

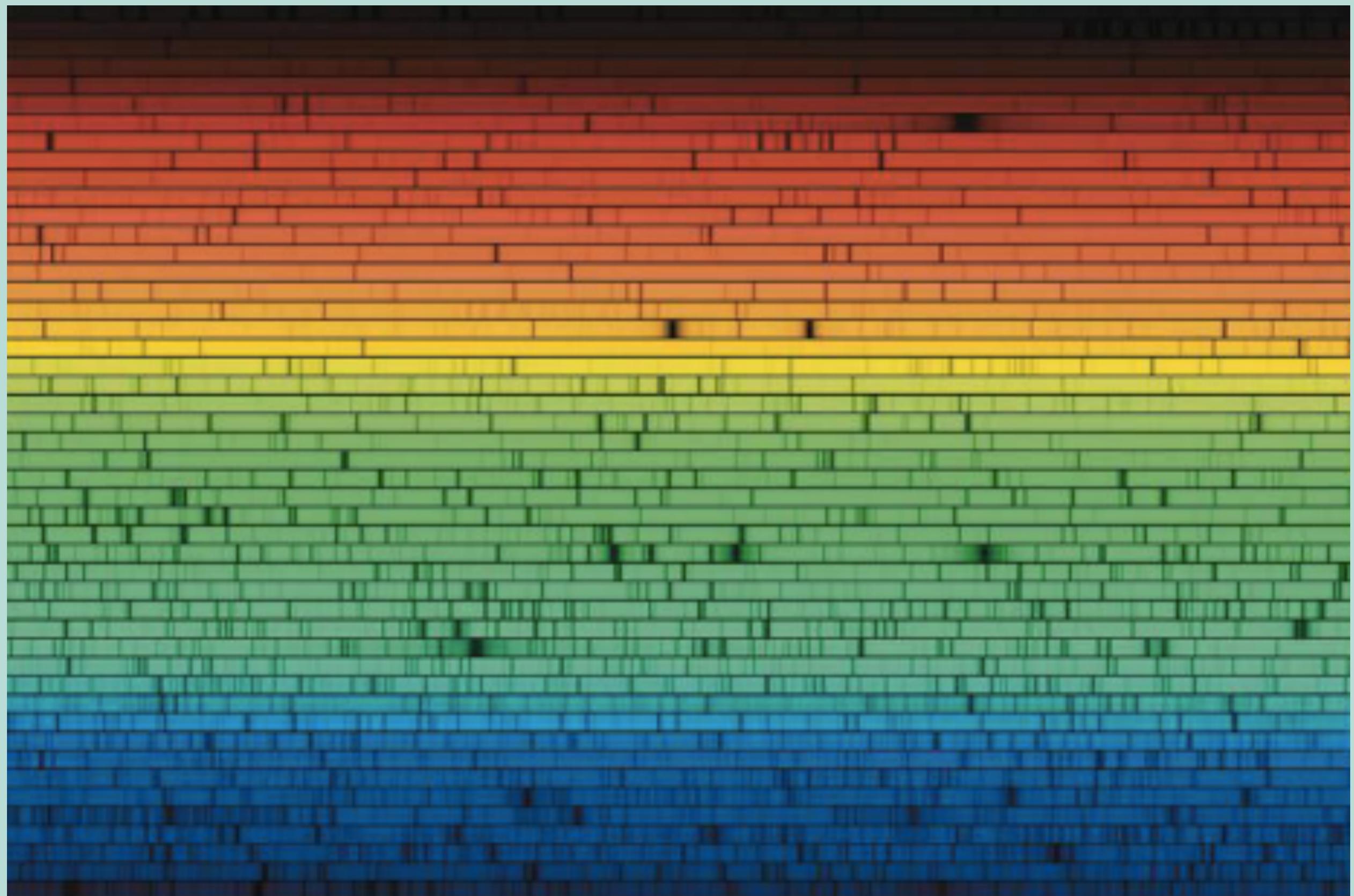


with your host:

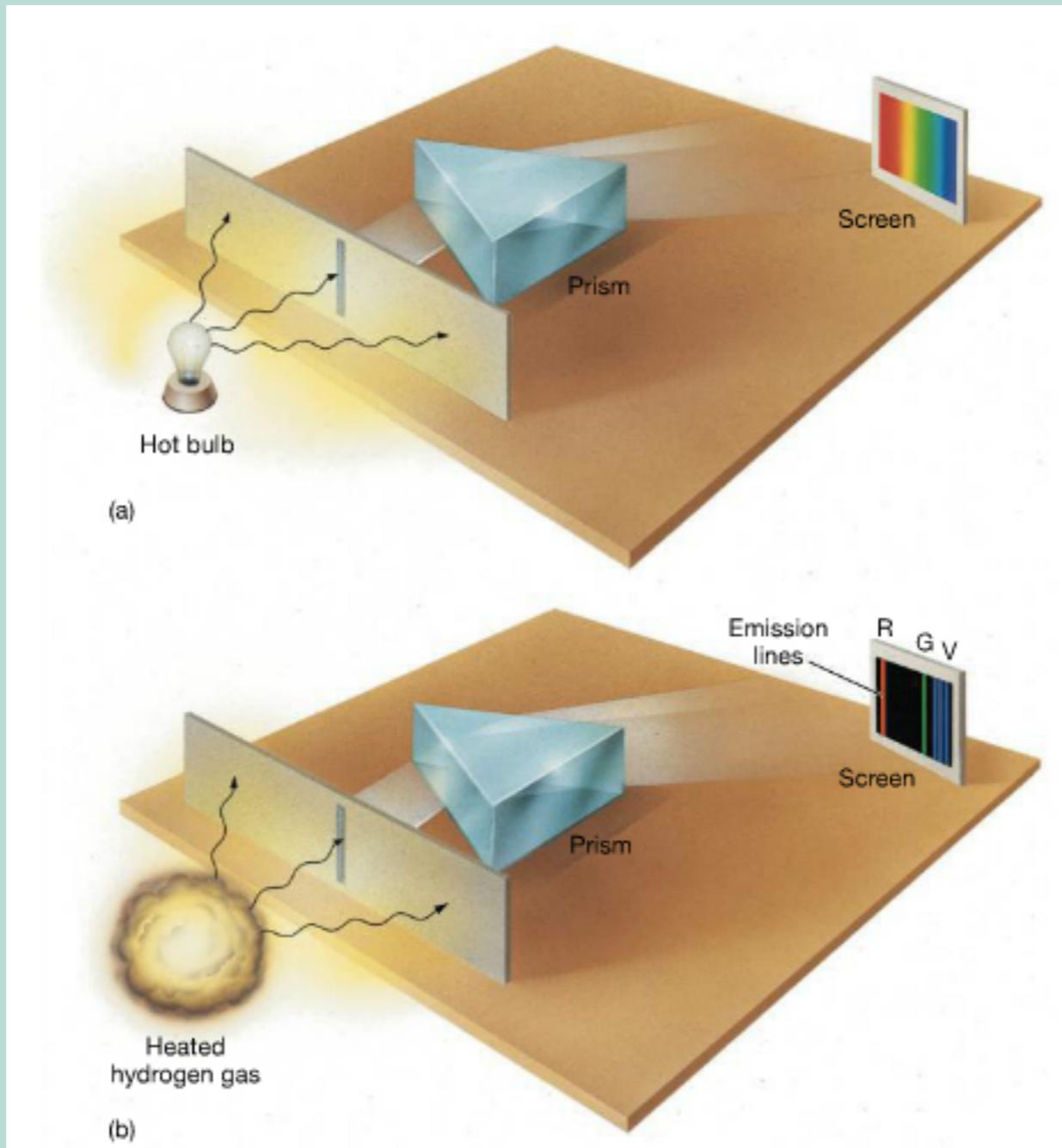


**Lecture 4:
Spectroscopy**

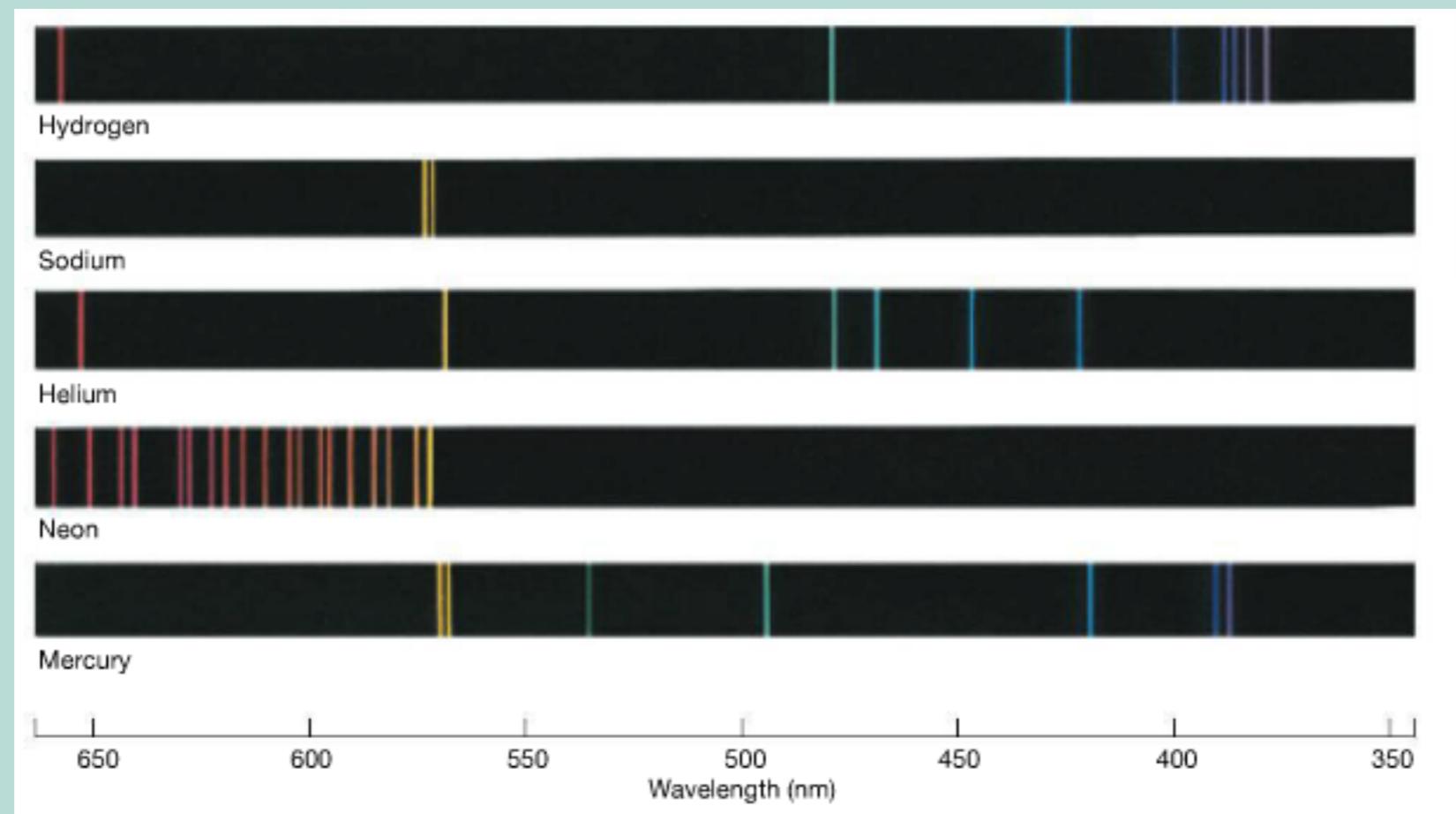
Coop



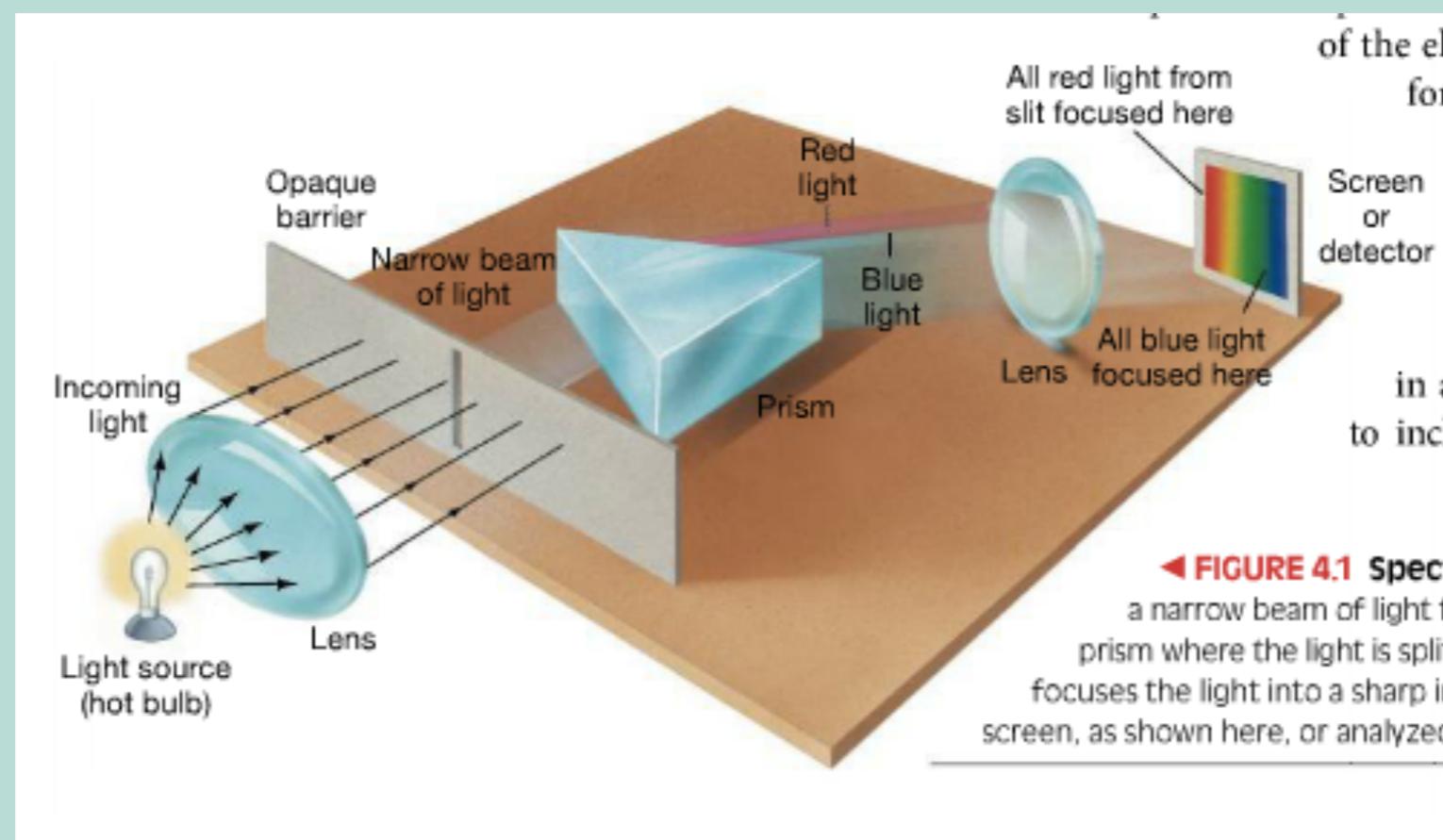
Black Body Radiation vs Hot Atomic Cloud



Atomic Fingerprints!



