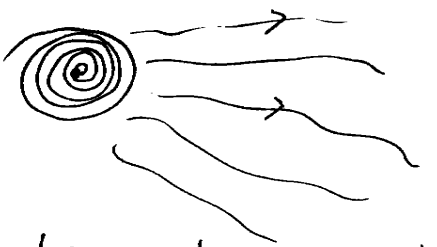
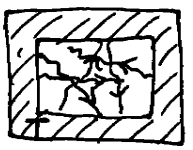
LAST TIME:

Classical mechanics + E&M → predicts unstable atoms



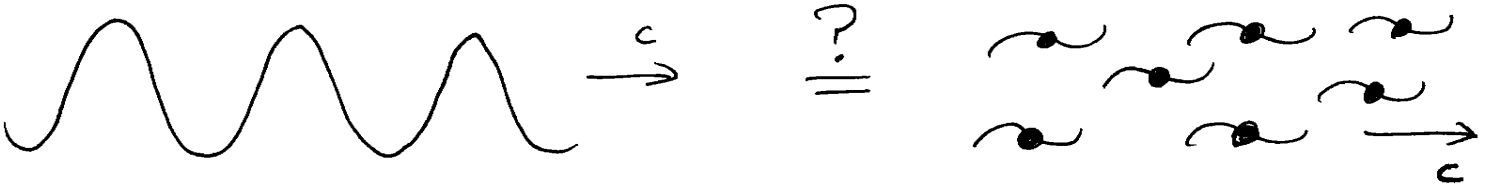
→ can't explain discrete atomic spectrum

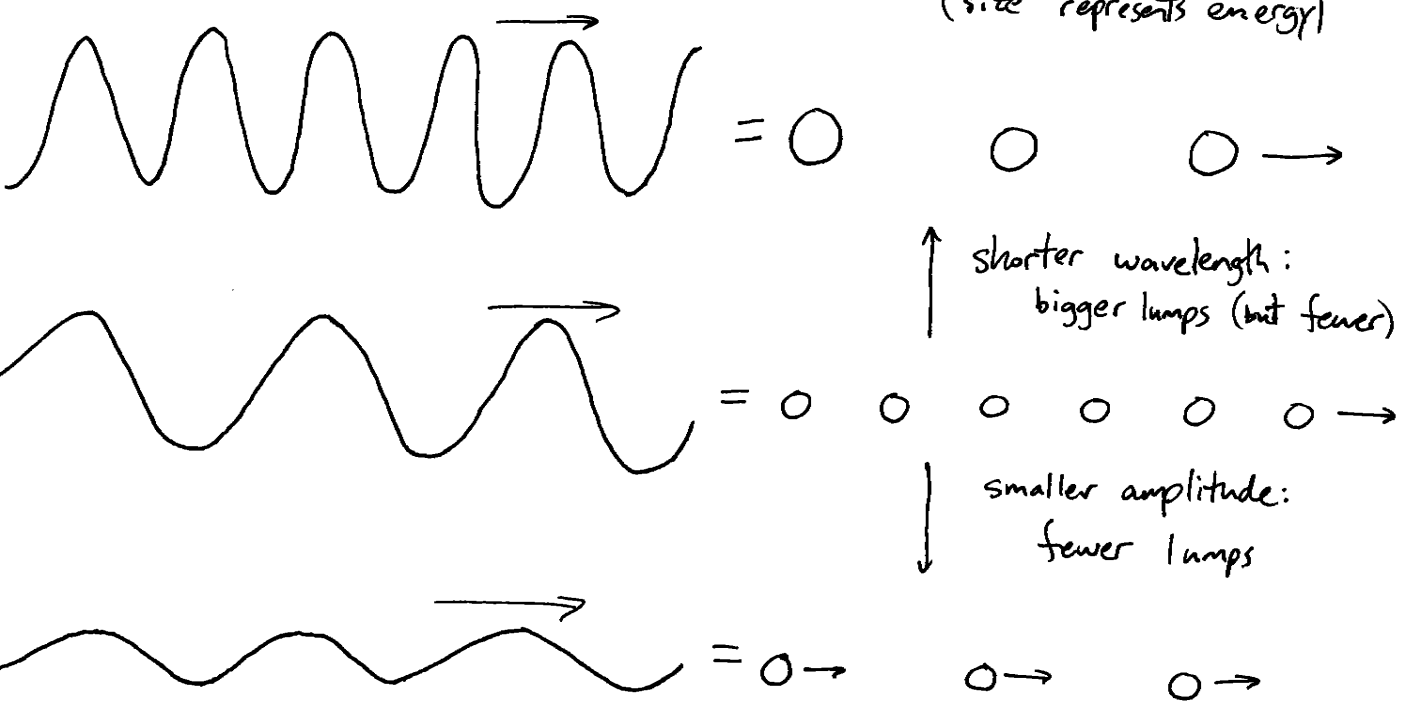
→ Can't explain blackbody spectrum



Planck: derived formula $I(f) \propto \frac{hf^3}{\exp\left(\frac{hf}{kT}\right) - 1}$ by assuming light can only be absorbed by walls in discrete amounts $E = hf$

Einstein: proposed that light itself comes in discrete "lumps" with energy $E = hf$ lumps = "PHOTONS"



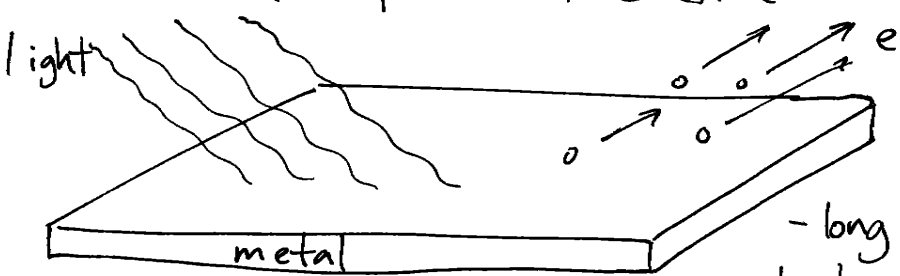


Frequency $\propto$ energy of photons

Intensity $\propto$ (# of photons per second) $\times$ (energy of photons)

How can we test this idea?

Einstein: use the photoelectric effect

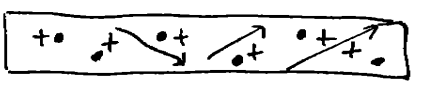


electrons: emitted only if wavelength short enough.

- long wavelengths: no electrons for any intensity

microscopic picture:

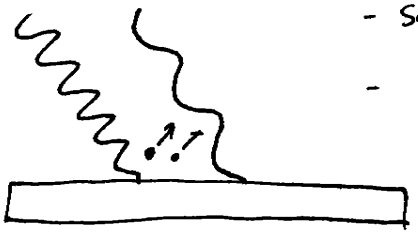
Atom:  requires energy to remove bound electron

Metal: 

electrons not bound to individual nuclei, but still require energy to remove from metal.

→ electrons are ejected when they absorb energy from the light

classical picture:



- same amplitude = same flux of energy
- why should colour of light matter?

Einstein's picture:

- electrons absorb single photons
- indiv. photons of long wavelength light don't have enough energy to eject an electron
- require $hf >$ binding energy for a photon to eject an electron.

(unlikely that electron will absorb 2 photons at once)