Physics 102 — March 3, 2014

- Ranking
- BB issues w/ writing assignment 5 ⟶ multiple columns

Schrödinger

$\hbar = h/2\pi$

input force here

energy

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

mass

spatial dependence

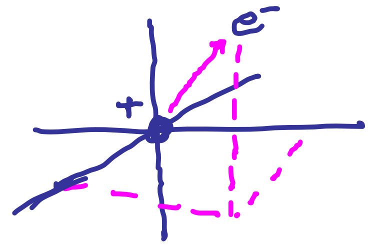
Heisenberg

Time independent Scrödinger equation

$\psi(x) \equiv$ Wave function

wave equation for waves/particles [can have mass]

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



For H atom input spherically symmetric Coulomb force here

Then Solve

⋮

get discrete/quantized STATES of energy and spatial position

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

Higher energy

low energy

"degenerate" + slightly higher energy

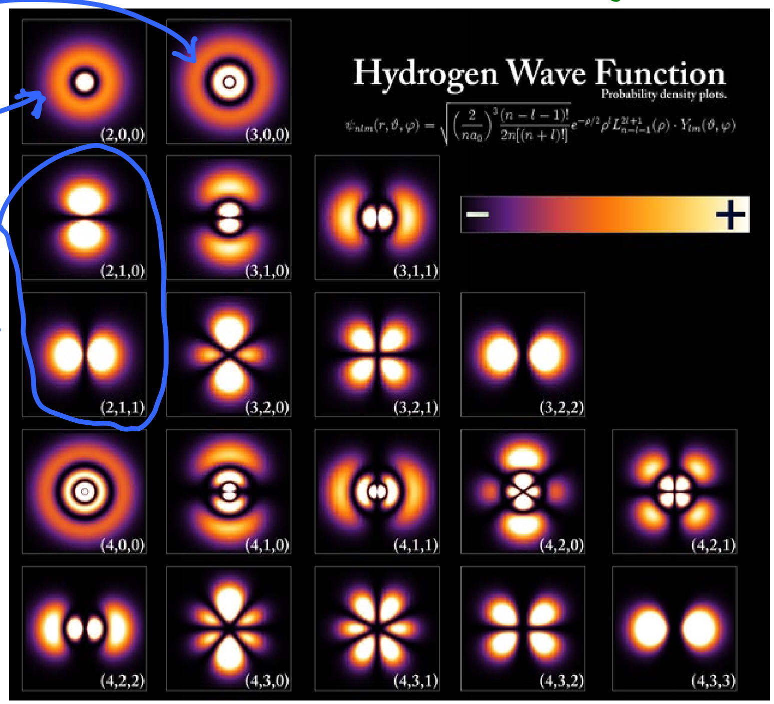
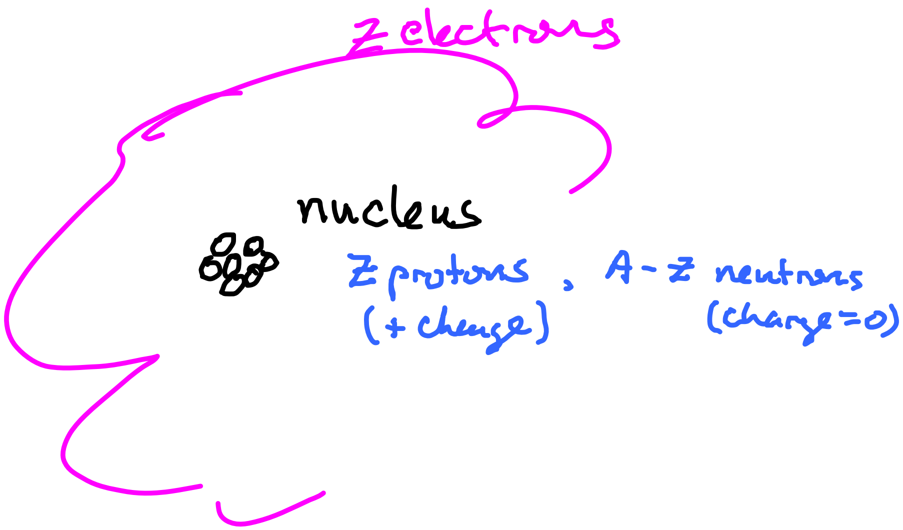


figure from http://en.wikipedia.org/wiki/File:Hydrogen_Density_Plots.png



as Z increases
electrons increase

How do they populate
Available STATES/orbitals ?

