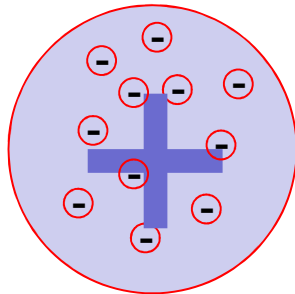


Atom model (J.J. Thomson)

Following Thomson's discovery of electron:

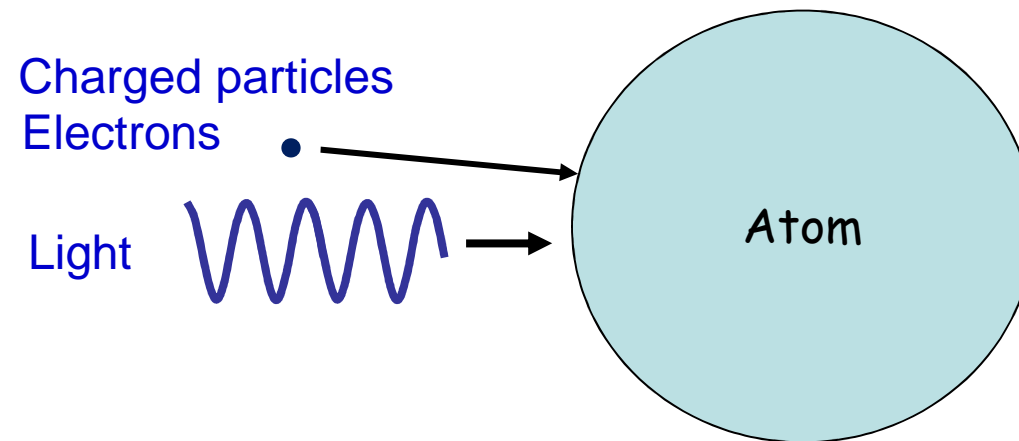
- Atoms must consist of positively and negatively charged particles
- But: How are the charges distributed?



electrons in
positively charged soup
(Plum-pudding model)

How to look at the structure of the atom?

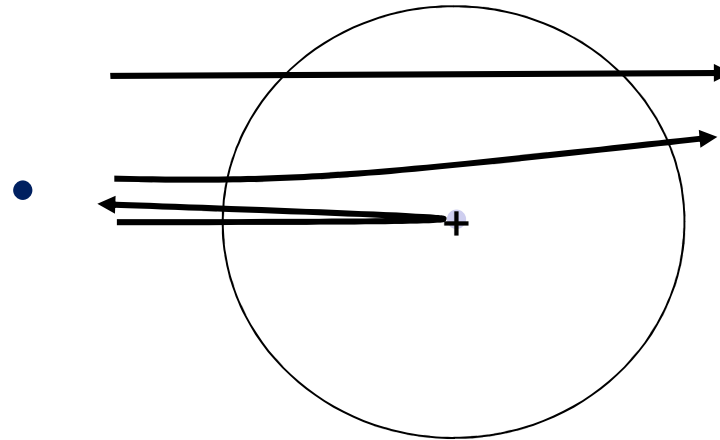
Experiment: Hit the atoms with electrons (particles) or light and see what happens?



How to look at the structure of the atom?

Ernest Rutherford (1911)

α -particles
(2 protons
+ 2 neutrons)



Conclusions:

- Atom is mainly empty with small positive nucleus
- Electrons orbiting nucleus

Google Map Perspective

Nucleus is 10000 times smaller than atom size

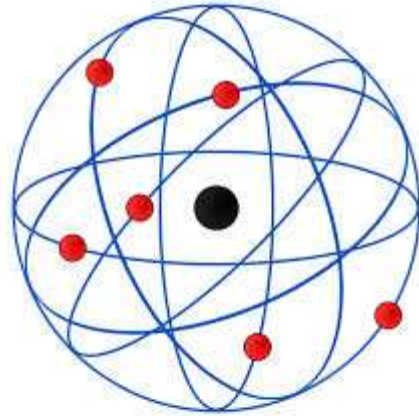


Nucleus = Gamov tower



Atom edge = Wyoming

Atom model (Rutherford)