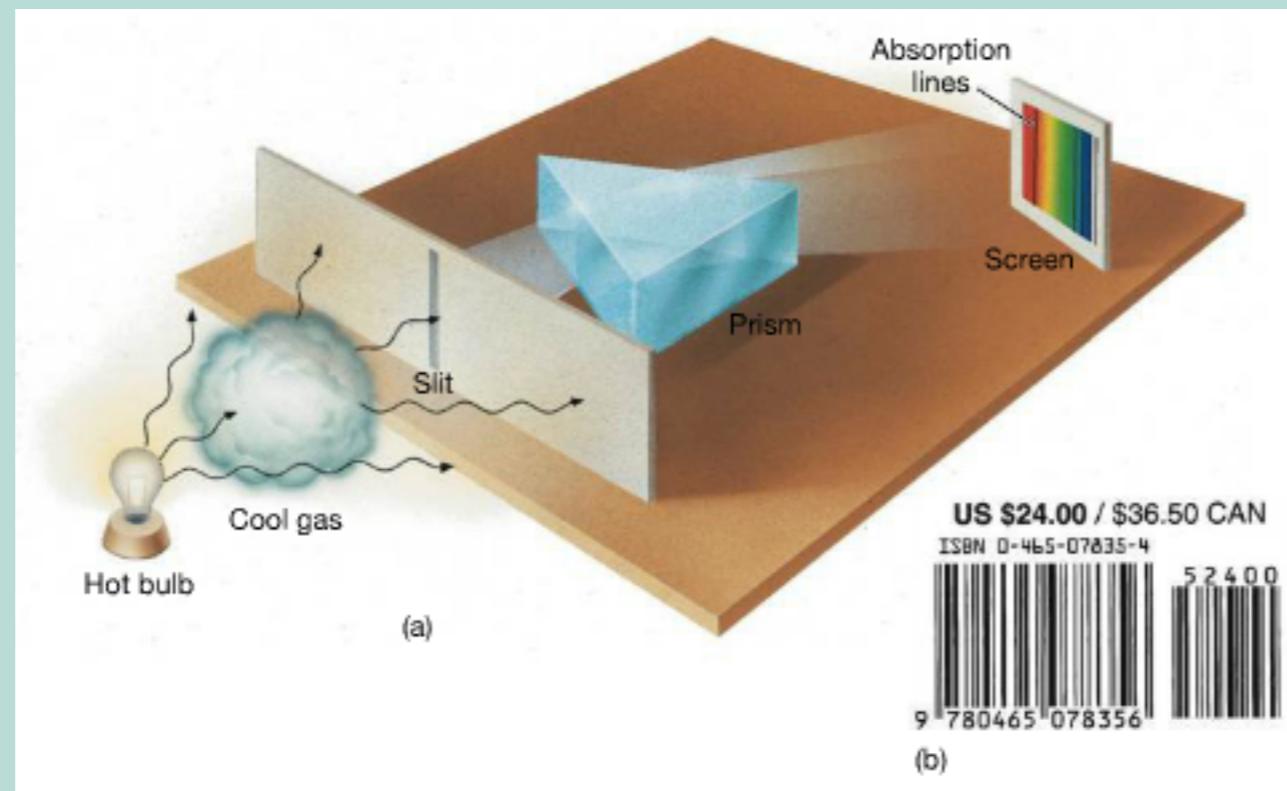
Measuring the emission spectrum



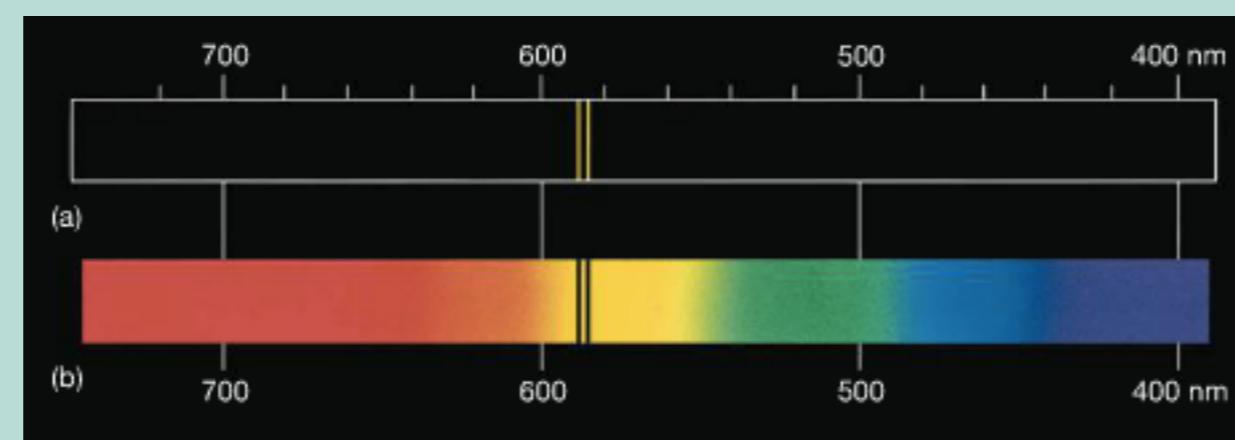
Old School Spectrograph



Absorption Spectrum



Absorption Emission Duality

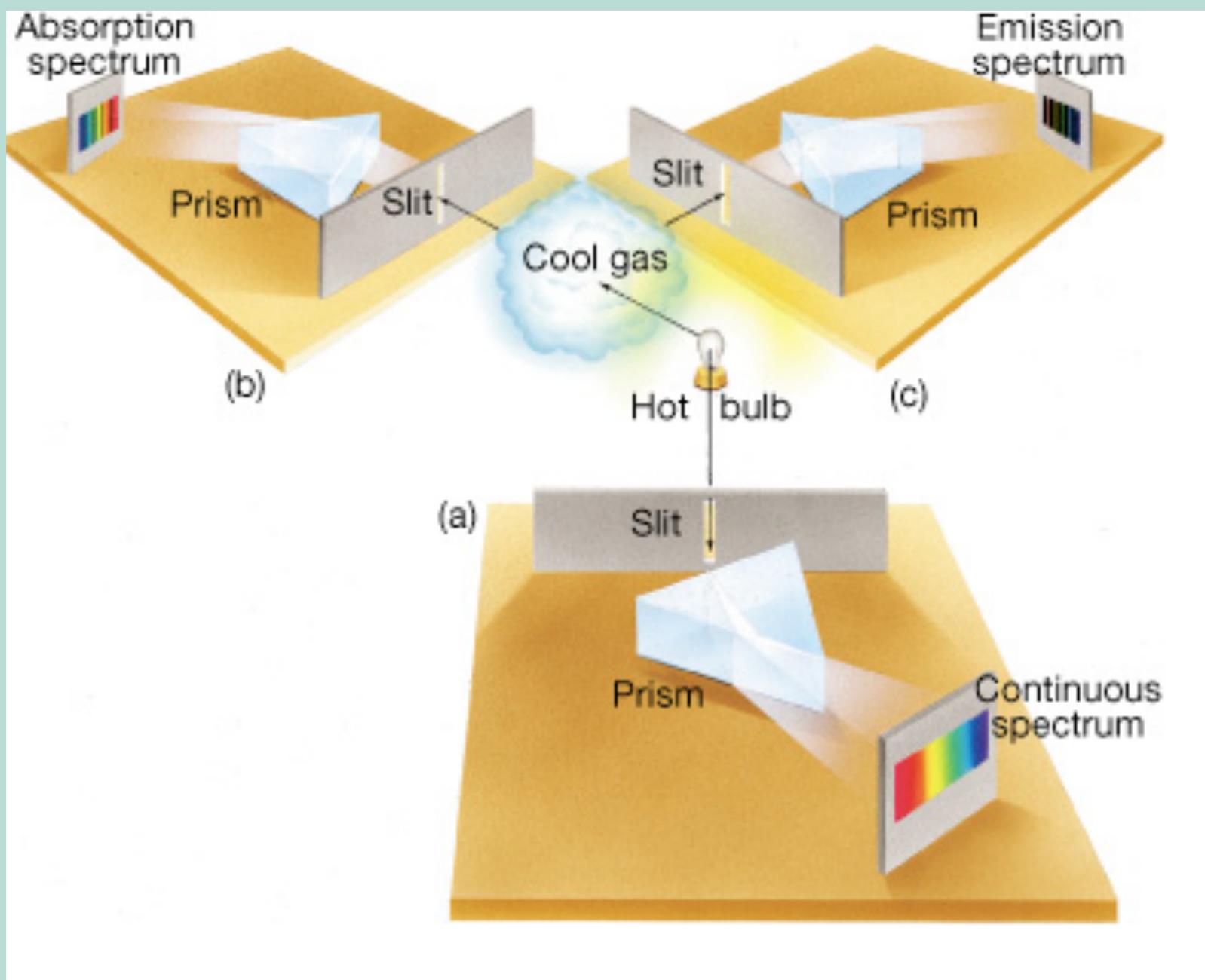


Gustav Kirchhof

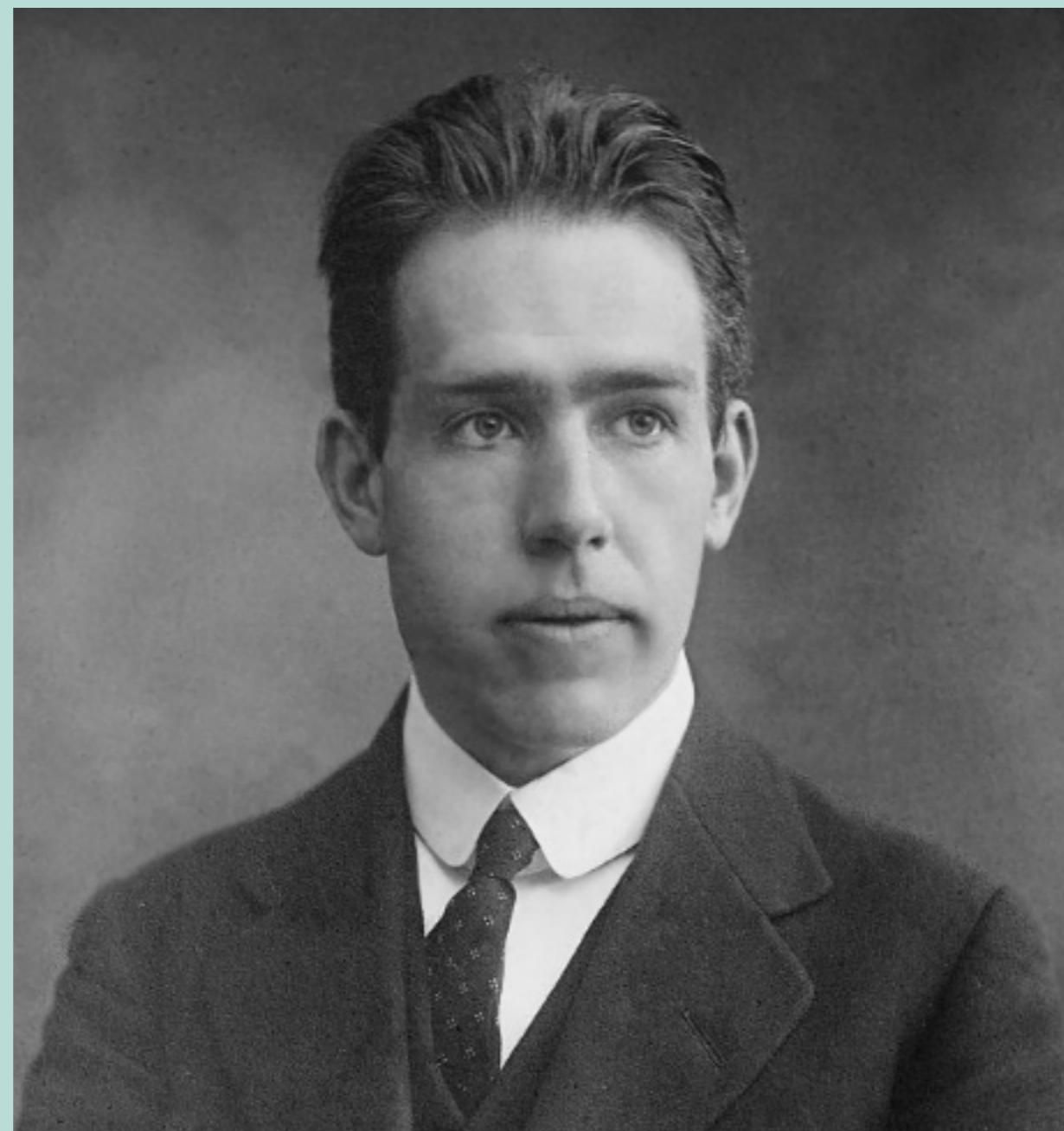