→ particle promiscuity
is important

Stern-Gerlach experiment — 1922

→ Discovery that electrons have spin

Spin

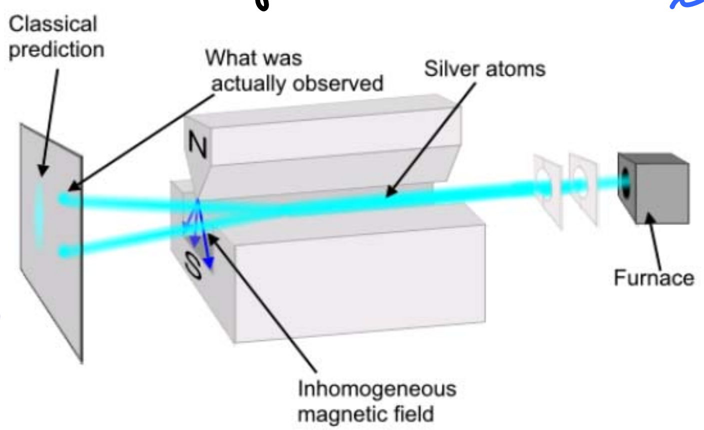


Diagram from Wikipedia

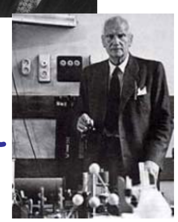
Otto Stern

-wikipedia

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

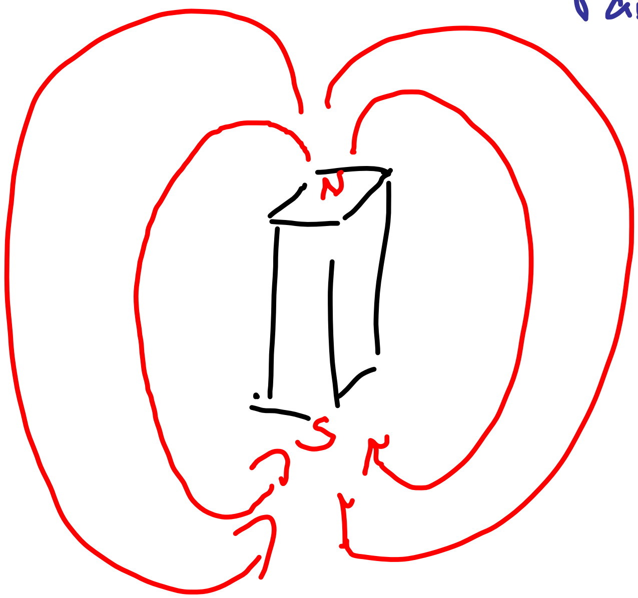
as quoted in Phys. Today Dec 03

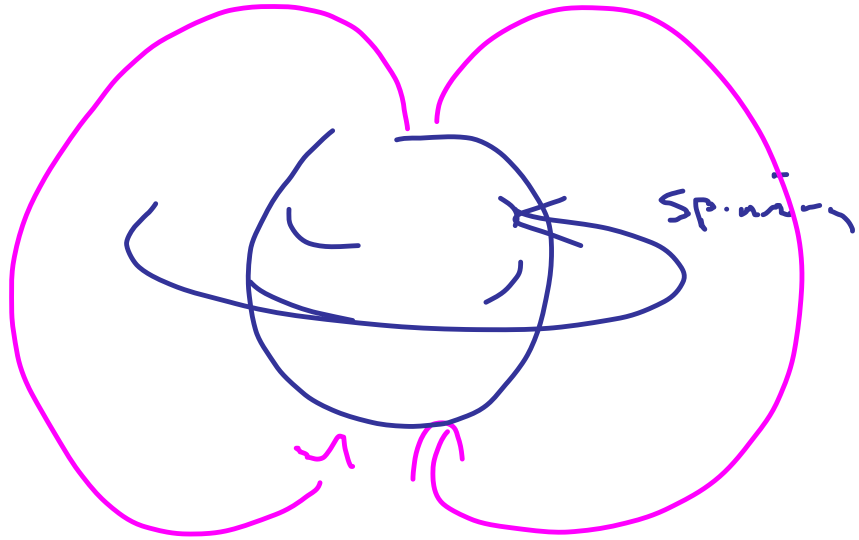
Walther Gerlach



from phys Today article
(Dec. 03)

