Effect

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The discovery of the effect

The discovery of the photoelectric effect began in the late 1840's by a man looking for a solution to something only somewhat related. Alexander Becquerel discovered said effect at the age of 19 by "studying the effect of light on electrolytic cells." His primary intention then was to uncover the mysteries of photovoltaics, but this proved equally interesting. Little progress was made until Heinrich Hertz demonstrated that metal bombarded by ultraviolet light produced sparks readily. 3 years later, Max Planck suggested electromagnetic energy is transferred in quanta, and then Einstein took the limelight and the Nobel Prize by discovering and naming said quanta photons.

In detail (running in the 1900's)

Early descriptions of the photoelectric effect were largely qualitative; three things were known:

1. There is some frequency for each metal that the radiation must be higher than to achieve electron emission
2. Electrons are released immediately, regardless of intensity of radiation
3. The energy released scales linearly with the frequency of the radiation

In detail, part 2 (running in the 1920's?)

Einstein provided us with the idea of photons, and as a result we learn that photons of higher frequencies contain more energy, encouraging us to elaborate and recognize that their is some value ϕ tied to all metals that represents the energy needed to release an electron; by kindergarten, the energy put in subtracted from the energy needed gives the energy released, or in equation form:

$$h\nu - \phi = E_e = \frac{1}{2} m_e v^2 \tag{1}$$

and we see that the light energy is converted to kinetic energy.

1. There is some value ϕ that the energy of a photon (represented by E = hv) must be higher than to release an electron.
2. Electrons are released immediately, regardless of intensity of radiation.
3. The energy released scales linearly (by above equation) with the frequency of the radiation.