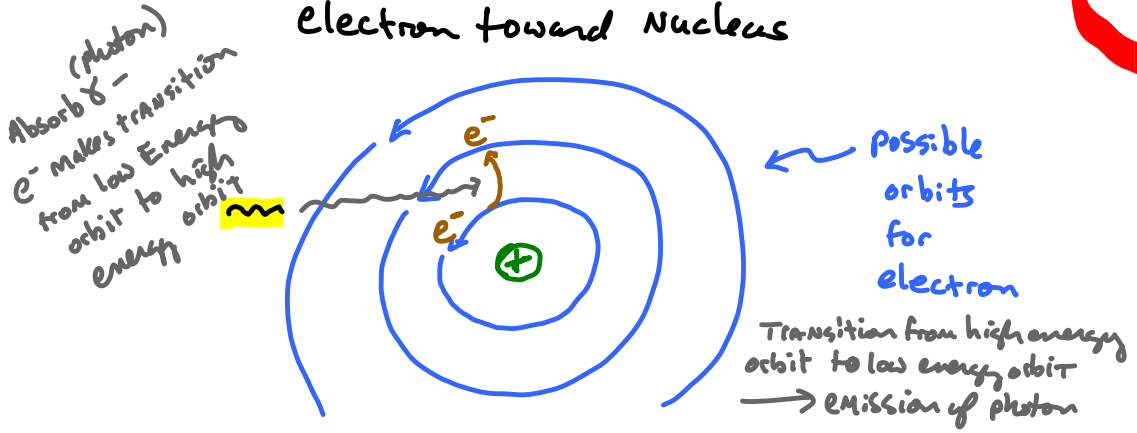
Physics 102 – February 26, 2014

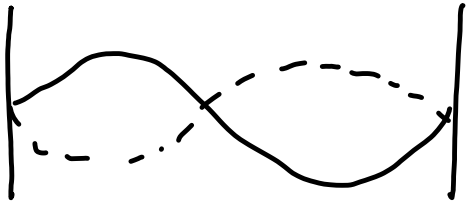
Bohr Model of the ATOM (1912)

- Positive Nucleus
- electrons orbit in circles
- only particular "discrete" orbits
  - ↑ known as quantization
- electric (coulomb) force holds electron on circle as it orbits ... attracts electron toward Nucleus