Born in Koenigsberg, Prussia
1824, 1887

Kirchoff's Laws

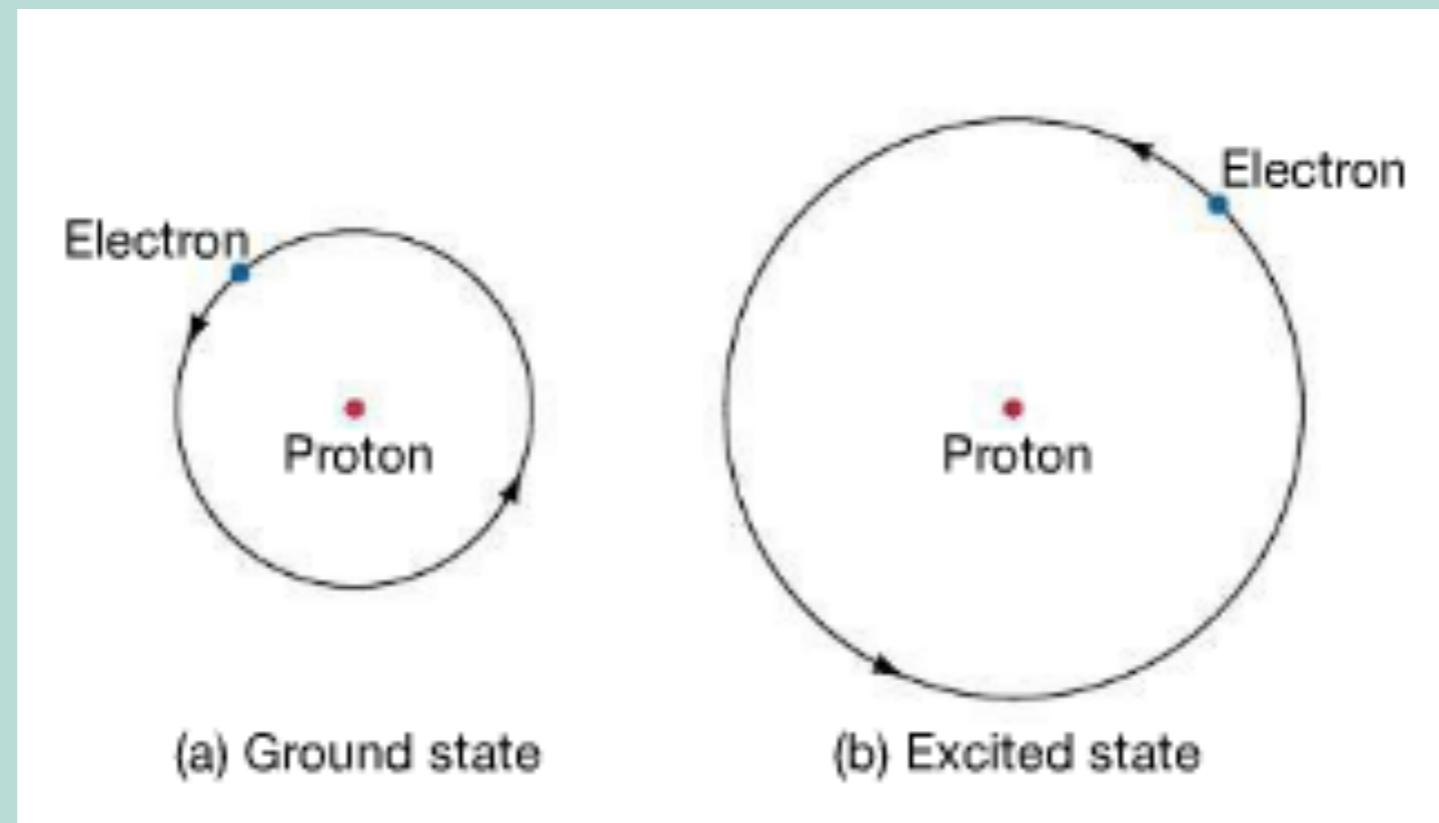


Niels Bohr

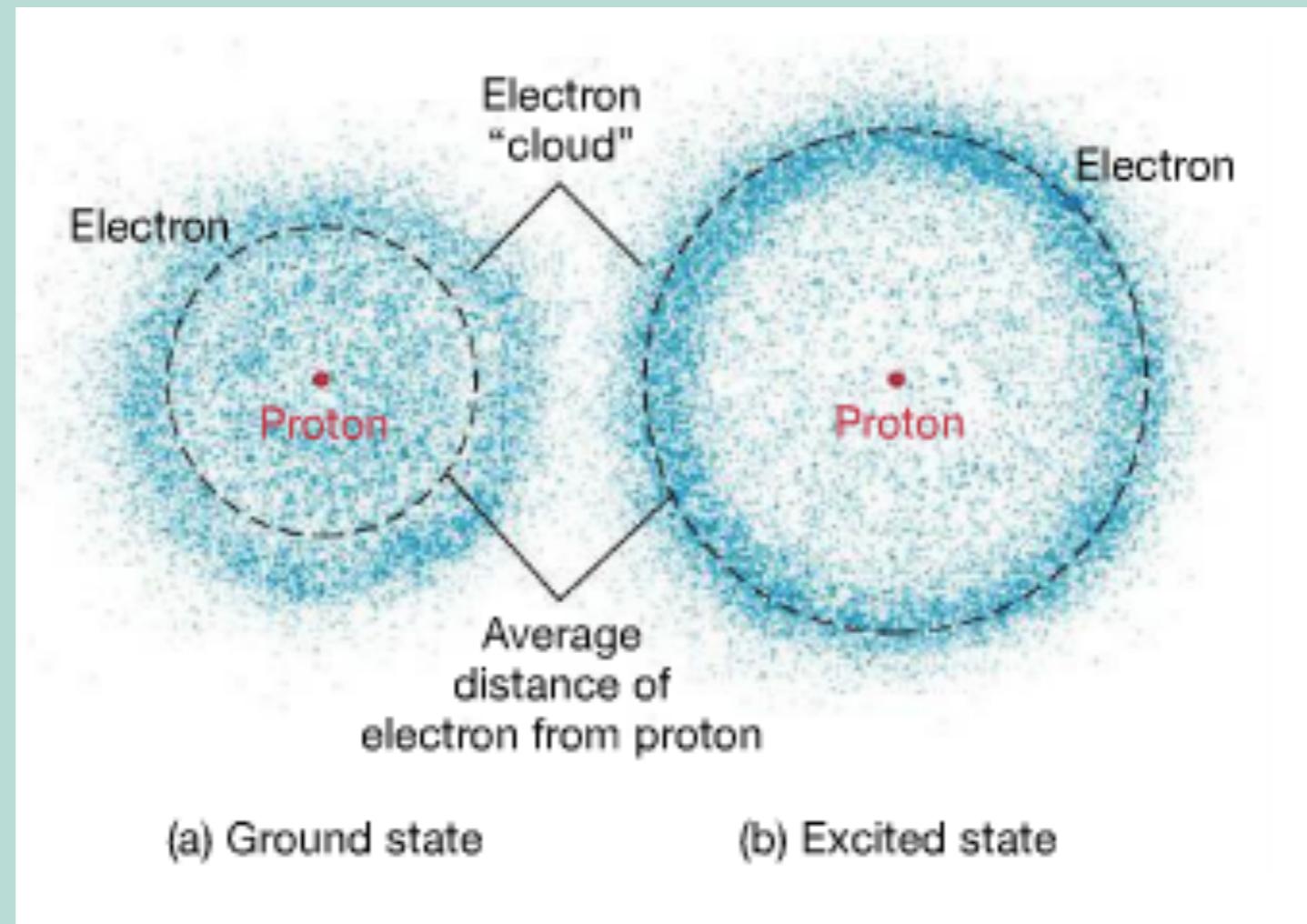


Born in Copenhagen, Denmark
1885 - 1962

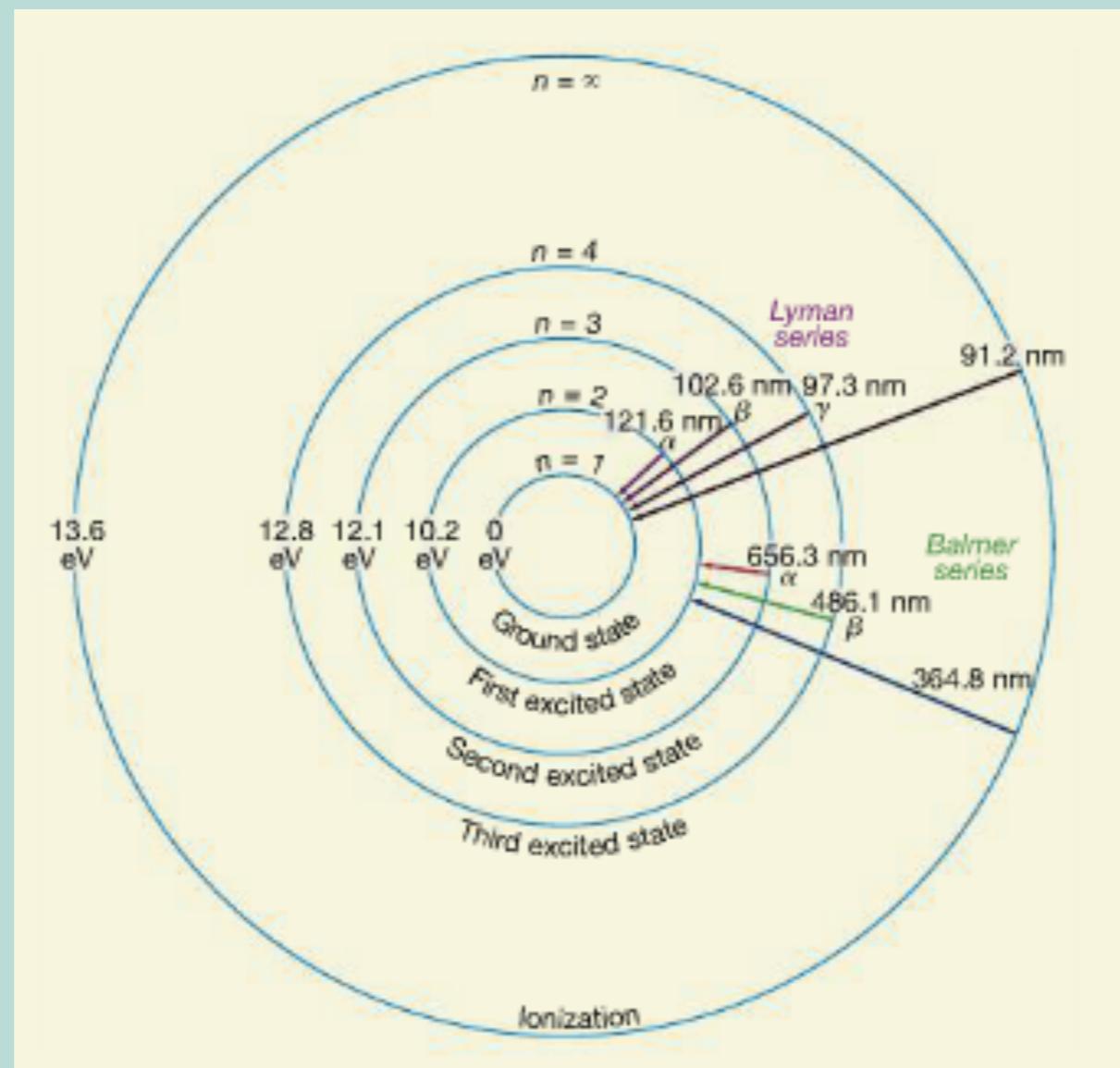
Simplified Model of the Atom



More Realistic Model of the Atom



Orbital Transitions