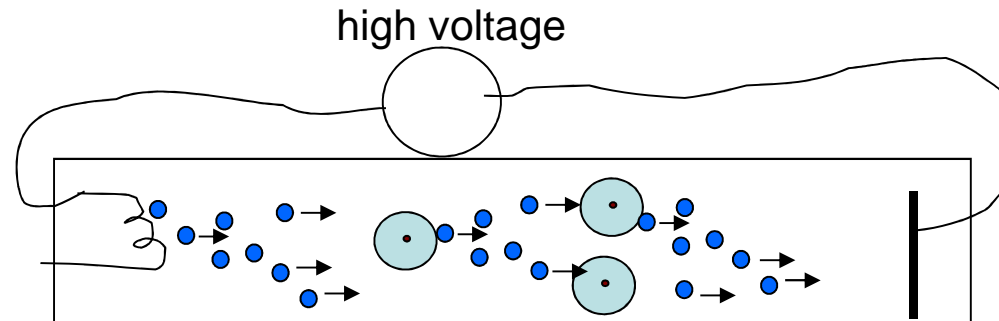


Planetary model:

A small massive positively charged nucleus surrounded by electrons in orbits

Which energies do the electrons have inside the atom?

Discharge lamps (Faraday)



- Electrons are set free from gas
- electrons are accelerated and collide with other atoms
- Tube appears to glow

Discharge lamps (Faraday)

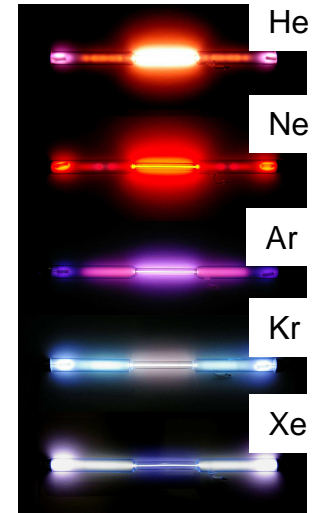
Shooting (lots of) electrons
at atoms

Specific light is observed

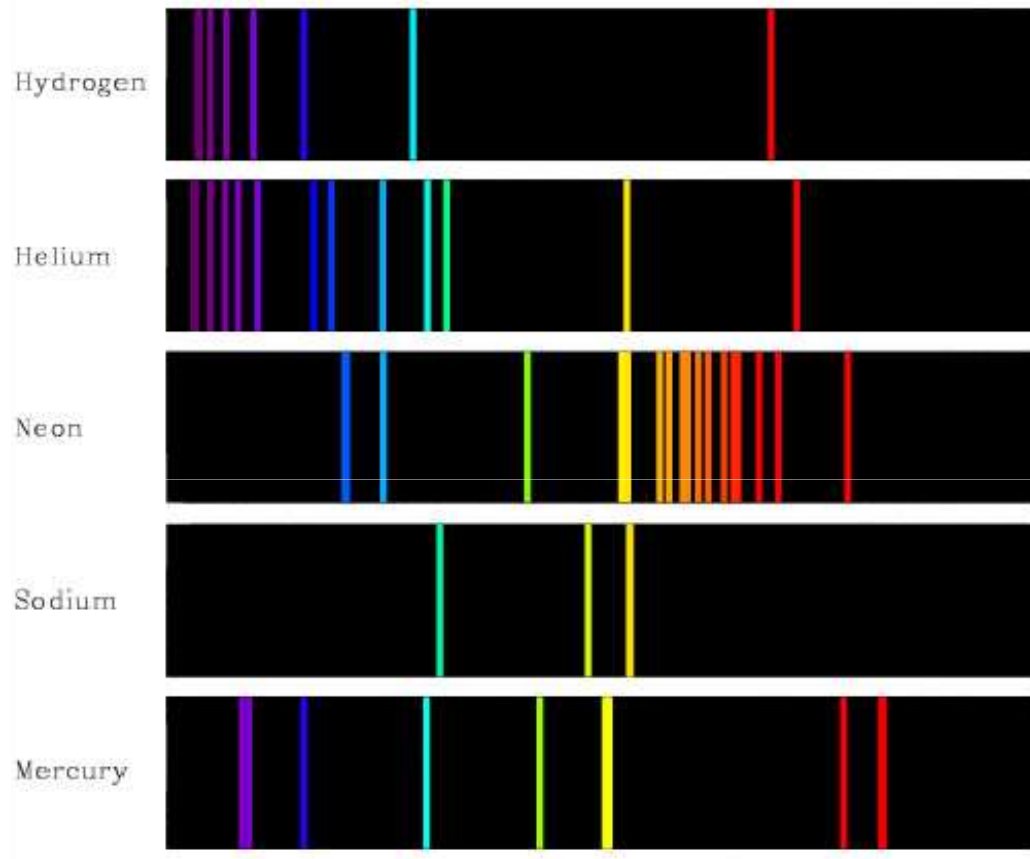
Neon lights

Mercury street lamps

Fluorescent lights



Discharge lamps - spectra



Observation:

