

Flame Test

- an **analytic procedure** used in chemistry to **detect the presence of certain elements**, primarily metal ions.



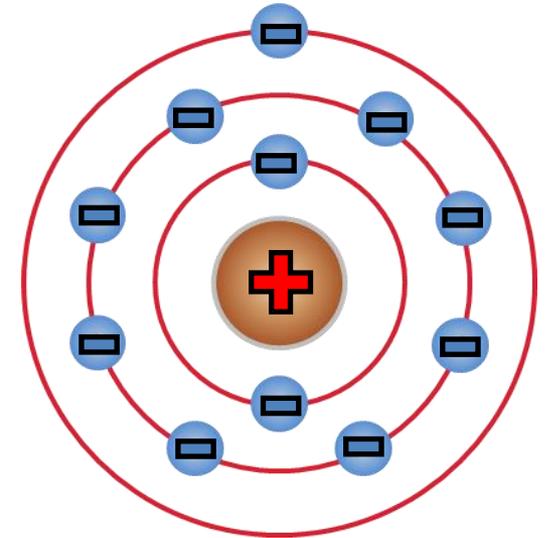
The idea:

- introduce a sample into flame to *heat*
- sample atoms *sublimate* (get *isolated*)
- since they are *hot*, they emit light
- specific colors are observed...

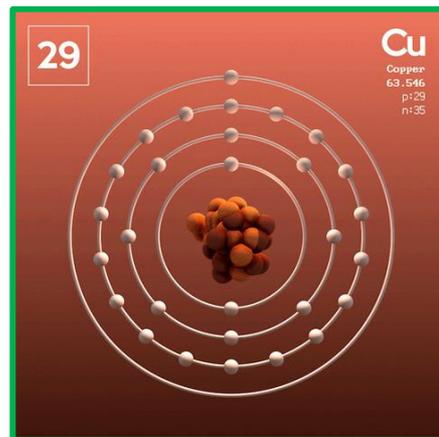
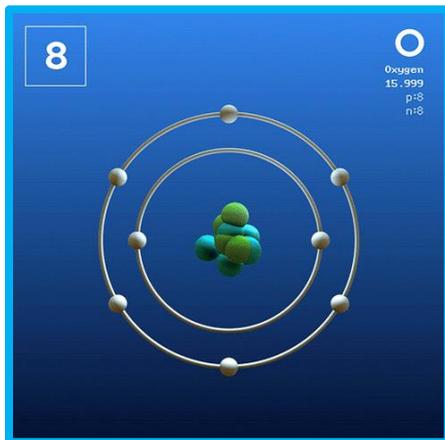
WHY?

Atomic Structure Review

- All atoms have:
 - a positively charged **nucleus**
 - and negatively charged **electrons** moving around within atomic orbitals
- Different atoms have **different number of electrons.**



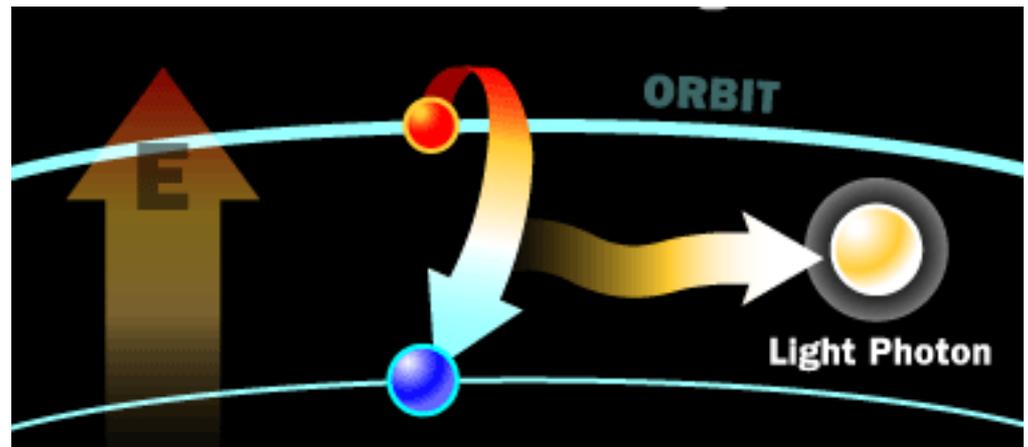
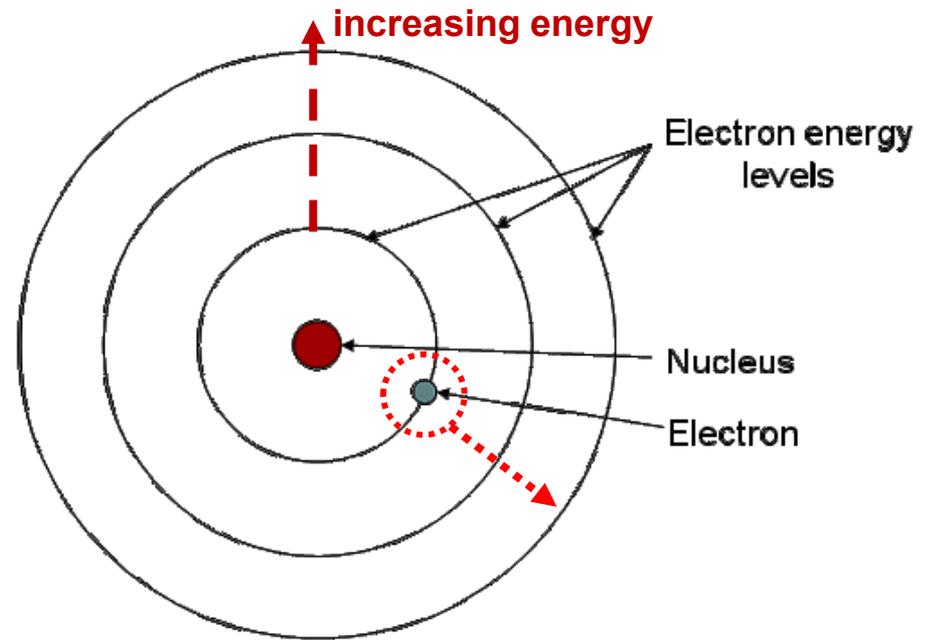
**Planetary
Model
Niels Bohr,
1913**



