I. Plum Pudding Model

JJ Thompson

II.

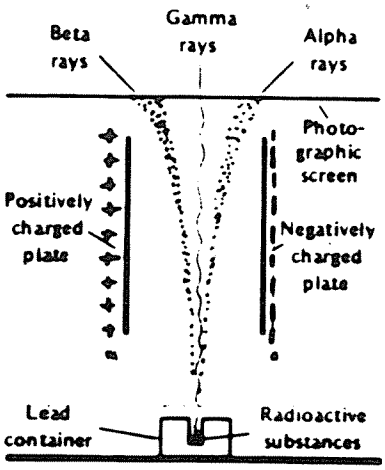


Fig. 30-1. Method of separating alpha, beta, and gamma rays emitted by a radioactive source.

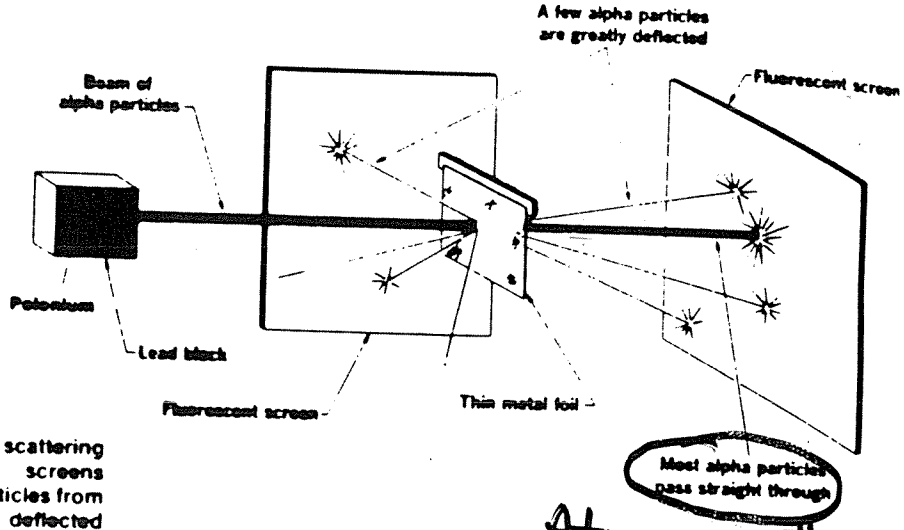
α alpha rays deflect toward (-) plate, have a + charge, Helium nucleus $^{4}_{2}He$ (2P, 2N)

β beta rays deflect toward (+) plate, have a - charge, high speed e^-

γ gamma rays No charge - Neutral, no mass, Very high penetrating energy.

Rutherford's Gold Foil Experiment

Any charged object emits Energy when it is accelerated. (Even circular motion because it is accelerating)



23-10 Rutherford's alpha scattering experiment. Fluorescent screens show whether the alpha particles from a sample of polonium are deflected as they strike a metal foil.

Atom is mostly empty space.

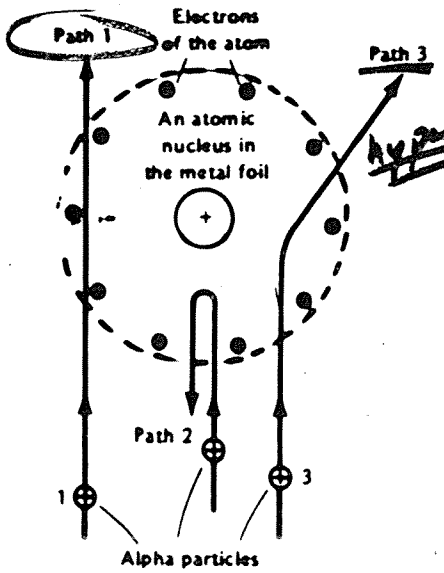


Fig. 30-4. Paths taken by alpha particles on nearing an atomic nucleus.

Rutherford's Planetary Model

- Mostly empty space
- Nucleus is small dense, + charged, contains most of the atoms mass.
- e^- are located in planetary motion outside of the nucleus.

(Using diff. metals, the atoms nuclear charge = # protons = atomic number)

Rutherford's model failed to explain:

1. Why electrons which have Ac and should emit energy don't spiral into the nucleus
2. Why bright line spectra is not continuous.

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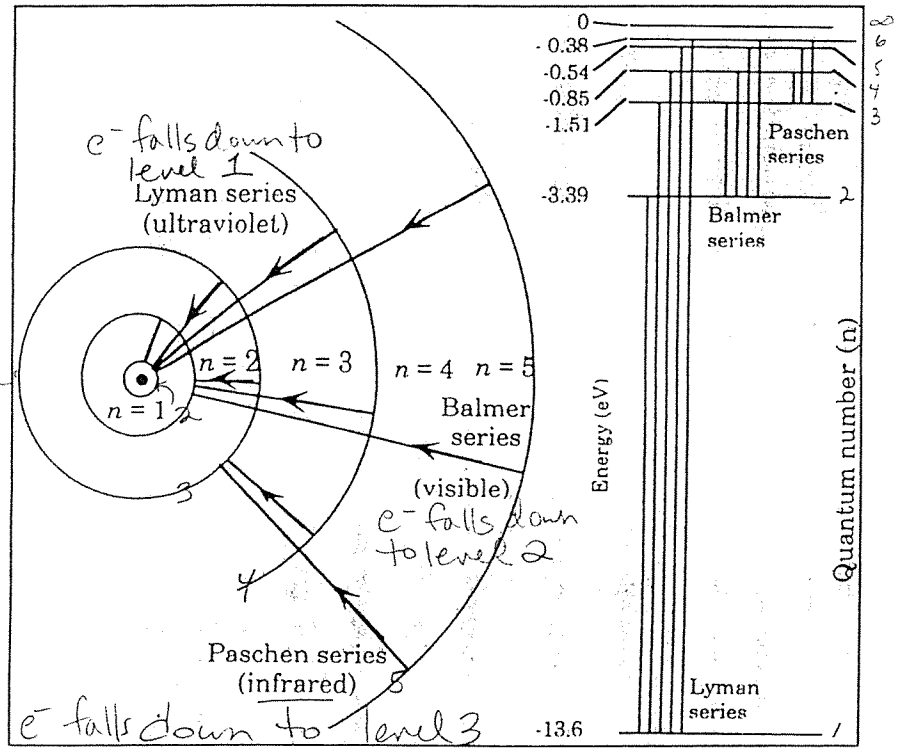
Bohr's Atom