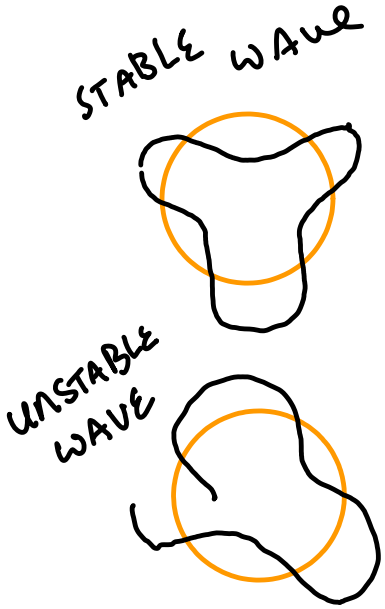
1913

- Nuclear ATOM
- Discrete STABLE circular orbits





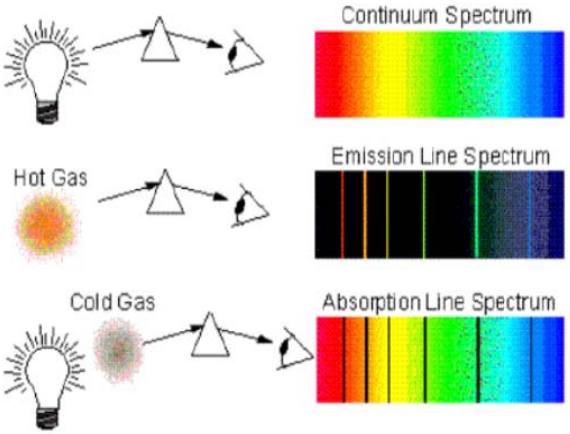
STANDING WAVE ON STRING

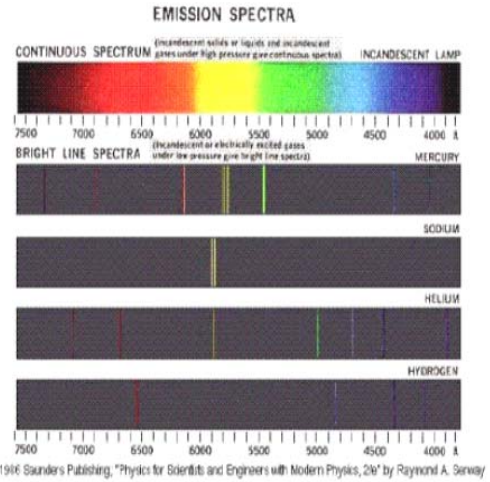


STANDING electron wave in Bohr Model

not historically accurate but reasonable intuition (plus same result) after de Broglie $\lambda = h/p$ insight of 1920's

Emission vs. Absorption

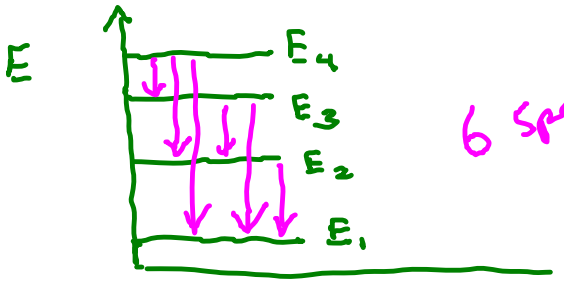




Different Atoms → different discrete frequency pattern

Atomic Fingerprinting

For an atom w/ 4 Energy levels, how many spectral lines will it have?



6 spectral lines

After de Broglie & Bohr ... what next

Werner Karl Heisenberg
(1901 - 1976)

Nobel Prize in physics - 1932
for "the creation of quantum Mechanics"
(Max Born, Pascual Jordan - co-workers)

Erwin Rudolf Josef Alexander Schrödinger
(1887 - 1961) Austria
1933 Nobel Prize in physics

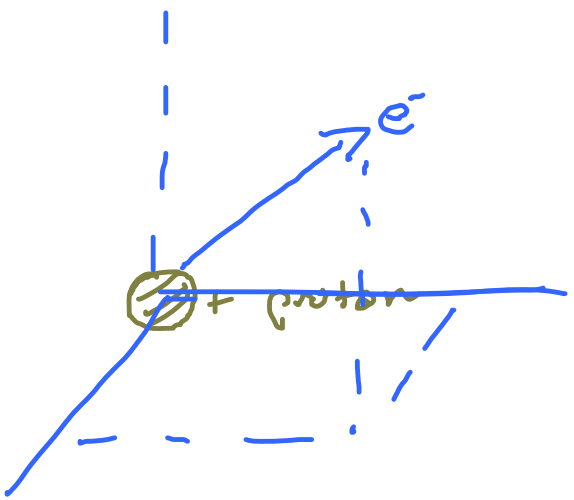
1926 - Paper on wave Mechanics of Matter
Annalen der Physik

"for discovery of new and productive forms of atomic theory"

general

$$-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2} + V\psi(x) = E\psi(x)$$ Schrödinger Equation

Just so you've seen it



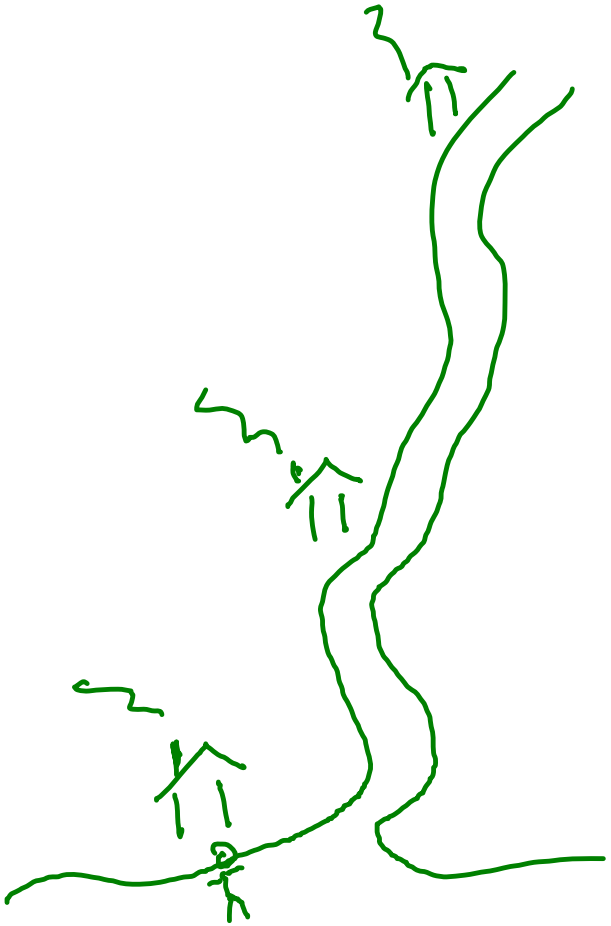
e^- in spherically symmetric "Potential"