Electrons in Atoms

Electrons in atoms exist in one or more energy levels (orbitals) around the nucleus.

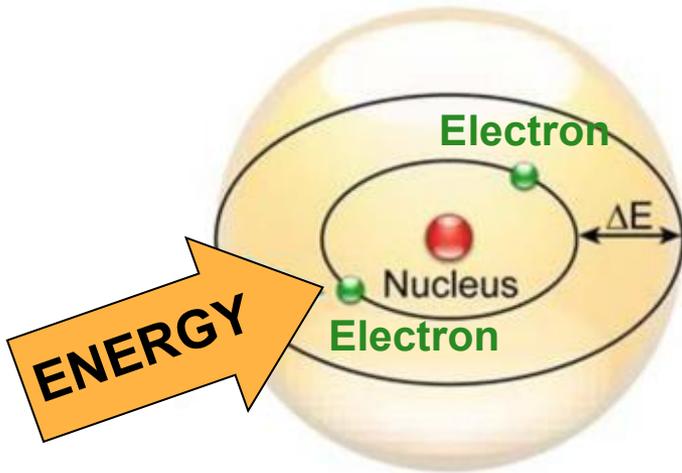
- When matter gains energy, for example by **being heated**, the additional energy pushes the electrons in atoms to higher energy orbitals.
- Electrons tend to return back to their initial orbitals; their “extra” **energy is emitted** in the form of a *particle-like packet of electromagnetic radiation* called a **photon**.



Emission of Light

results from **oscillations of electrons** (“jumps” back and forth between energy levels in atoms)

ground state
 (“cool”)

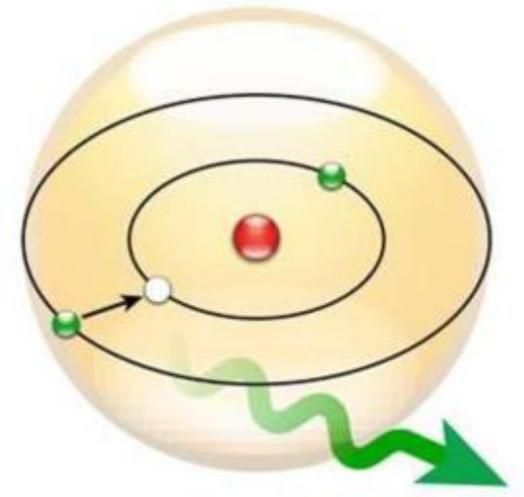


(ANY ENERGY: heat, kinetic/collision, chemical, electromagnetic)

excited state
 (“hot”)