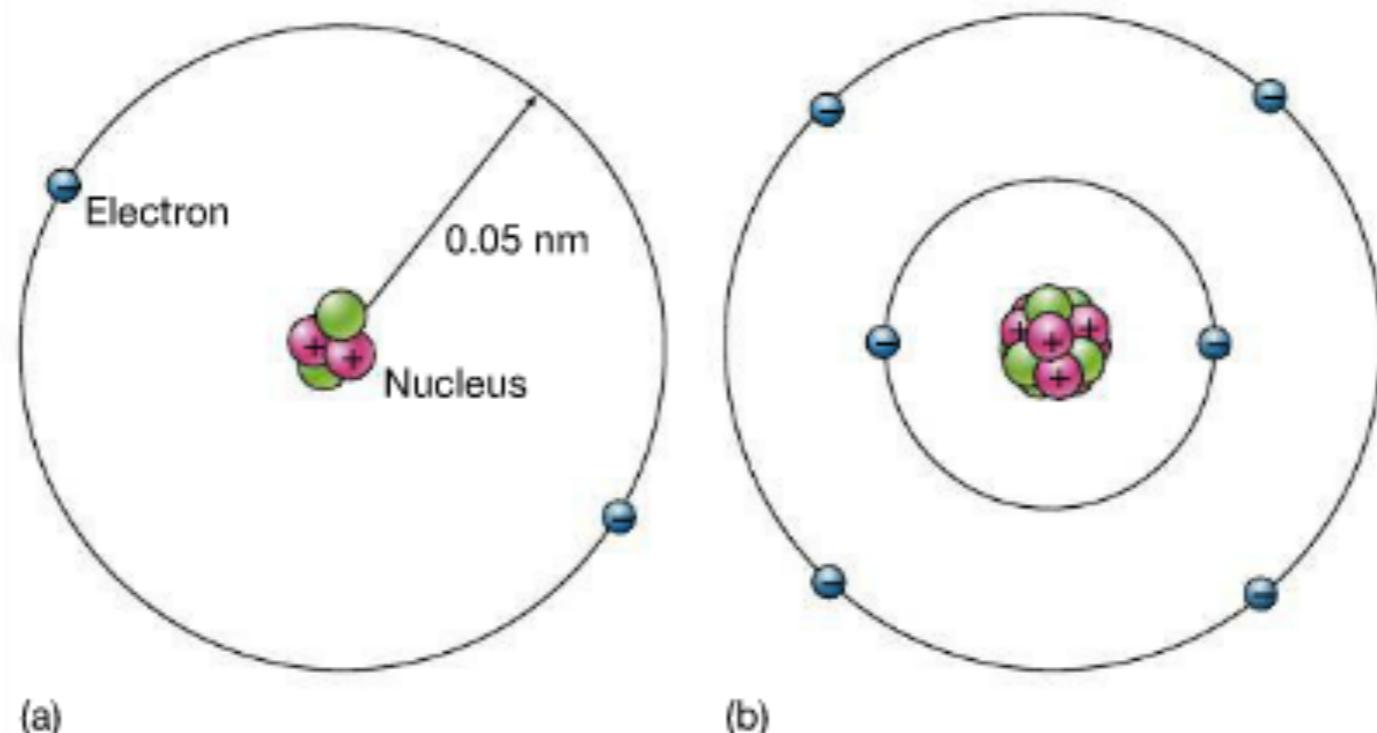


$$E_f - E_i = hf$$

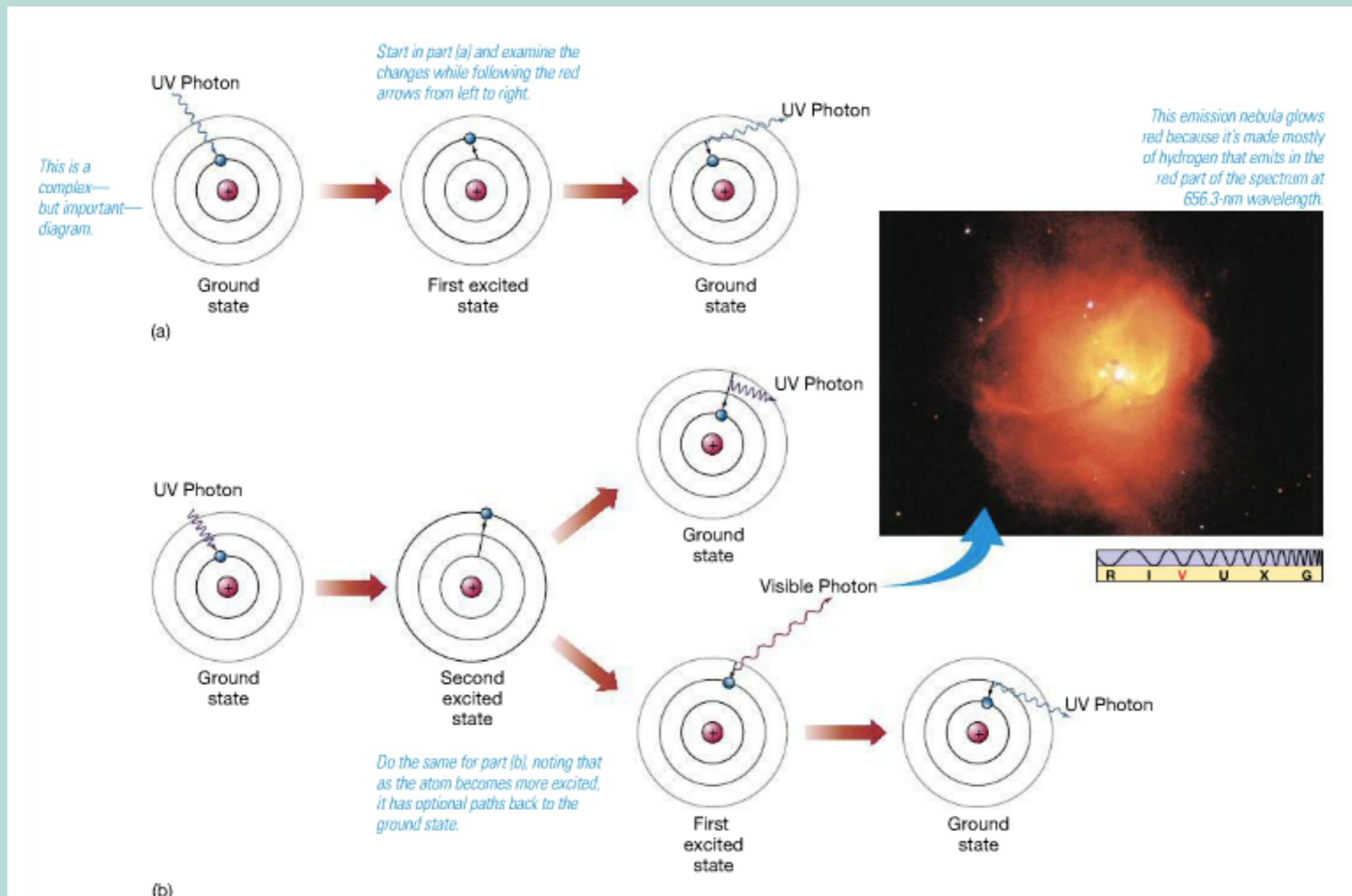
Nobel Prize (1922)

More Complicated Nuclei

Remember, the clean orbitals shown here and in other atomic diagrams are really more like fuzzy "clouds" of electron energy levels, as shown in Figure 4.9.