plug into Schr. eqn + Solve

⟶ only particular spatial "orbitals" are allowed

correspond to particular energies

"STATES" in which e^- allowed to exist.

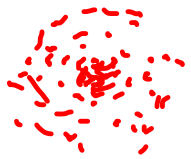


Sketch of "probability density"

Probability that you might find e^- at this point in H atom

lowest energy state

$n=1$



$n=2$

Only discrete energies and spatial states allowed for the electron to occupy → orbital

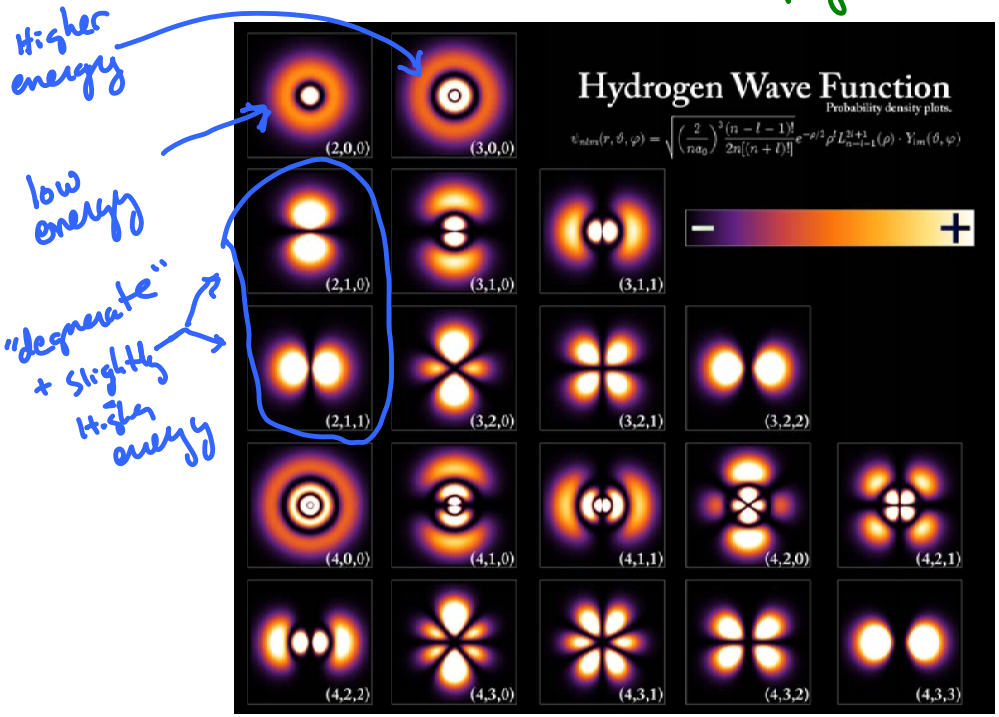
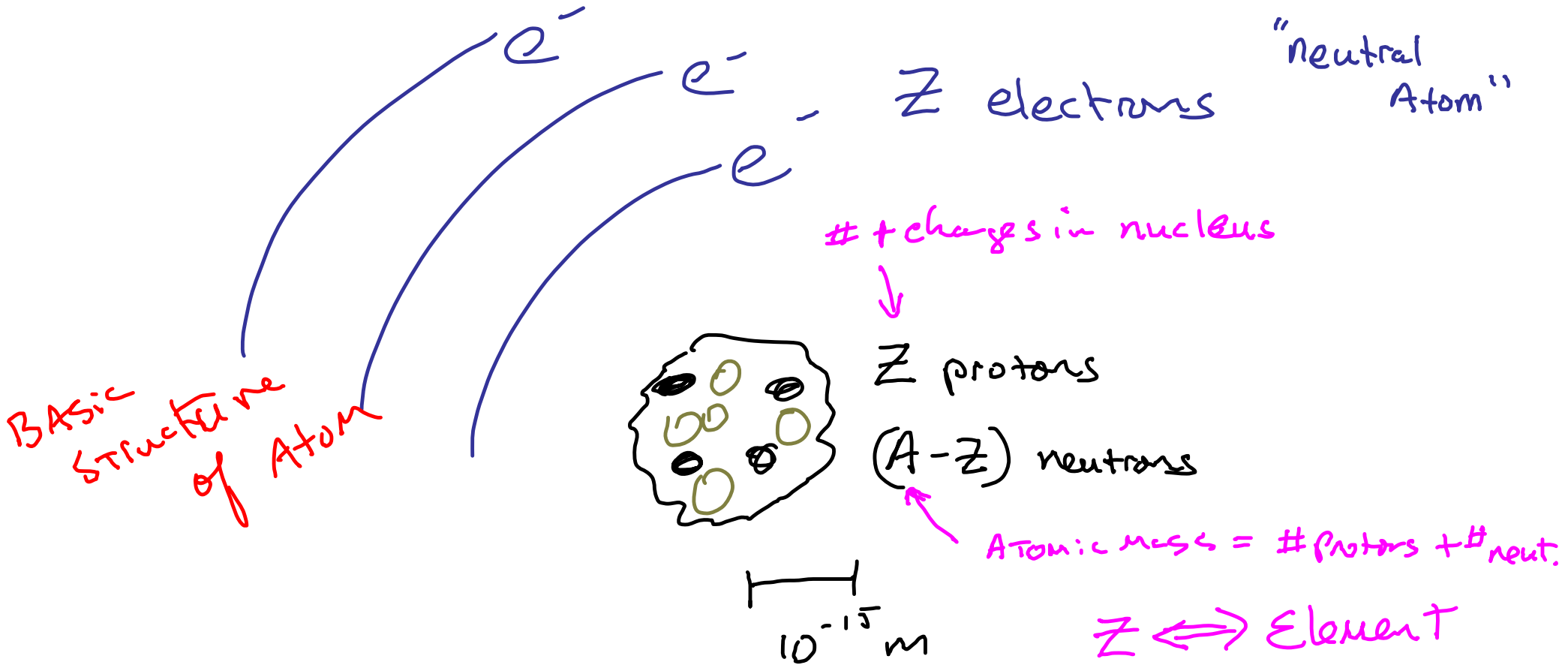