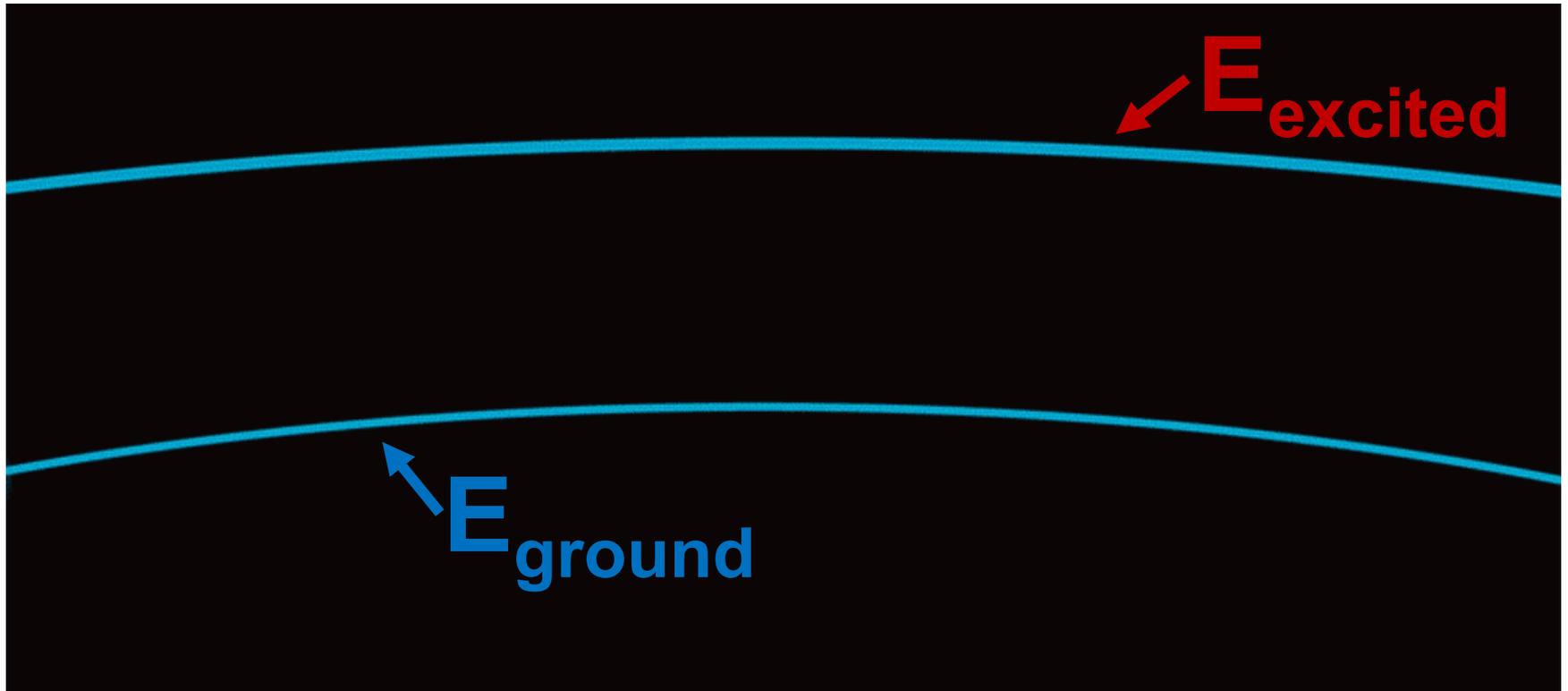
back to
 ground state



LIGHT
 (ENERGY!)