Particles have spin





Z , W
Higgs H
photon γ

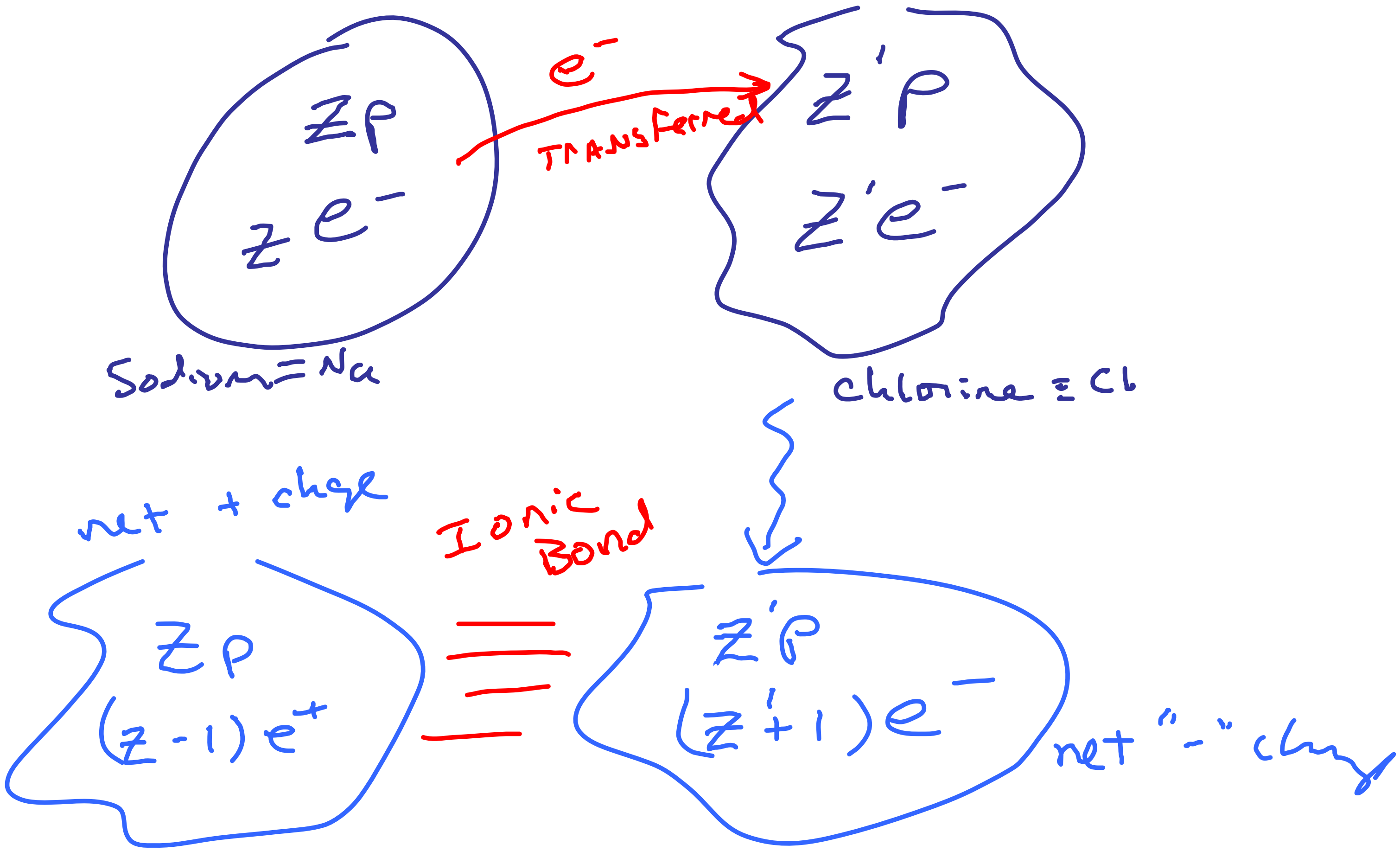
