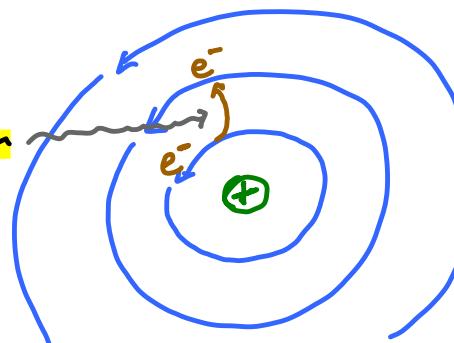


Bohr Model of the ATOM (K12)

Physics 102 - February 26, 2014

- 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

Absorb (photon)
 e^- makes transition
from low Energy
orbit to high
energy orbit

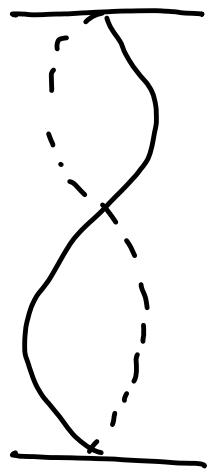


Possible orbits for electron
Transition from high energy orbit to low energy orbit
→ emission of photon

- Nuclear ATOM
- Discrete STABLE circular orbits

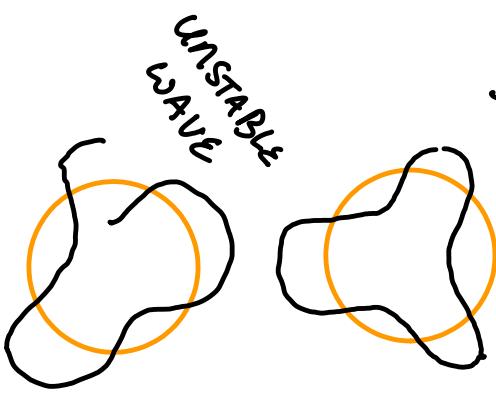
1913





standing wave on string

stable wave

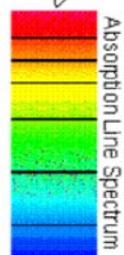
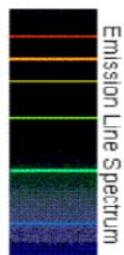
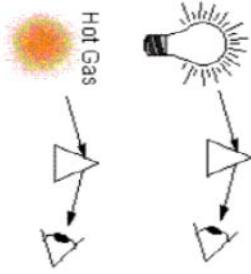


standing electron wave
in Bohr model

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

Continuum Spectrum

Emission
Vs.
Absorption



EMISSION SPECTRA

CONTINUOUS SPECTRUM (continuous white light passes over continuous spectra)

INCANDESCENT LAMP

Different atoms
→ different frequency
discrete pattern

BRIGHT LINE SPECTRA (continuous white light passes over discrete spectra)

(only few wavelengths are present in the spectra)

HYDROGEN

HELIUM

SODIUM

MERCURY

Atomic
Fingerprinting

© 1996 Sinauer Publishing. "Principles of Science and Engineering with Modern Physics," 2nd Ed. by Raymond A. Serway.

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



Afther "Bohr
de Broglie" Pohl
... 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

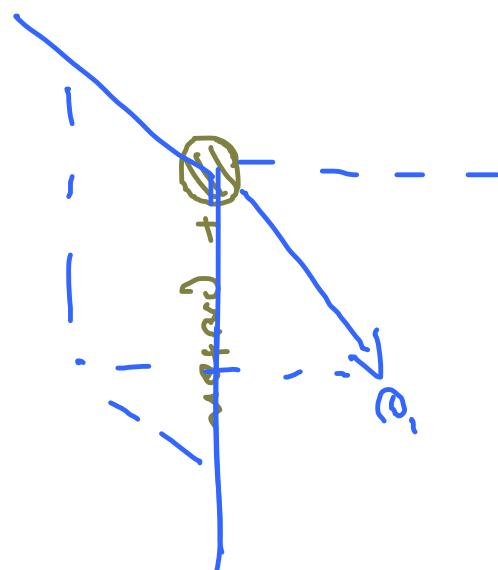
"for discovery of new and productive forms of
atomic theory"

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

Just so
you've seen
it



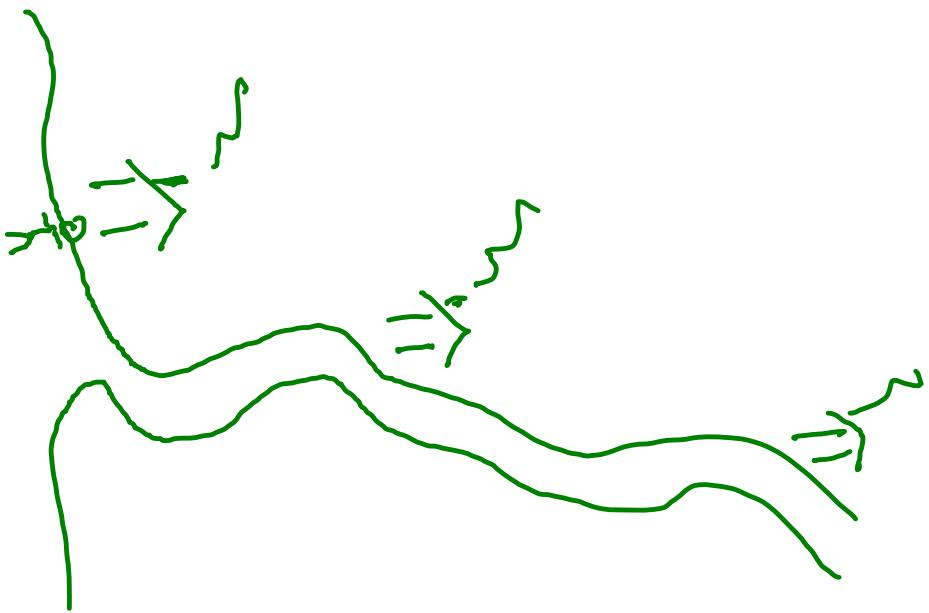
e^- in spherically symmetric
"Potential"