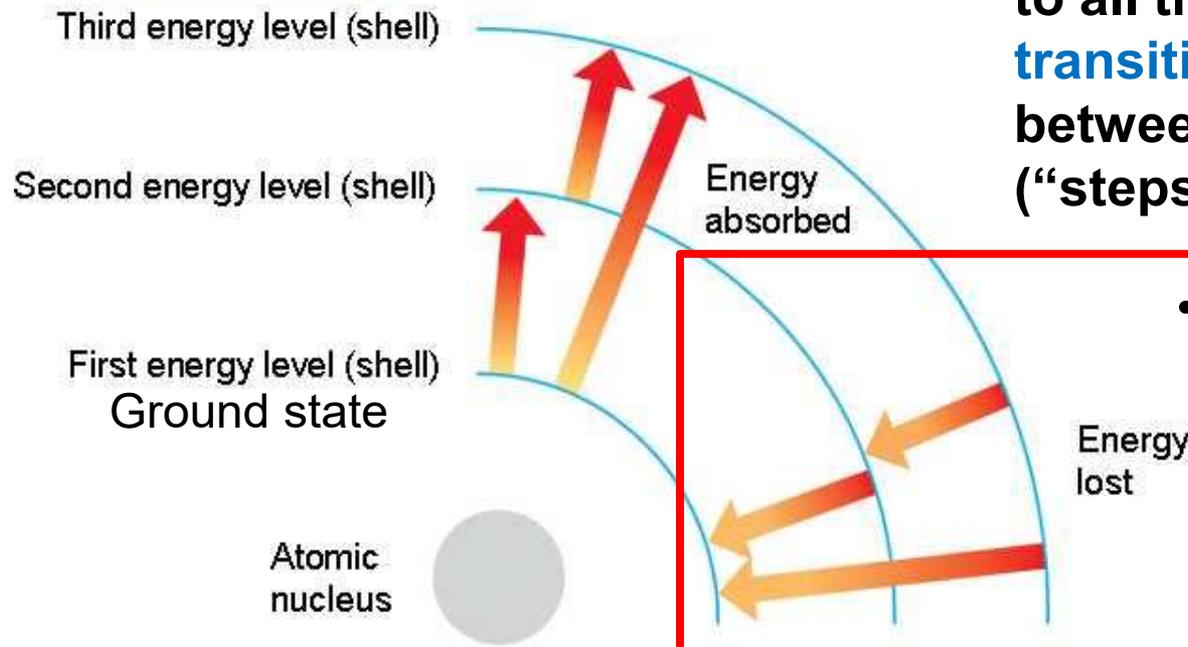
Color of Light

is defined by electron transition



$$\text{Photon Frequency} \sim E_{\text{photon}} = E_{\text{excited}} - E_{\text{ground}}$$

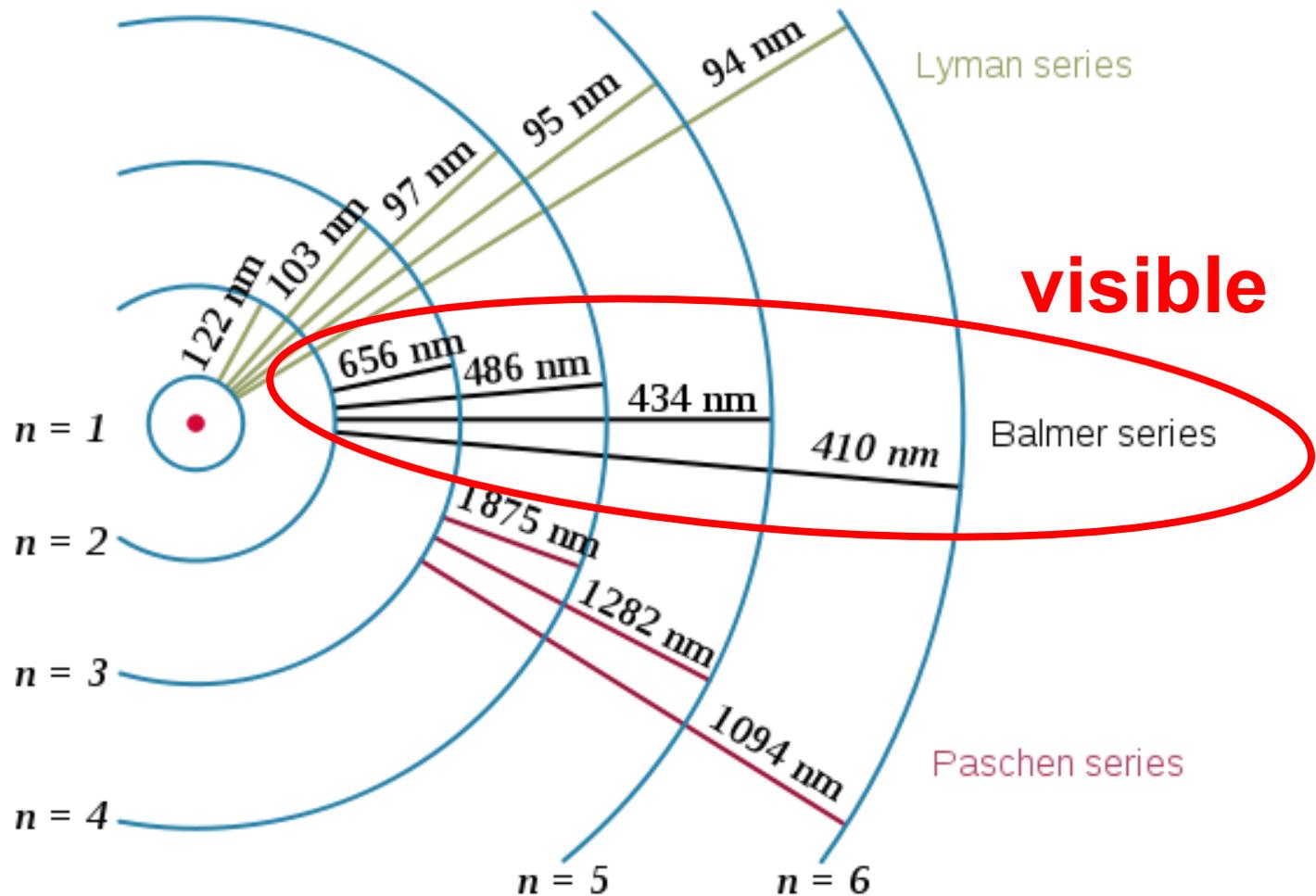
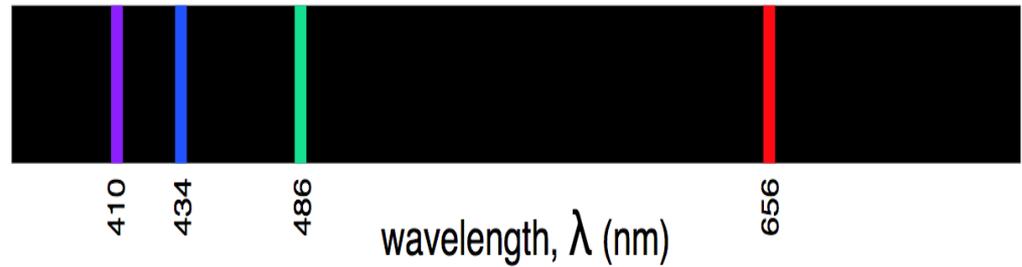
A ***ball bouncing down a flight of stairs*** provides an analogy for energy levels of electrons in atoms: it can only rest on each step, not between steps; the lowest possible step is “ground”.