Not continuous
(white light)

Discrete lines
Specific for
atomic species

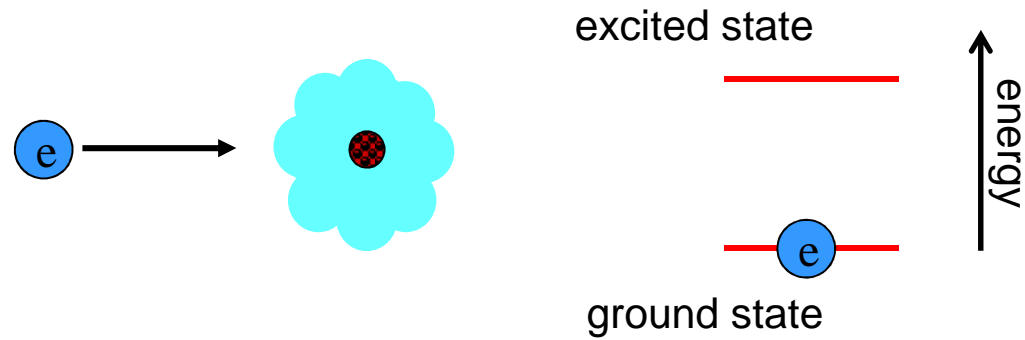
In discharge lamps each type of atoms produces a unique set of discrete colors. Given Einstein's interpretation as light consisting of energy quanta with energy $E = hf = hc/\lambda$ what do these observations imply about the electrons in the atom?

-Student's discussion –

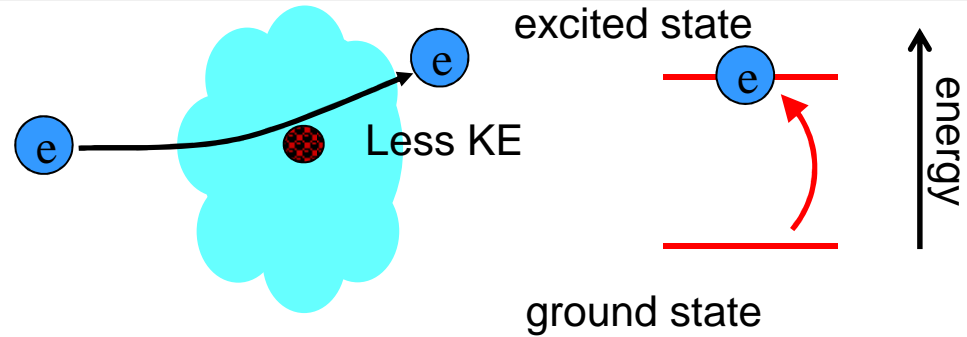
Key answers:

- Electrons can only have certain discrete energies in the atom
- When electron changes its energy it releases light
- Electron changes between discrete energy levels

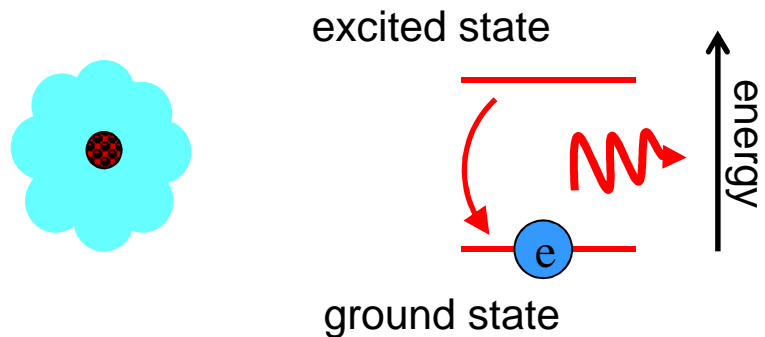
Step 1: Free electron collides with atom