Spin is quantized

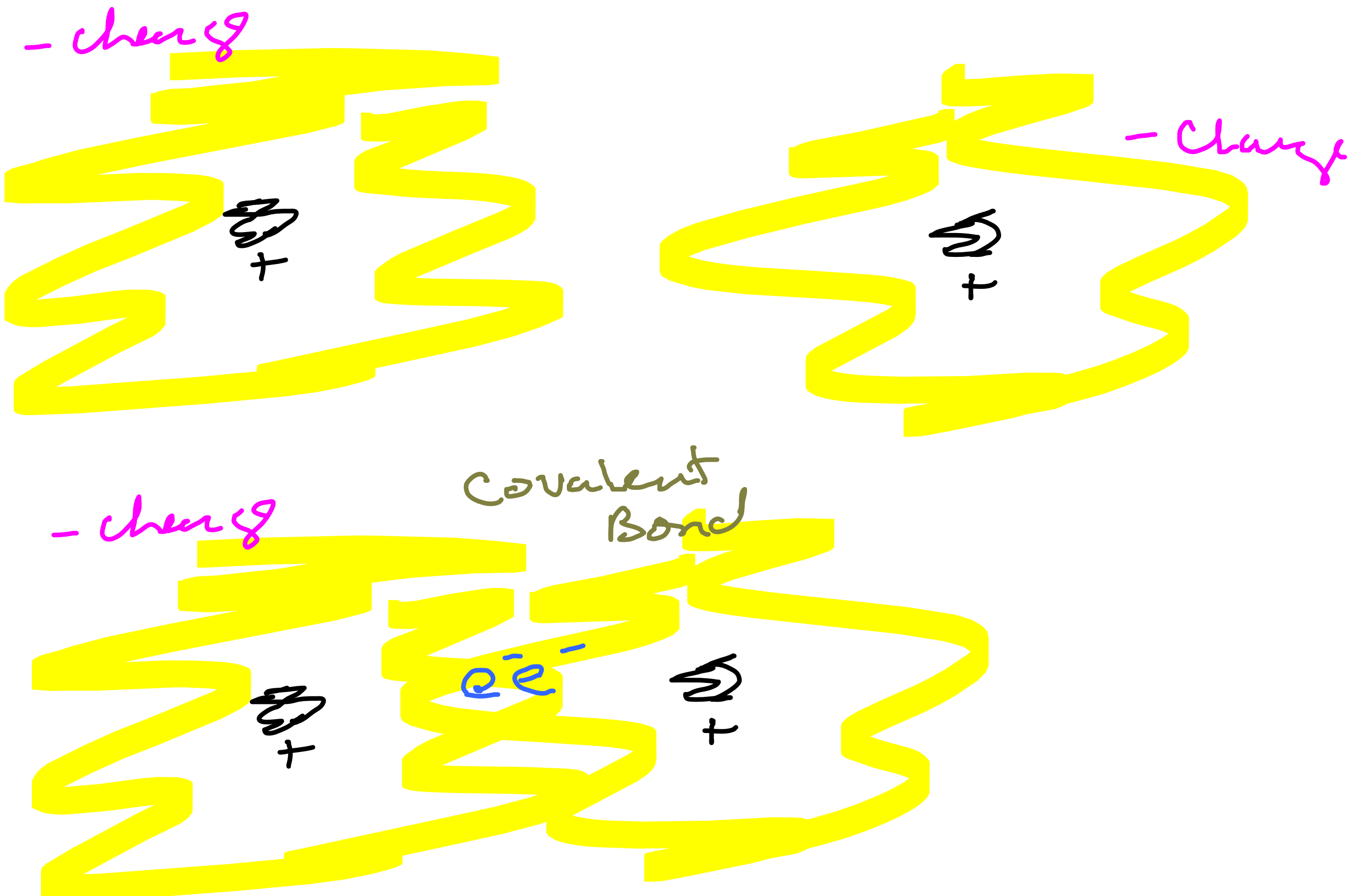
$0, \frac{1}{2}, 1, \frac{3}{2}, 2 \ldots$