- An isolated atom will only have light emissions of **certain colors** corresponding to all the **allowed transitions** of electrons between energy levels (“steps”).

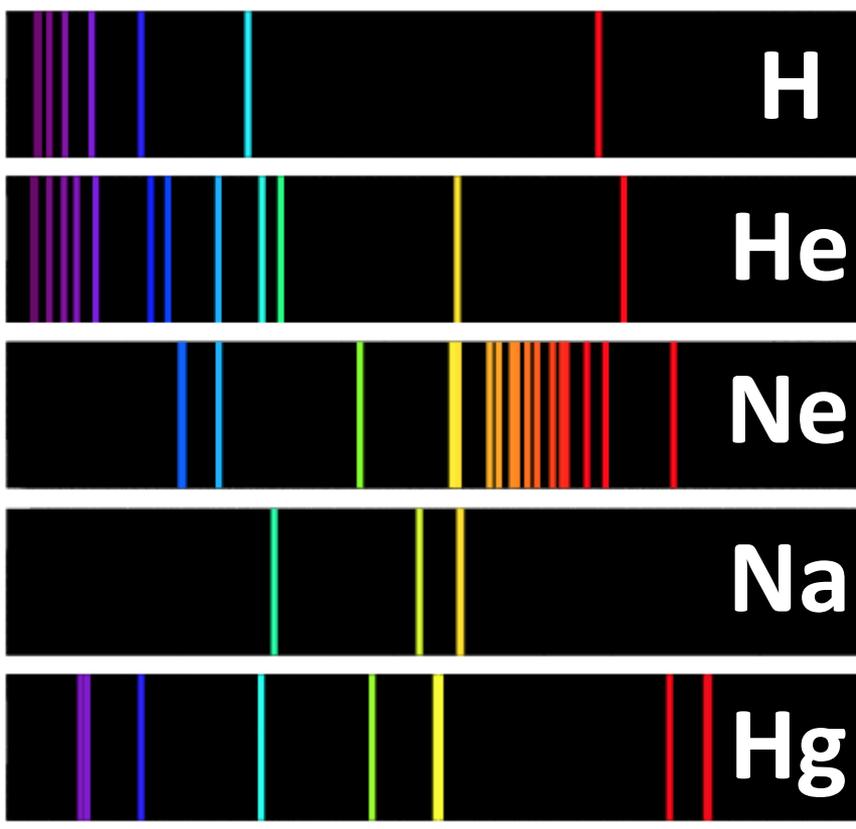
- This set of distinct colors is called **line emission spectrum**

Hydrogen Atom



Atomic Spectrum

Each particular chemical element has a unique electron configuration and hence its own **unique line emission spectrum**, also called atomic spectrum.



- **Spectroscopy** can be used to **identify the elements** in matter of unknown composition.
- Similarly, the **emission spectra of simple molecules** can be used in **chemical analysis of substances**.
- Emission spectra are given by **matter in a gaseous state**: the atoms or molecules are so far apart that they behave like they are isolated.