$E_{photon} = E_i - E_f$

Energy is absorbed when the electron goes from a lower to a higher energy level.
Energy is released when the electron goes from a higher to a lower energy level.

Bohr was very successful in predicting the behavior of all single electron atoms. H, He^{+1}, Li^{+2} etc.

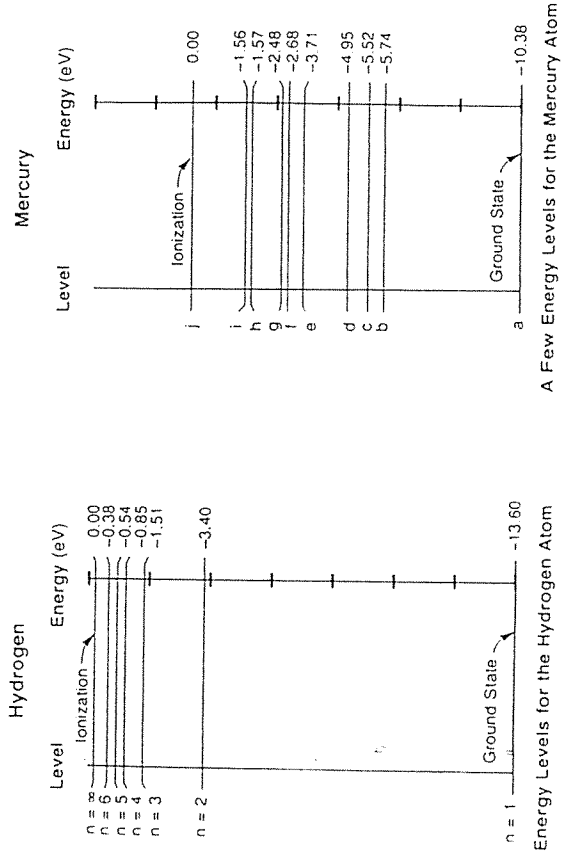
Have students number the levels. 1 ← level 1 is the ground state



Note - e⁻ can not go between steps.

Ground State - level n = 1 - lowest energy
∞ - electron is removed from the atom

Energy Level Diagrams



Use the same equation for energy level changes

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1. Calculate these values for the hydrogen atom:
 a) $E_6 - E_5$ b) $E_6 - E_3$ c) $E_4 - E_2$ d) $E_5 - E_2$ e) $E_5 - E_3$

2. Use problem 1 solutions to determine the frequencies of the photons emitted when the hydrogen atom passes through the energy differences.

3. Use Problem 2 solutions to determine the wavelengths of the photons having the frequencies listed.

4. For each of the photons emitted in problem 1 determine the "color" of the photon and the series.

	$E_i - E_f$	(1) $E_{photon} = E_i - E_f$	(2) $E = hf$ (convert eV → J)	(3) $v = f\lambda$	(4) color	Series
a)	$E_6 - E_5$	$-0.38eV - (-0.54eV) = +0.16eV$	$0.16eV(1.6\times10^{-19}\ J/eV) = 2.56\times10^{-20}\ J$; $\frac{2.56\times10^{-20}\ J}{6.6\times10^{-34}\ J\cdot s} = 3.9\times10^{13}\ Hz$	$\frac{3\times10^8\ m/s}{3.9\times10^{13}\ Hz} = \lambda = 7.7\times10^{-6}\ m$	See Ref table Spectrum longer than Red → Infrared	See the level it returns to No Name
b)	$E_6 - E_3$	$+1.13eV$				
c)	$E_4 - E_2$	$+2.55eV$	$2.7\times10^{14}\ Hz$	$1.1\times10^{-6}\ m$	Infrared	Paschen
d)	$E_5 - E_2$	$+2.86eV$	$6.1\times10^{14}\ Hz$	$4.9\times10^{-7}\ m$	Blue/Green	Balmer
			$6.9\times10^{14}\ Hz$	$4.3\times10^{-7}\ m$	Violet	Balmer
e)	$E_5 - E_3$	$+0.97eV$ This is the E given off by the e^- in this move	$2.3\times10^{14}\ Hz$	$1.3\times10^{-6}\ m$	Infrared.	Paschen

5. Why was the Bohr model unsuccessful in predicting more complex atoms?
When more than one e^- is present the electrons interact with each other.

6. Compare and contrast Rutherford's model with Bohr's model of the atom.
Both - Nucleus - contains Protons + Neutrons
Rutherford e^- are in orbit around the nucleus at any position
Bohr e^- may only occupy specific energy levels around the nucleus. - Bohr's atom explains why the spectrum (produced by the electron changing energy levels) is not continuous.

Give out wintergreen lifesavers. Observe breaking in dark. Why does this happen?