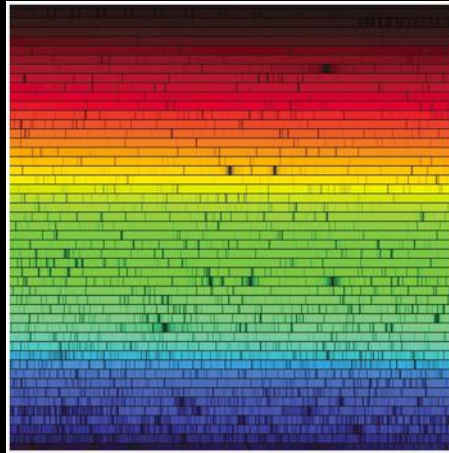
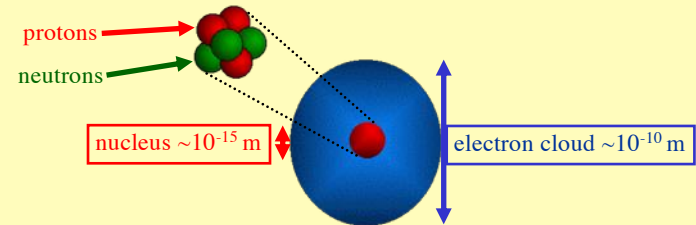


Atoms & Spectra



Atoms

- matter is composed of *atoms*
- contain a *nucleus* of positive *protons* & neutral *neutrons* surrounded by negative *electron* “cloud”



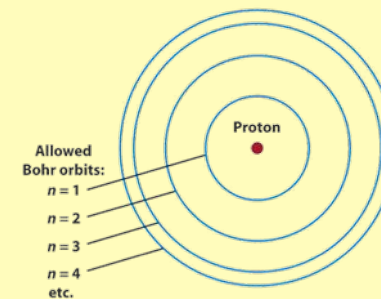
- number of *protons* determines *physical properties* (*ie*) *determines which element we have*

- *H* and *He* make up ~99% of all matter

Periodic Table of the Elements																		2					
1 H Hydrogen																	2 He Helium						
3 Li Lithium	4 Be Beryllium																	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium																	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton						
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon						
55 Cs Cesium	56 Ba Barium	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	72 Hf Hafnium						
73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon										
87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium								

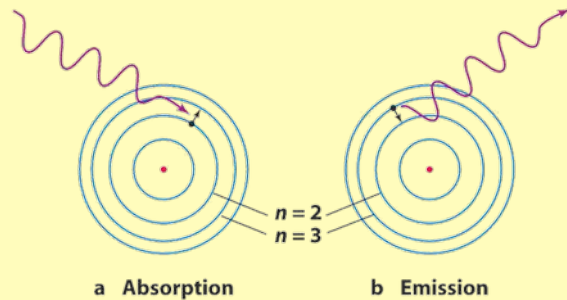
- *molecules* have two or more atoms (*eg*) O_2 , H_2O
- *molecules'* properties can *differ* from constituents

The H Atom



- *electrons* only occupy certain “orbits” (“rungs”)
- their orbits *equate* to *specific energies*
- *want* to be *closest* to *nucleus* (*lowest energy orbit*)

- **transitions**: electron movement **between orbits**
- atom **absorbs** energy: electron moves **outward**
- atom **emits** energy: electron moves **inward**
- **absorption/emission** only at **specific wavelengths**



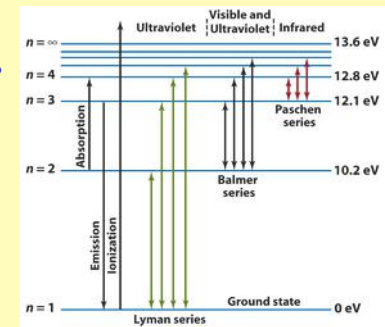
- atoms typically **neutral** (# protons = # electrons)
- if an atom **gains/loses electron(s)** becomes an **ion**

Q: electron in H atom absorbs >13.6 eV & escapes, resulting in...?

Q: Which **Balmer** transition is most likely to emit UV? Why?

CLICKER: electrons moving from $n=3$ to $n=2$...

(a) absorb UV (b) absorb visible (c) absorb infrared
(d) emit UV (e) emit visible (f) emit infrared (g) are ionized



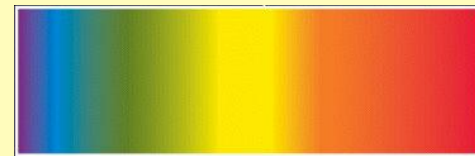
Types of Spectra

- **emission line**, **continuous**, **absorption line**
- **emission line**: from a **hot, low density gas**
- source **emits** light only at **certain wavelengths**



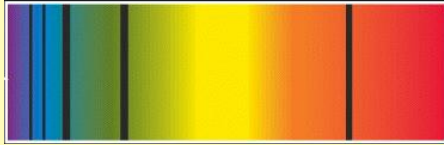
(eg) neon signs, sodium street lamps, aurora

- **continuous**: from a **hot, high density gas OR a glowing solid**
- source emits at **all wavelengths** (but **not** equally!)



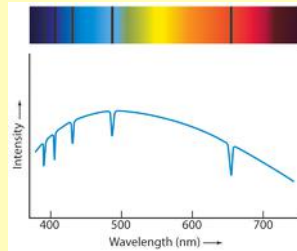
(eg) light bulb filaments, heated metal

- **absorption line:** from a *hot, high density gas* surrounded by a *cooler, low density gas*

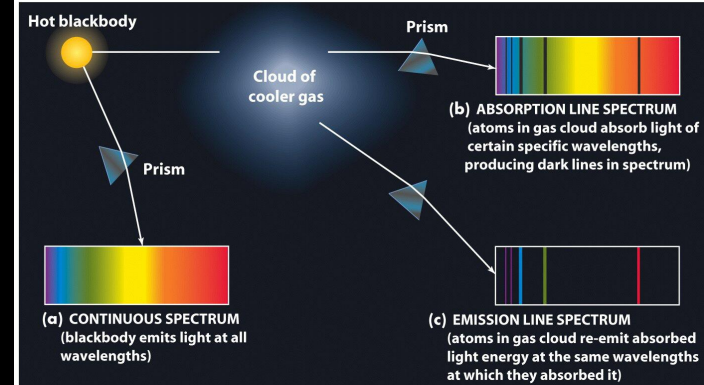
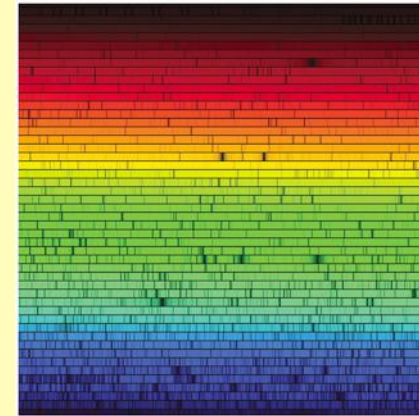


- *high density gas emits at all wavelengths*; cooler low density gas between source & observer absorbs *some* light at *specific* energies

(eg) stars



Solar Spectrum



- *absorption & emission lines come from electron transitions within atoms and molecules*

- *every atom or molecule has a unique spectral signature*