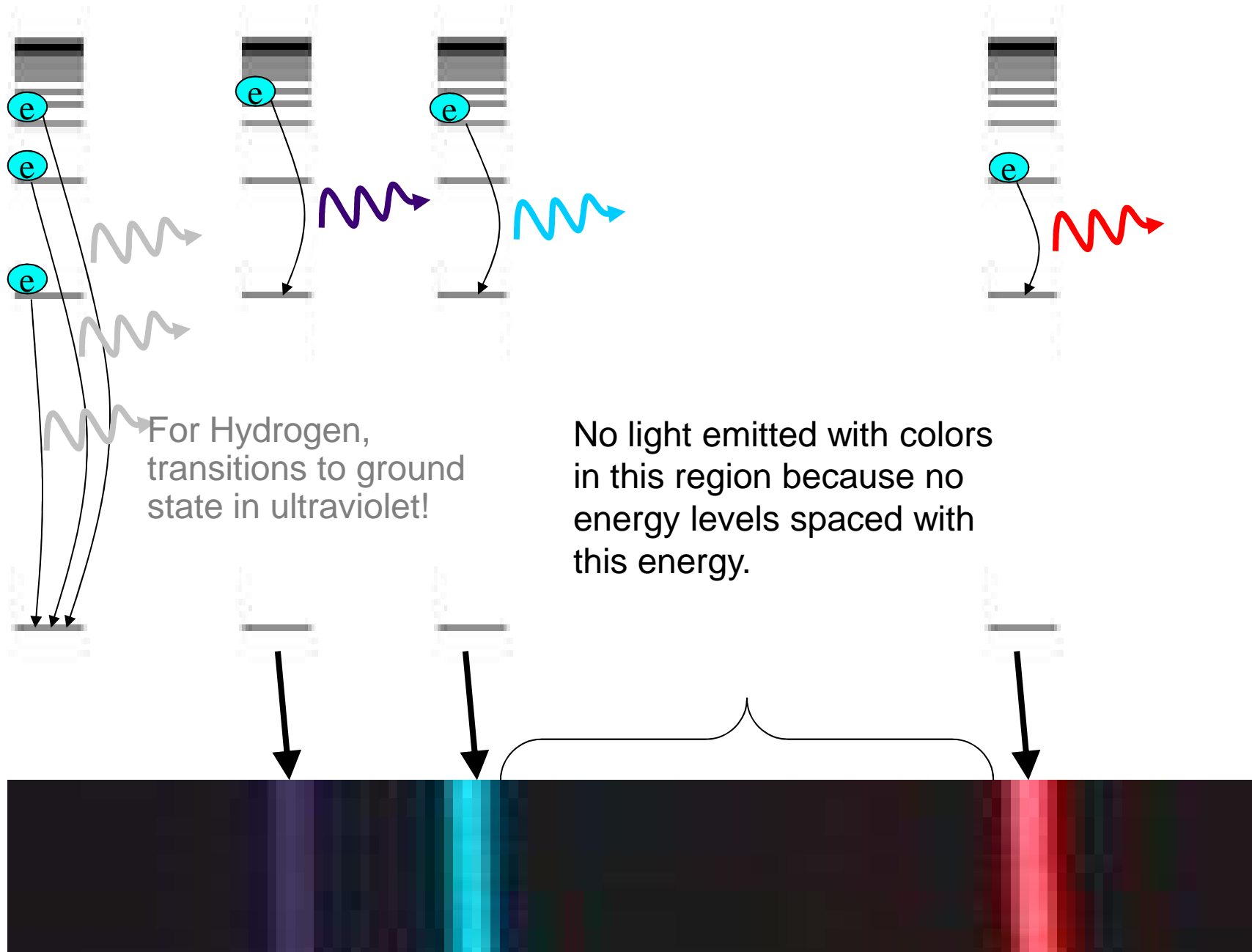


Step 2: Electron in atom gets discrete amount of energy (excited atom)



Step 3: Atom is "lazy" – goes back to low energy ground state





For Hydrogen, transitions to ground state in ultraviolet!

No light emitted with colors in this region because no energy levels spaced with this energy.

Summary so far

- Atoms have specific, fixed energy levels
- Different set of energy levels for different atoms
- 1 photon emitted per electron jump down between energy levels.
Photon color determined by energy difference.
- Atom spends very little time (10^{-8} s) in excited state before hopping back down to lowest unfilled level.
- If electron not stuck in atom, it can have any energy.

If many colliding electrons have an energy between that of level 2 and level 3 when they hit the atom (in the ground state)

- (A) no levels will be excited, and so no light will come out.
- (B) 1 color of light will come out
- (C) 2 colors of light will come out
- (D) 3 colors of light will come out**
- (E) 4 colors come out.