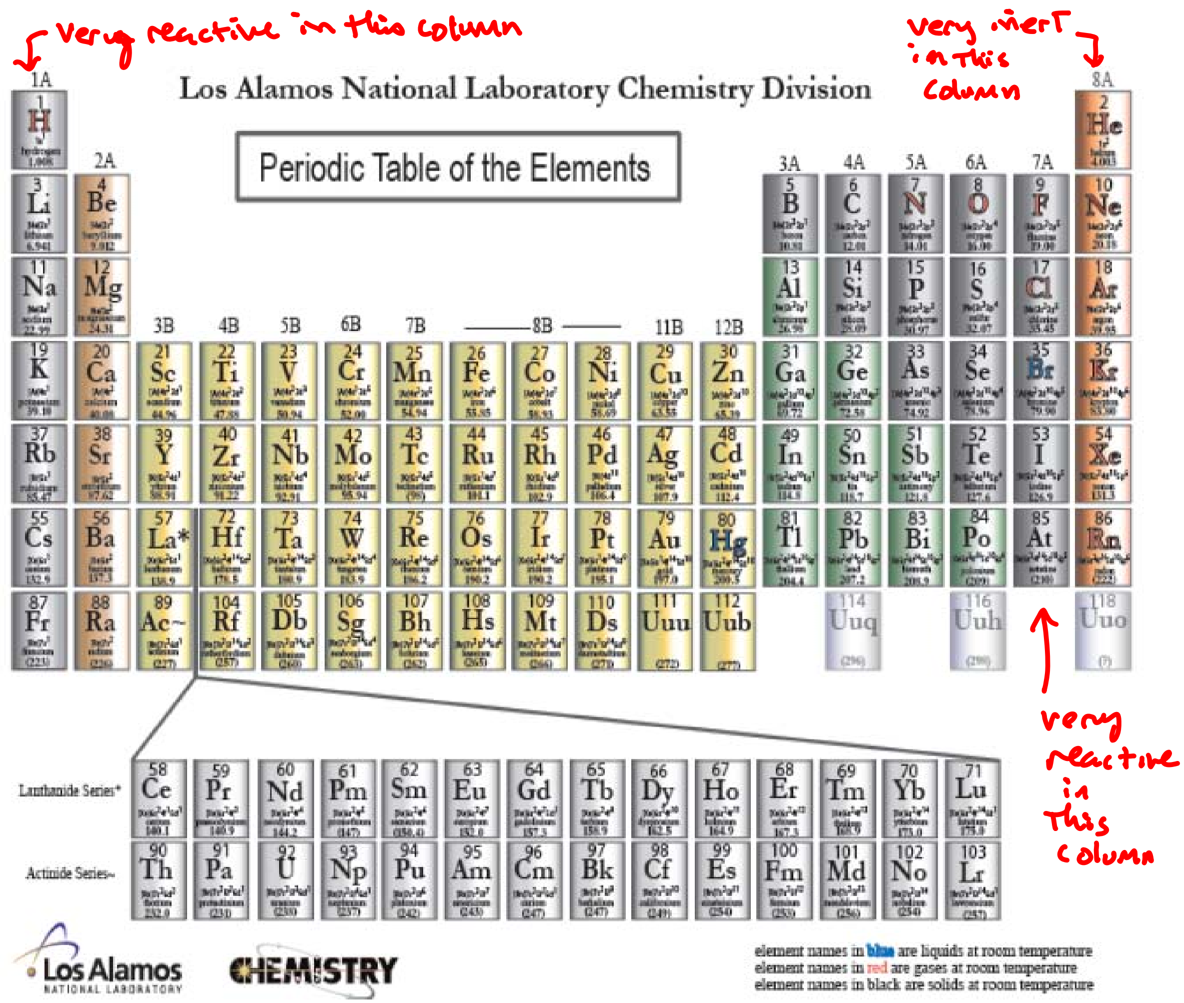
Integer spin $\rightarrow$ Bosons
Bose-Einstein statistics

half-integer spin $\rightarrow$ Fermions
e, proton, neutron

"outer" electrons most important in determining size + chemical characteristics of atom


e⁻
TRANSFERRED
Zp
z e⁻
Sodium = Na
Z'p
Z'e⁻
chlorine = Cl
net + charge
Ionic Bond
Zp
(z - 1) e
Z'p
(z' + 1) e⁻
net "-" charge