plus 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

$n=1$



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

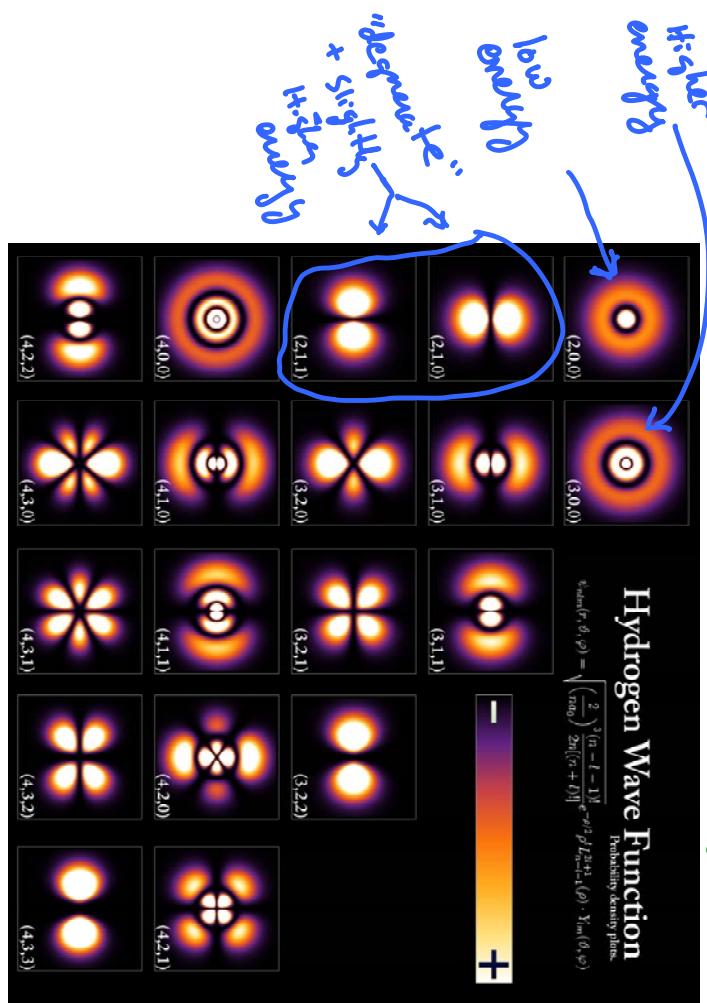


figure from <http://en.wikipedia.org/wiki/File:Hydrogen-Density-Plots.png>.

"

neutral
Atom"

e^- e^- e^- Z electrons

charges in nucleus



Z protons

$(A-Z)$ neutrons

Atom: mass = # protons + # neut.

10^{-15} m

$Z \Leftrightarrow$ Element

Basic
Structure
of Atom

Some # P , differing # neutrons \rightarrow isotopes

Analogy of
condos in a
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 judgment on morals
of electrons.



Stern-Gerlach experiment - 1922

→ Discovering that electrons have spin

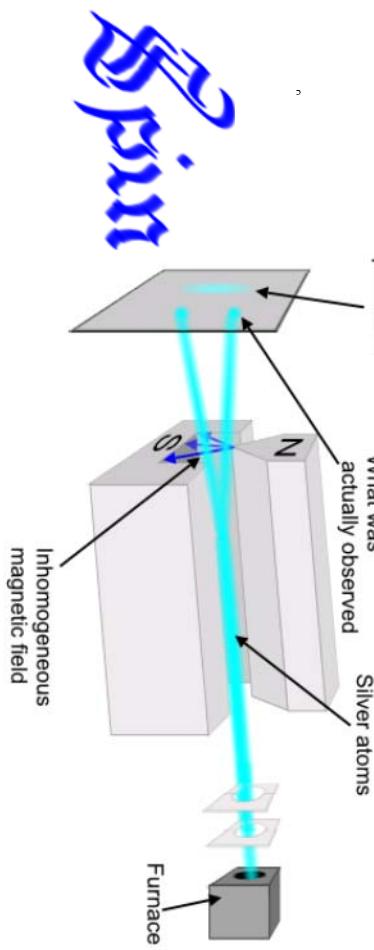


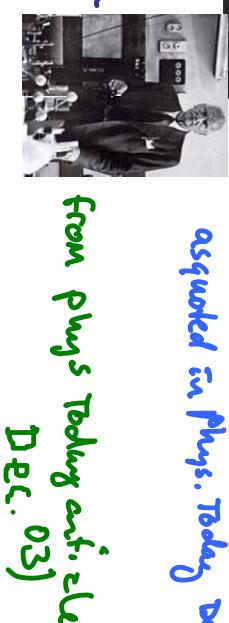
Diagram from
Wikipedia

oπo Stern

"If this nonsense from Bohr will prove to be right we will quit physics."
-Werner Heisenberg
(Stern quoted in 1943)

as quoted in Phys. Today Dec 03

Walther Gerlach



from phys Today article
Dec. 03)