Announcements

To join clicker to class today (Clickers with LCD display joins automatically):

- Turn on the Clicker (the red LED comes on).
- Push "Join" button followed by "20" followed by the "Send" button (switches to flashing green LED if successful).

- Quiz tomorrow on everything covered in lecture and discussion last week.
- A new suggested reading and problems has been sent out and posted.

" If you are not getting class e-mails sign yourself up using the link to the e-mail discussion list on the class web site.

" Lab this week is a couple of worksheets and if time checkin.

" Lab next week is *Line Spectra and Significant Digits*. THERE IS A PRELAB YOU MUST HAVE COMPLETED WHEN YOU COME TO LAB NEXT WEEK. Watch for the lab handout on the e-mail discussion list or download it from the class web site.

Review

- Wave particle duality.
- Quantum model of the atom. ns, np, nd, nf orbitals (n = 1, 2, 3, ...)
- Higher numbered shells (n-levels) are higher energy because they are farther from the nucleus on average.

S orbital

p_x, p_y, and p_z orbitals

Review

- Pauli exclusion principle and how to read the ground state electronic configuration from the periodic table.
  - At most two electrons of opposite spin in each orbital.
  - Extra stability of half-full and full d leads to moving electron from s to d. Cr: $[Ar]3d^{5}4s^{1}$ and Cu:$[Ar]3d^{10}4s^{1}$.
  - f-Block filling order varies.
  - More practice in lab this week + electronic configuration of ions.

Review

" In a multi-electron atom electrons in lower shells also shield or screen the electrons which are farther out.

Farther out electrons see a smaller effective nuclear charge (sometimes called Z_{eff}).

Within a shell the probability of electrons being near the nucleus goes in the following order s > p > d > f > g.

Orbitals that penetrate more see a larger Z_{eff} and are lower energy, making s fill before p, which fills before d, etc...

First Ionization Energies

Chang Fig. 8.9

Sequential Ionization Energies

Z	element	The First Eleven Ionization Energies of the Elements (J x 10^{18}) 3s, 2p, 2s, 1s.										
1	H	2.18										
2	He	3.94	8.72									
3	Li	0.86	12.1	20.								
4	Be	1.49	2.92	25.	35.							
5	B	1.33	4.03	6.08	41.	54.						
6	C	1.80	3.90	7.67	10.3	63.	78.					
7	N	2.33	4.75	7.61	12.4	15.6	88.	107.				
8	O	2.18	5.62	8.80	12.4	18.2	22.1	118.				
9	F	2.79	5.60	10.0	14.0	18.3	25.2	29.7	N/A	N/A		
10	Ne	3.46	6.56	10.2	15.6	20.2	25.3	33.2	N/A	N/A	N/A	
11	Na	0.82	7.57	11.4	15.8	22.1	27.5	33.4	42.3	48.0	234.	264.

Atomic Radius

Chang Fig. 8.5

Common Ions Formed

Chang Fig. 2.10

Nuclear Chemistry or Radiochemistry

" Mass spectrometry
" Isotopes
" Writing Nuclear Reactions
" Fusion (How the Universe developed the elements it has)
" Nuclear binding energy & band of stability (why only some elements and isotopes are common)
" Natural Radioactivity
" Biological effects of radioactivity
" Transmutation
" Uses of Isotopes

Mass Spectrometer

Chang figure 3.3

Isotopes of H

Chang Marginal Figure section 2.3

Fusion of Hydrogen

"This is a multistep process

Step 1: $2\ {}^{1}_{1}H \longrightarrow {}^{2}_{1}H + {}^{0}_{1}e$ (positron)

Step 2 : ${}^{1}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}He$

Step 3: $2\ {}^{3}_{2}He \longrightarrow {}^{4}_{2}He + 2\ {}^{1}_{1}H$

- Note need 2 of steps 1 and 2 to generate enough He for the last step.
- positrons eventually collide with ${}^{0}_{-1}e$ (electrons) destroying each other to produce energy in the form of gamma (ϒ) rays.

"You do not need to know this just be able to understand equations.

Fusion of Heavier Elements in Larger Stars

- ${}^{2}_{1}H + {}^{4}_{2}\alpha$--> ${}^{6}_{3}Li$ (stable isotope)
- 2 ${}^{4}_{2}\alpha$ --> ${}^{8}_{4}Be$ (but rapidly decays...)
- Still may see ${}^{8}_{4}Be + {}^{4}_{2}\alpha$ --> ${}^{12}_{6}C$ (stable)
- More collisions ---> heavier nuclei.
- Dense Centers of large stars kinetic energy of hot nuclei can overcome electrostatic repulsion to fuse nuclei up to ${}^{56}_{26}Fe$.
- Cannot go any farther with fusion.