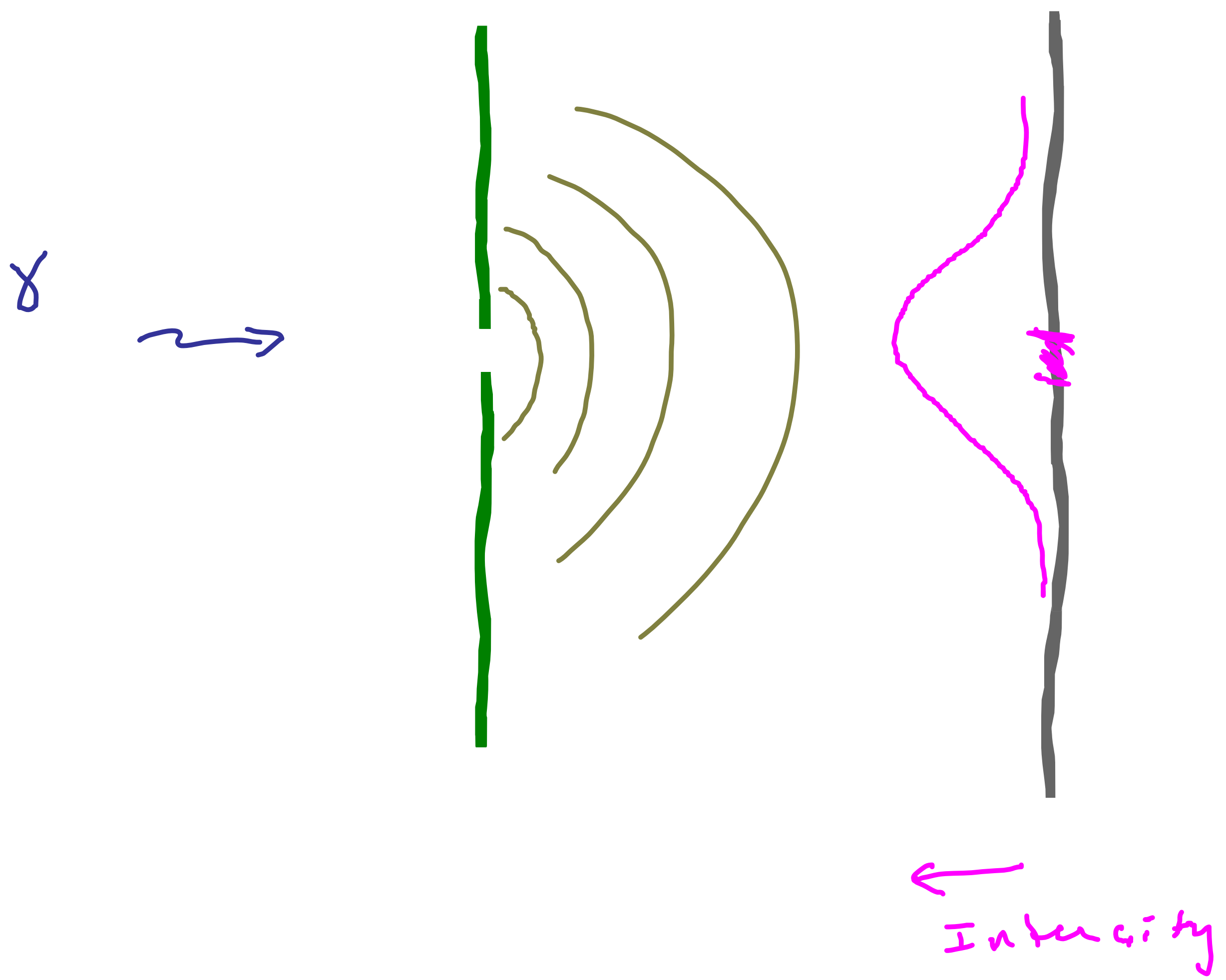

- charge
+
- charge
+
Covalent Bond
- charge
e⁻ e⁻
+
+

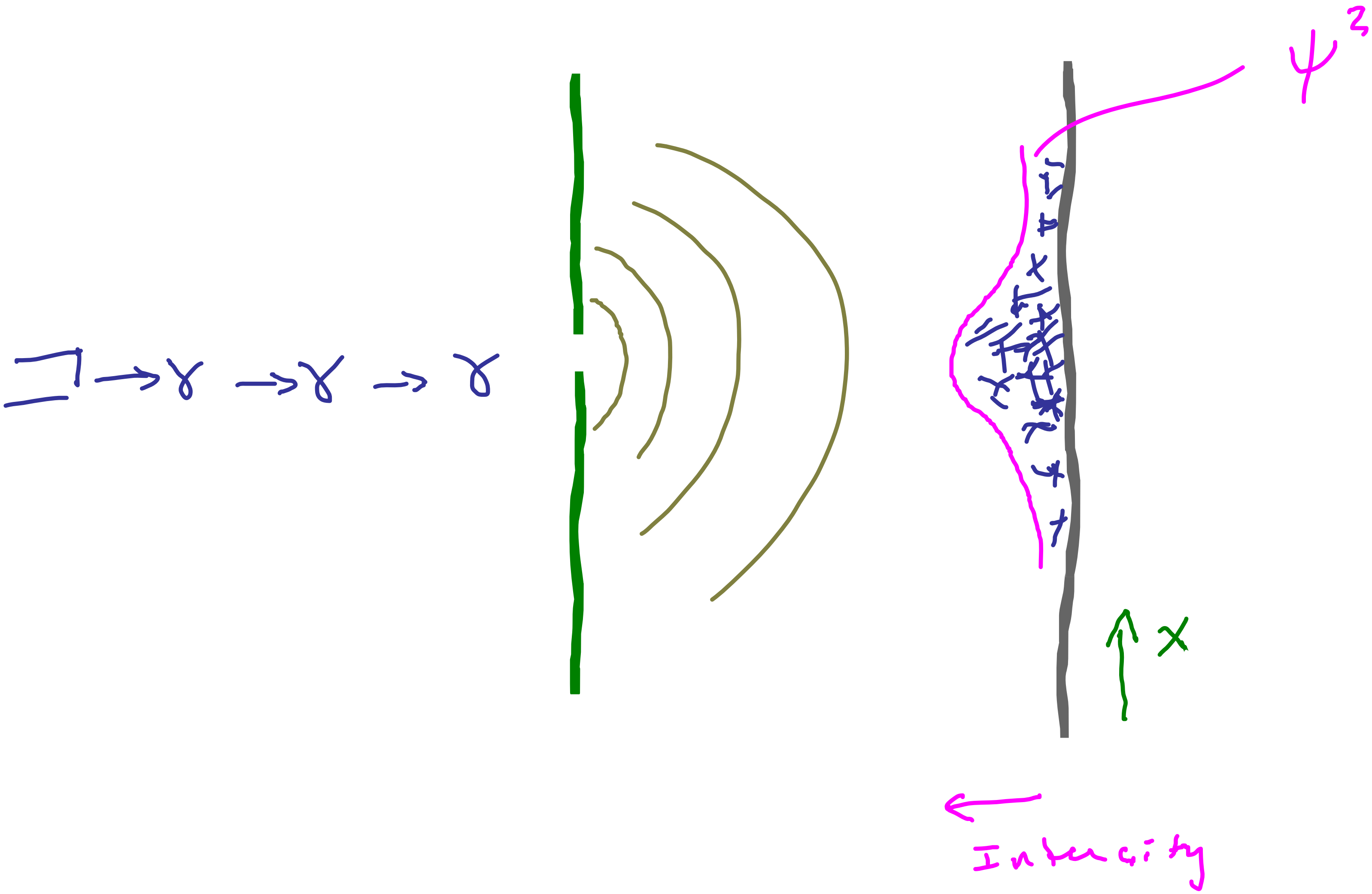

very reactive in this column
very inert in this column
very reactive in this column
Los Alamos National Laboratory Chemistry Division
Periodic Table of the Elements
Lanthanide Series*
Actinide Series~
element names in blue are liquids at room temperature
element names in red are gases at room temperature
element names in black are solids at room temperature
Los Alamos NATIONAL LABORATORY
CHEMISTRY

Max Born German (1882-1970)