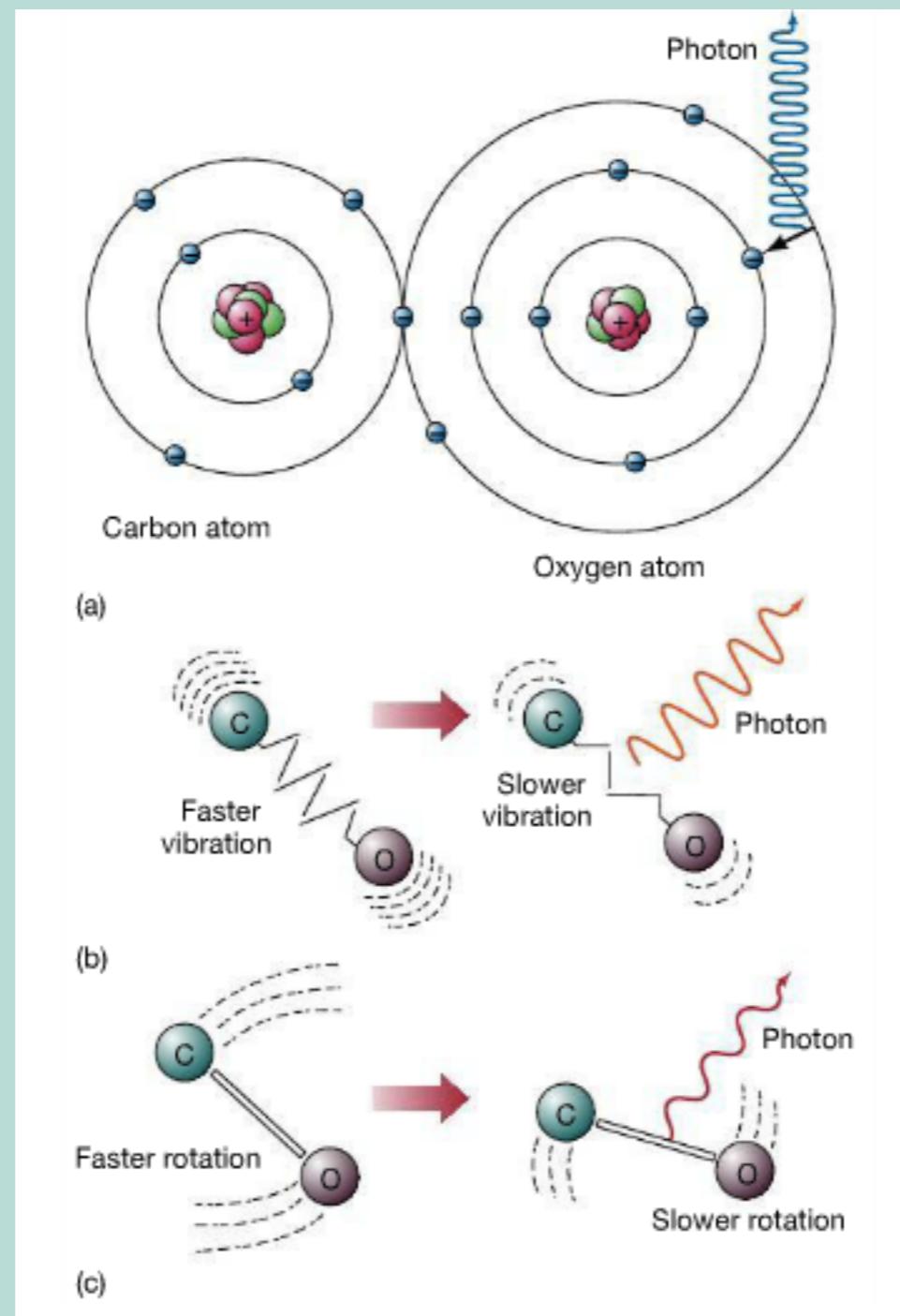


Cascading Photons

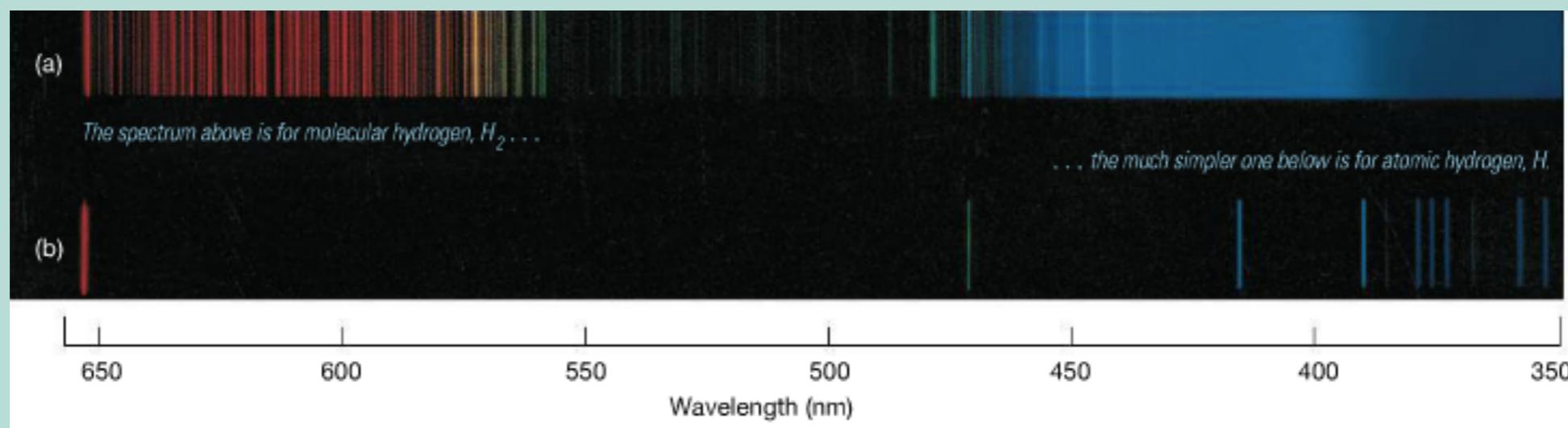


Molecular Spectra

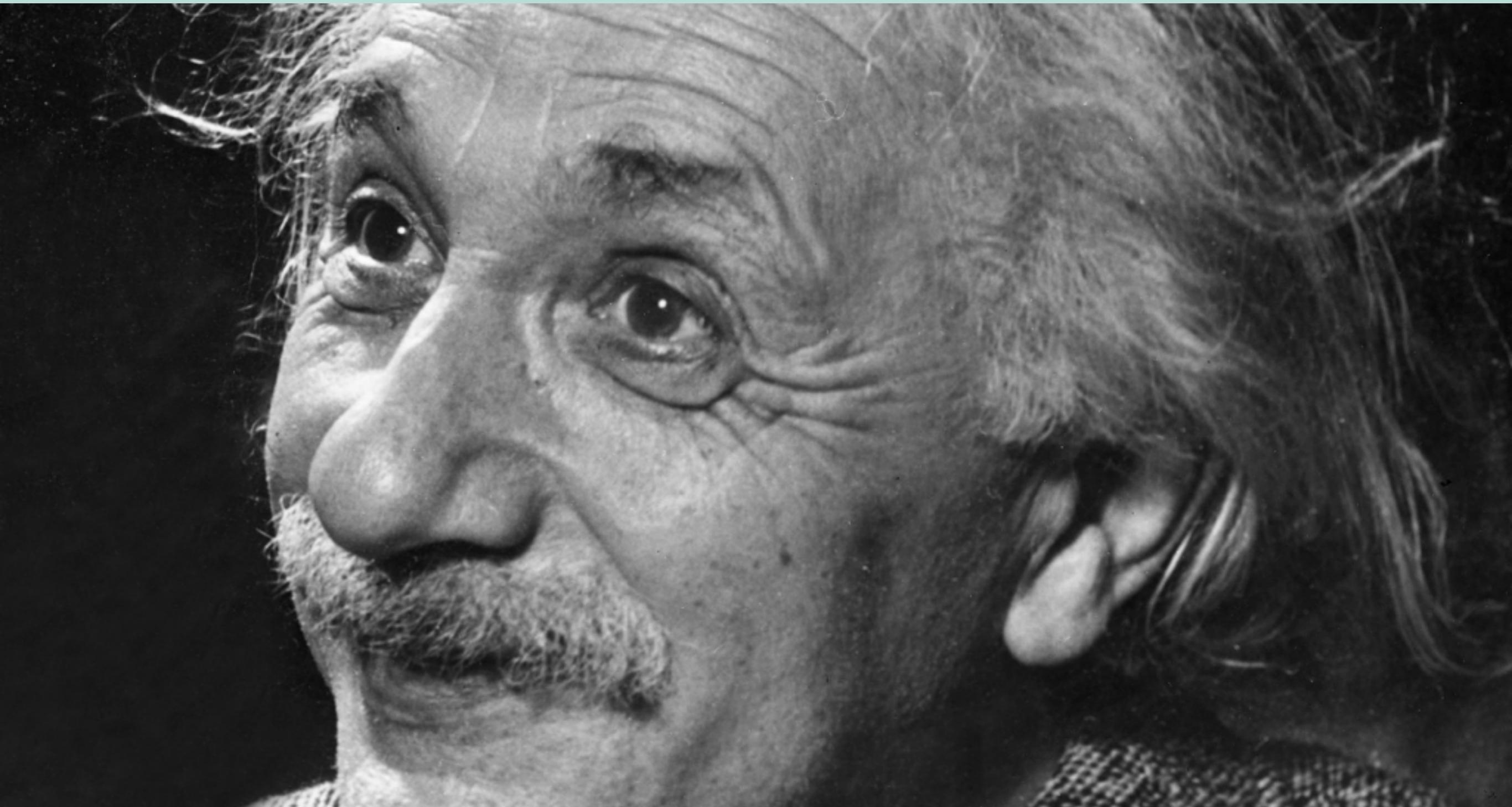
Electric vs Vibrational vs Rotational Energy



Spectra get complicated for molecules...