figure from http://en.wikipedia.org/wiki/File:Hydrogen_Density_Plots.png



Some # p, differing # neutrons ⟶ isotopes

Analogy of condos in a ski village to allowed quantum STATES in an atom.

discrete places to reside.

different energies to reach those places.

Some states with different spatial configurations have the same energy — said to be "degenerate" ... no judgement on Morals of electrons.

Stern-Gerlach experiment — 1922

→ Discovery that electrons have Spin

Spin

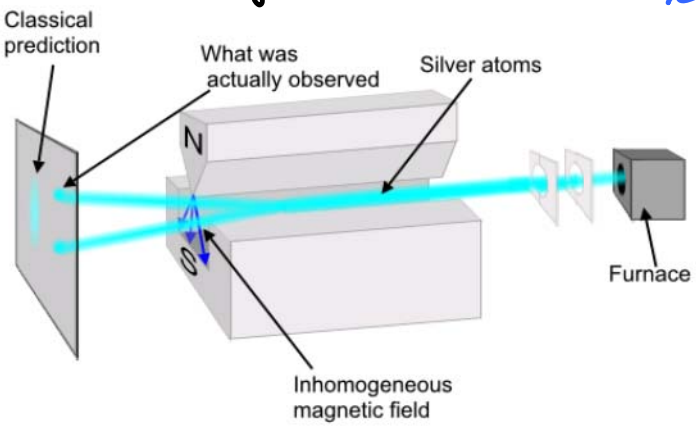


Diagram from Wikipedia

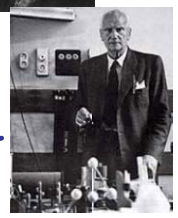
Otto Stern

"If this nonsense from Bohr will prove to be right we will quit physics."
(Stern vowed in 1913)

-wikipedia

as quoted in Phys. Today Dec 03

Walther Gerlach



from phys Today article Dec. 03)