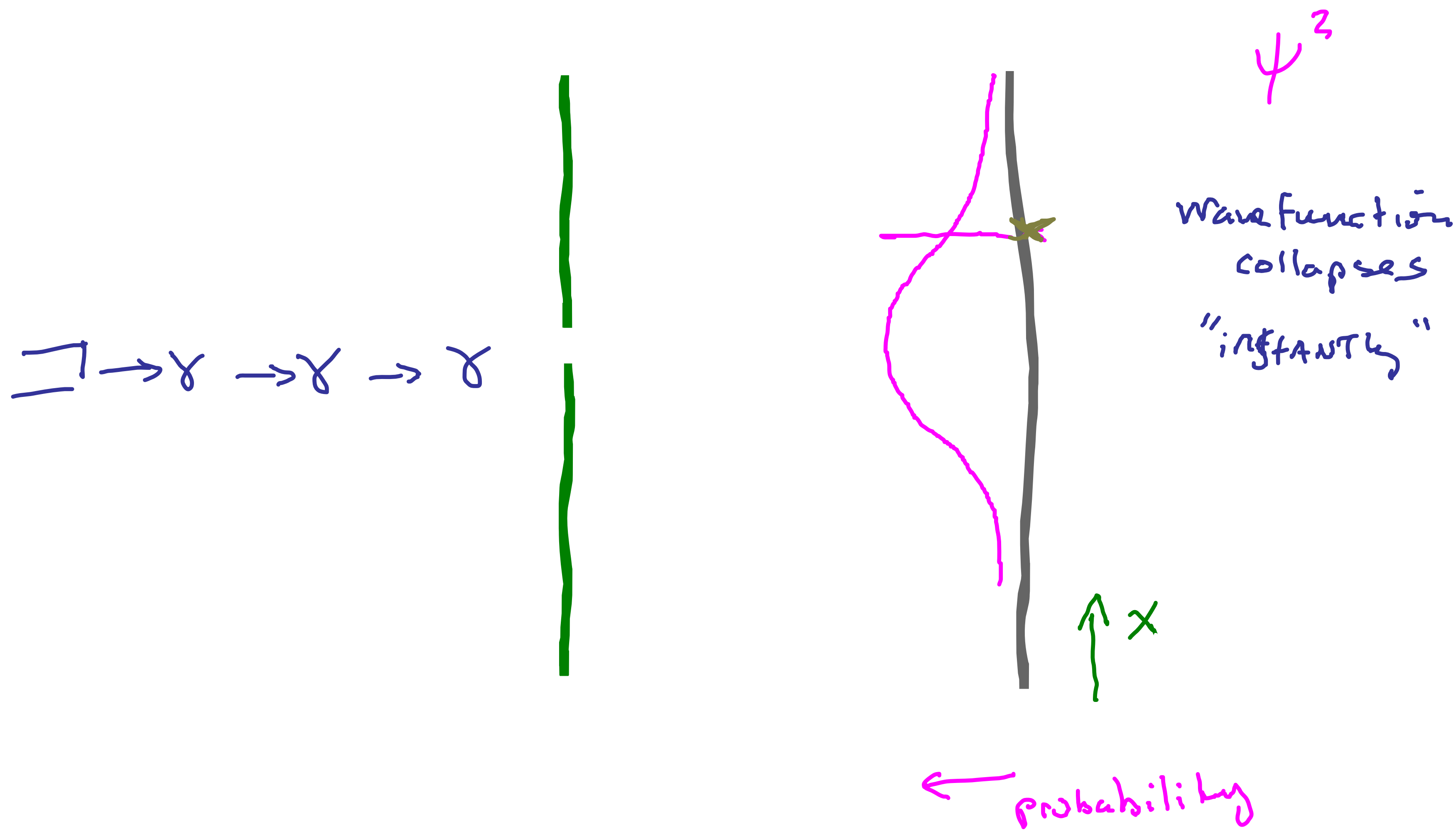
$\psi_{(x)}$ wave function

$\psi^2_{(x)}$ ~ probability of finding the particle in that STATE

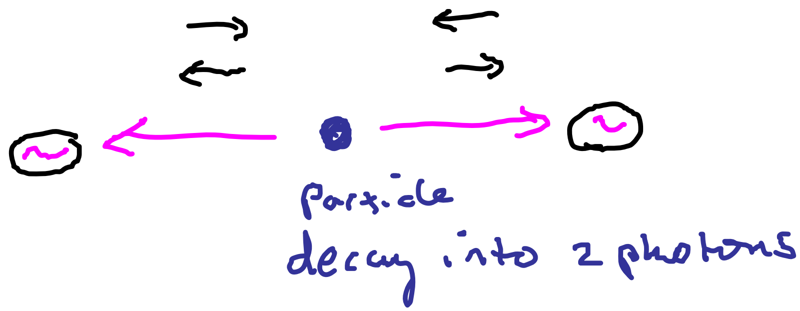

γ
I
Intensity



ψ^2
x
Intensity



γ γ γ
ψ^2
wavefunction collapses "instantly"
x
probability


particle
decay into 2 photons