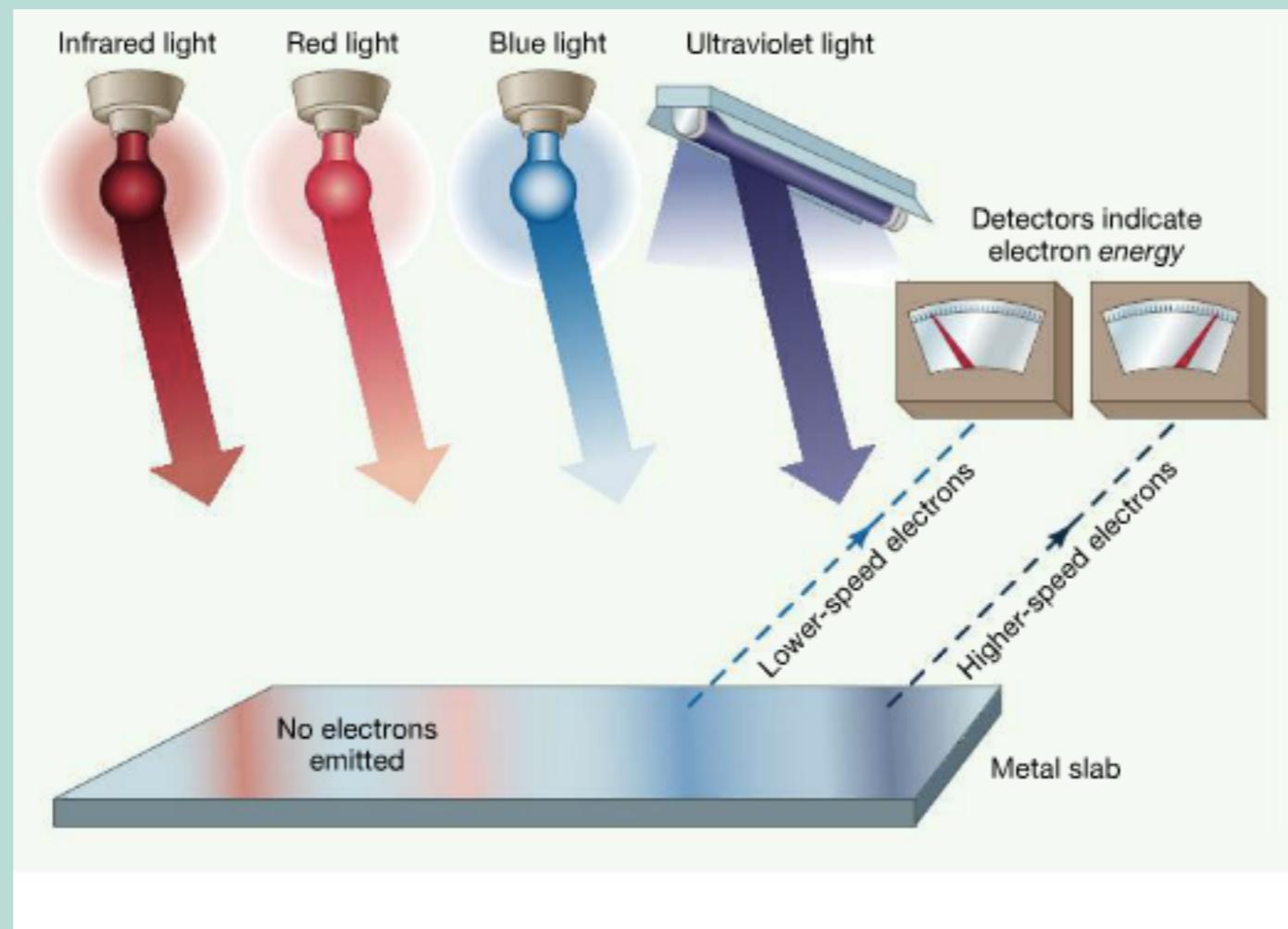
Albert Einstein



Born in Ulm, Württemberg (Germany)

π, 1879 - 1955

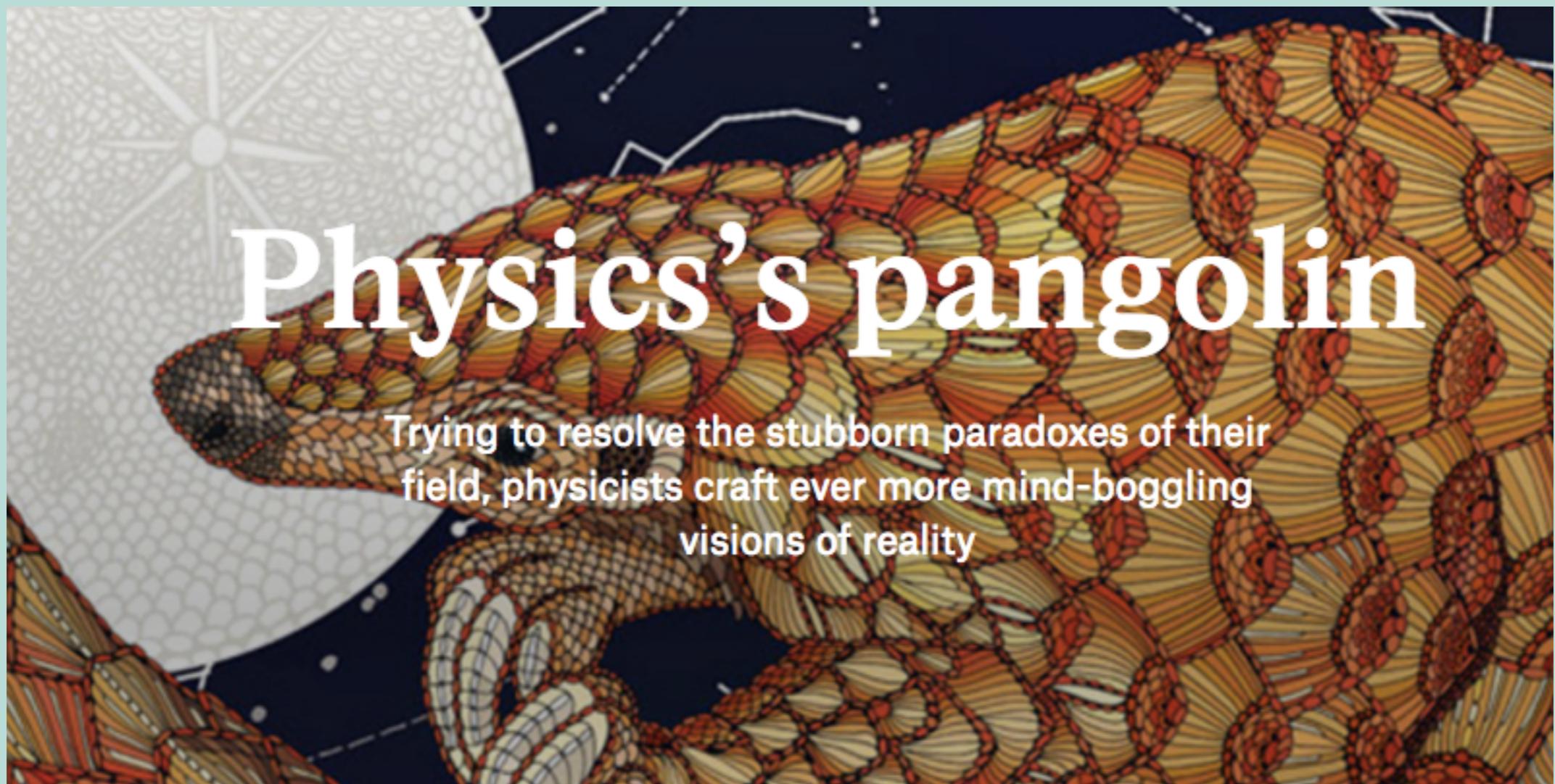
The Photoelectric Effect



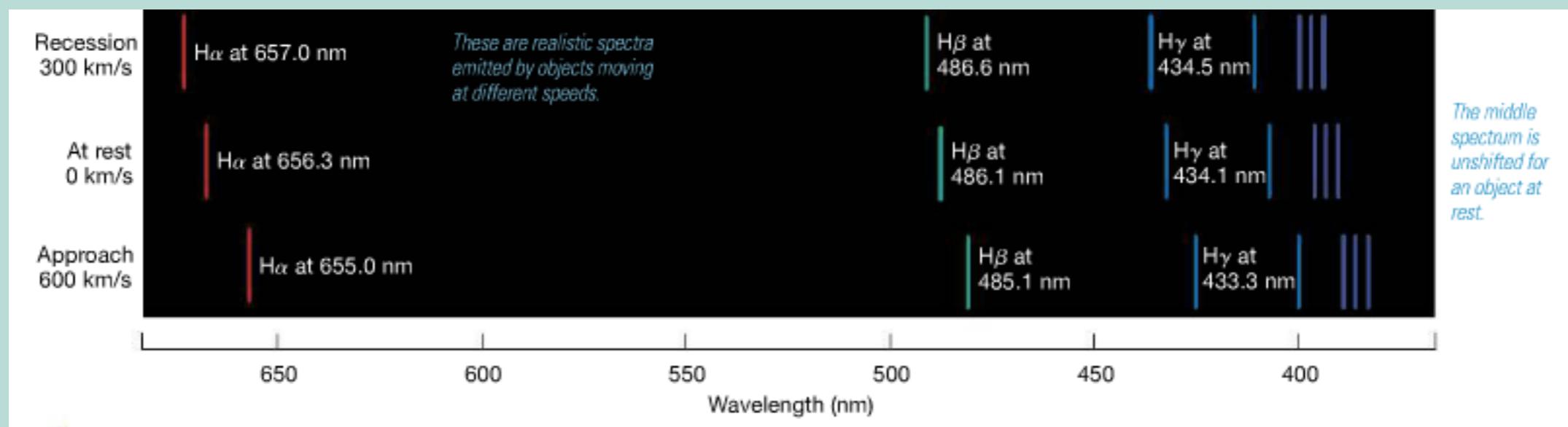
Nobel Prize (1921)

