

MLT / FPT / CSWT | SEMESTER 1

BS105 Applied Chemistry

Bohr model and hydrogen spectrum

Today we answer one question from last class:
why does electron not fall into the nucleus?

Class 2

No derivations

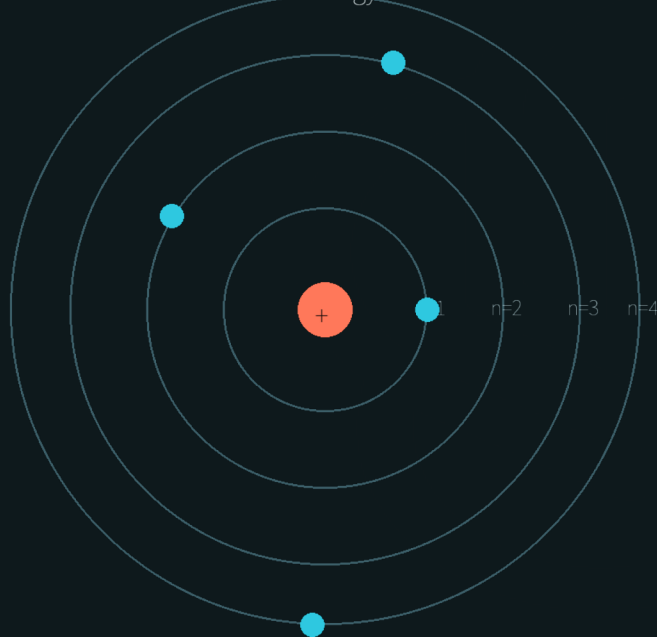
Rutherford worked, but one problem remained

- > Idea of Nucleus was correct.
- > But moving/circulating electron should lose energy and fall in.
- > Atoms are stable in real life, so model was incomplete.
- > Bohr gave a simple fix using fixed energy levels.

BOHR POSTULATES

Bohr proposed: Electrons can stay only in allowed orbits

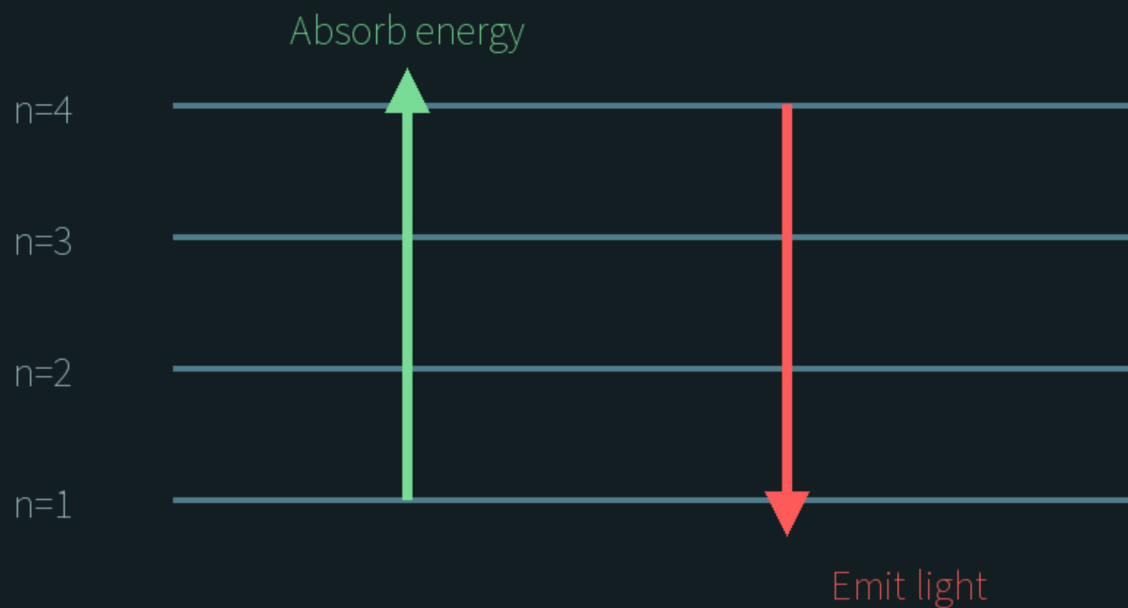
Bohr model: electrons in fixed energy levels



- > Orbit = fixed energy level ($n=1,2,3\dots$).
- > No energy loss while electron stays in “stationary state”.
- > Energy changes only during jump between levels.
- > $n=1$ is closest and lowest-energy level.

Quantum jump: Absorb up, emit down

Electron jump idea



Hydrogen gives lines, not rainbow

Hydrogen visible lines (Balmer)



Visible lines often memorized: red 656, blue-green 486, violet 434 and 410 nm.

COMPARE

Continuous vs line spectrum

Continuous spectrum



Hydrogen line spectrum



Each line = one fixed energy gap

- > Electron can jump only between allowed levels.
- > Each jump has fixed energy difference.
- > Fixed energy means fixed light frequency and wavelength.
- > So we see separate bright lines.

Keep only these relations

$$E_2 - E_1 = h.\nu \text{ and } c = \nu.\lambda$$

- > No derivation
- > Only meaning: bigger energy gap: higher frequency: shorter wavelength.

EXAMPLE

One simple question

**Electron drops from $n=3$ to $n=2$ in hydrogen.
What happens?**

- > Electron loses energy.
- > That energy comes out as one photon.
- > So one bright spectral line appears.

Where Bohr works and where it fails

Works well

- > Hydrogen atom
- > Hydrogen-like ions
- > Explain Line spectrum

Not enough for

- > Many-electron atoms
- > Fine spectral details
- > Modern quantum model

What to write in the exam?

- > State Bohr postulates in points.
- > Explain electron jump and emission/absorption.
- > Explain why hydrogen gives line spectrum.
- > Draw the Bohr model and label $n=1$, $n=2$, $n=3$.

Summary

- > Electrons stay in fixed levels (stationary orbits) in Bohr model.
- > No energy loss when in stationary states.
- > Energy releases (or absorbed) only when electron jumps.
- > Hydrogen atom line spectra comes from fixed energy gaps.