Wave Particle Duality

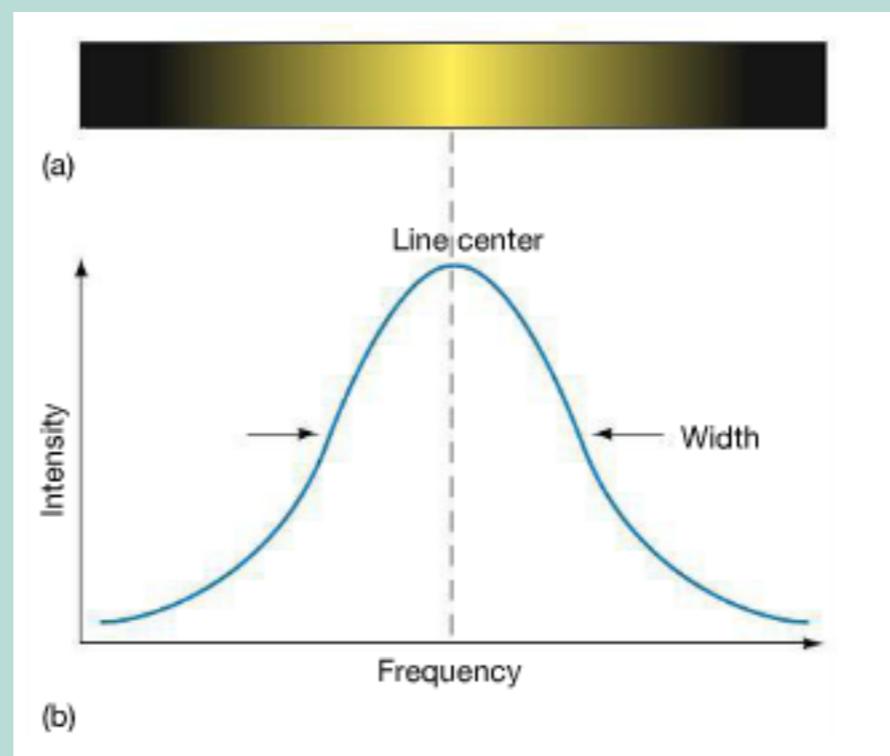
Many people find it confusing that light can behave in two such different ways. To be truthful, modern physicists don't yet fully understand *why* nature displays this wave-particle duality. Nevertheless, there is irrefutable experimental evidence for both of these aspects of radiation. Environmental



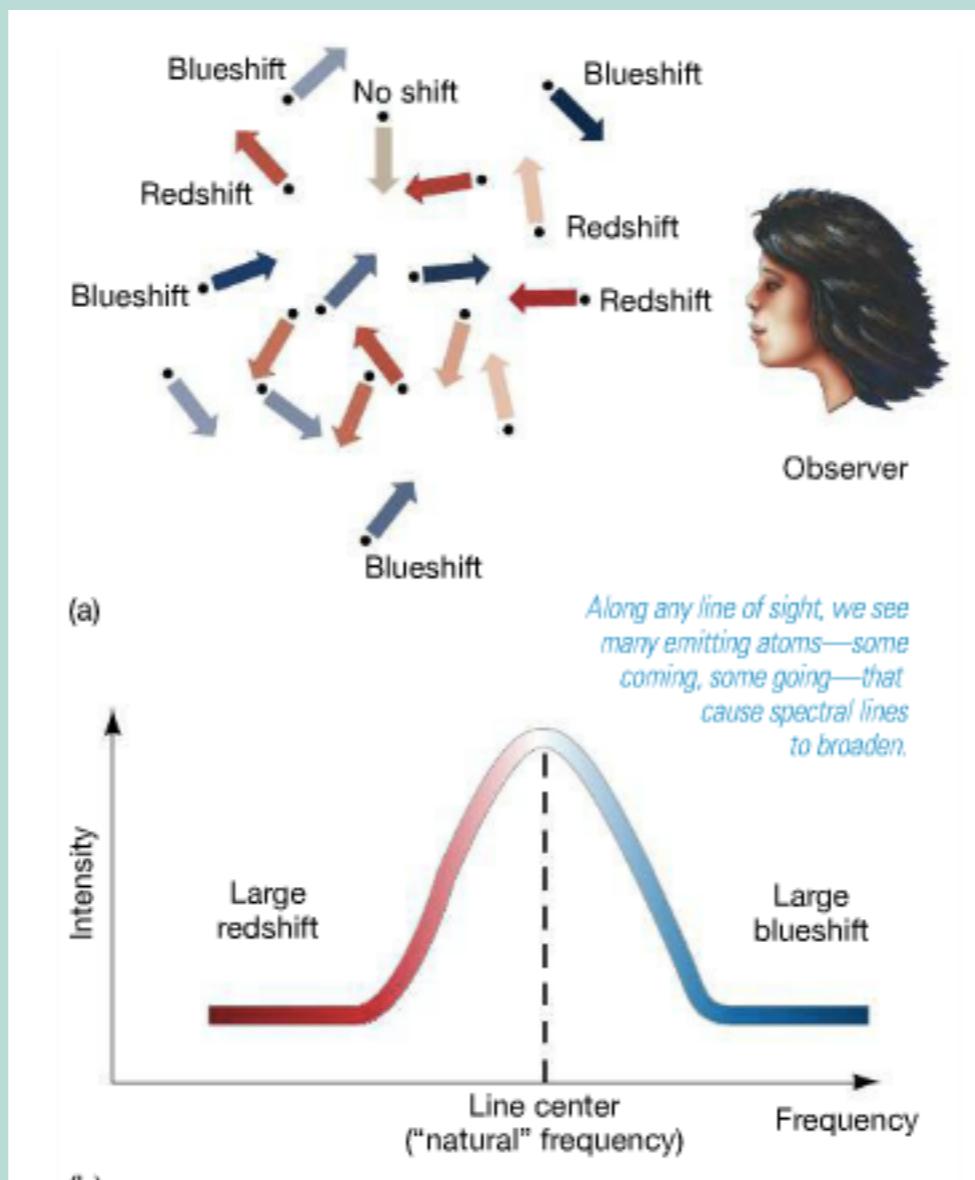
Doppler Effect (revisited)



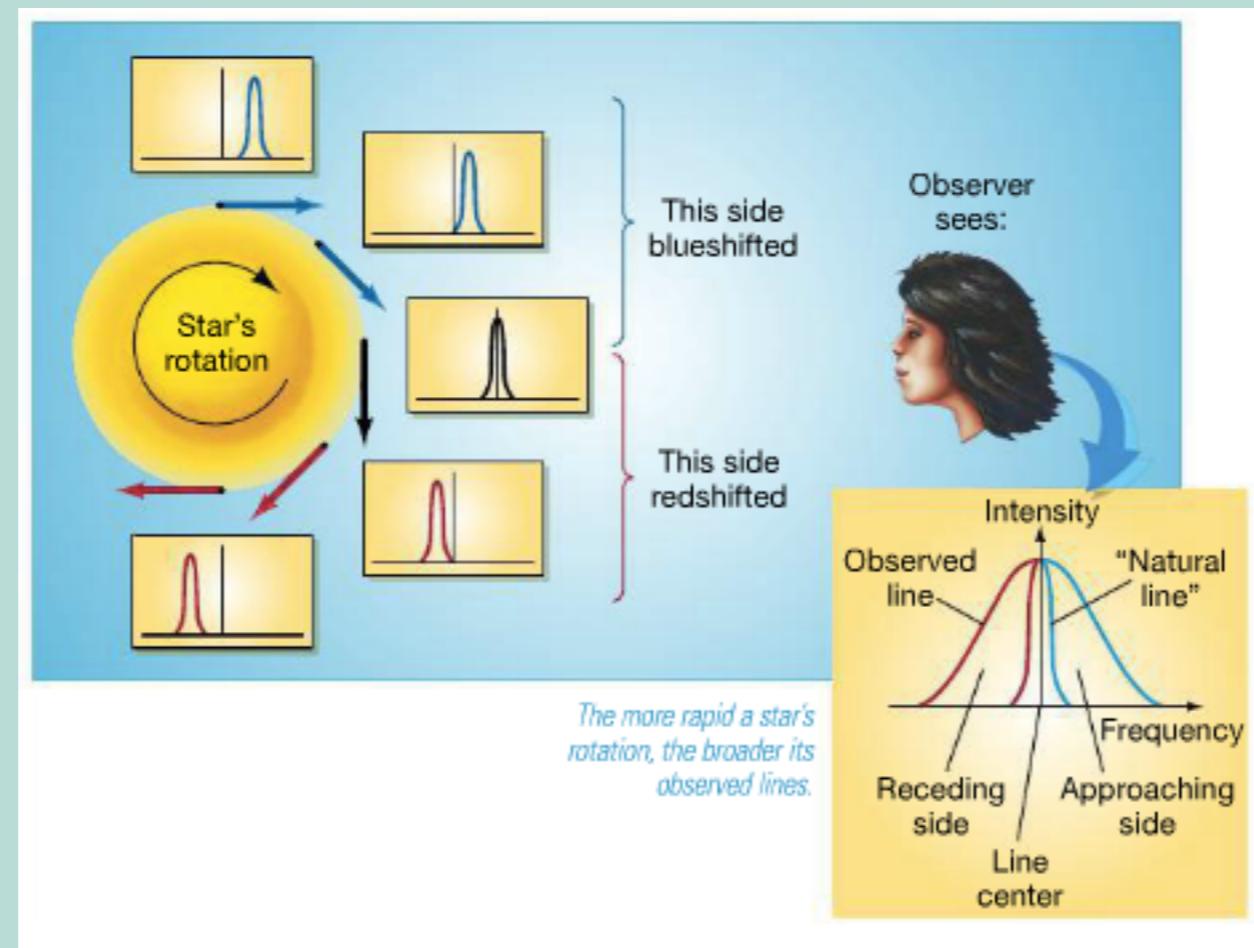
Line Broadening



Velocity Dispersion



Rotational Velocity Measurements



Observed Spectral Characteristic	Information Provided
Peak frequency or wavelength (continuous spectra only)	Temperature (Wien's law)
Lines present	Composition, temperature
Line intensities	Composition, temperature
Line width	Temperature, turbulence, rotation speed, density, magnetic field
Doppler shift	Line-of-sight velocity

1927 Slovay Conference

