

# Announcements

Monday, February 02, 2009

- Ch 3 MC due Wed, Feb 4.
- Ch 4 MC due Wed, Feb 11.

**Experiment 2** in lab this week. Have the prelab done before you come to lab!

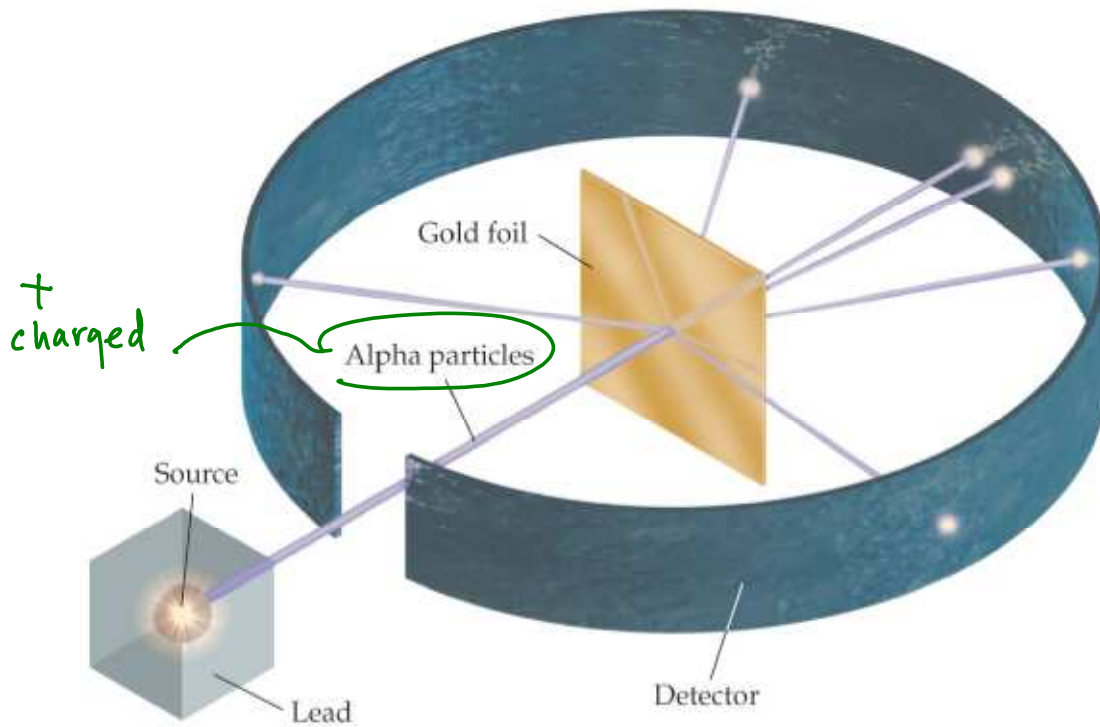
If you're having trouble:

- See me during my office hours
- See a tutor in the academic support center - bring a problem you're having trouble with
- Work with a friend or study group
- Post a question to the D2L discussions

# Discovery of the nucleus

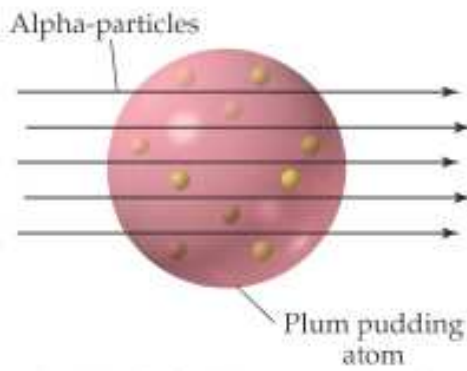
Rutherford

Gold foil experiment: to test plum pudding model

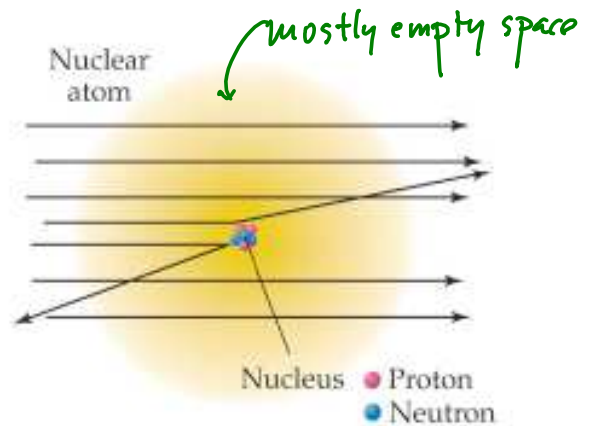


Expected: alpha particles to fly straight through foil

Actually: most went straight through, but some were strongly deflected.



(a) Rutherford's expected result



(b) Rutherford's actual result

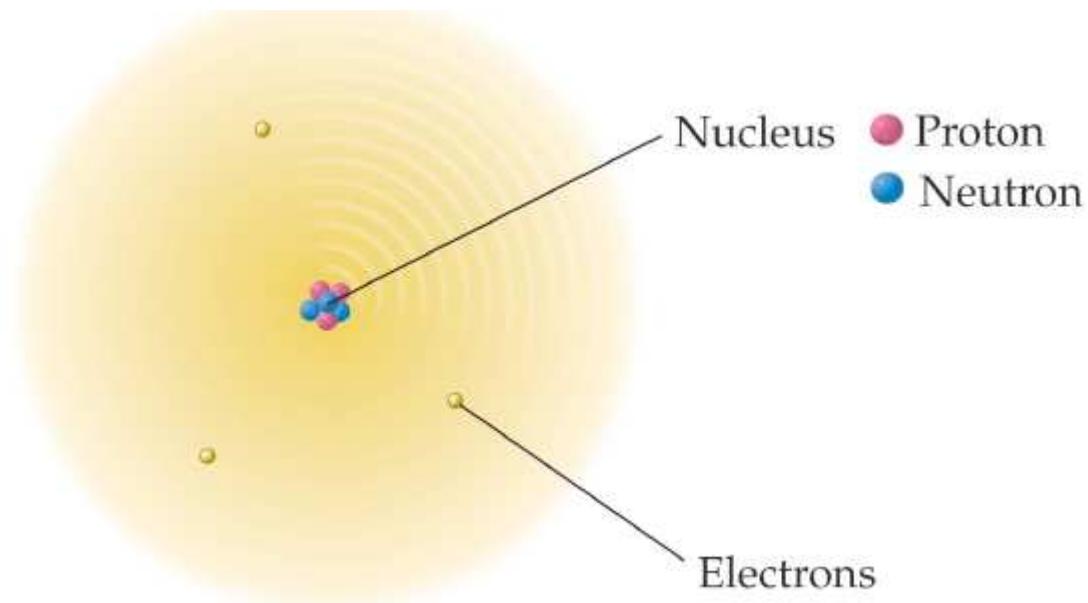
## Modern nuclear model of the atom

### Conclusions:

- Atoms are mostly empty space
- Atoms must contain a dense positively-charged core that is small but massive

**Nucleus:** Rutherford's name for the (+)-charged core of the atom

### Modern model of the atom:



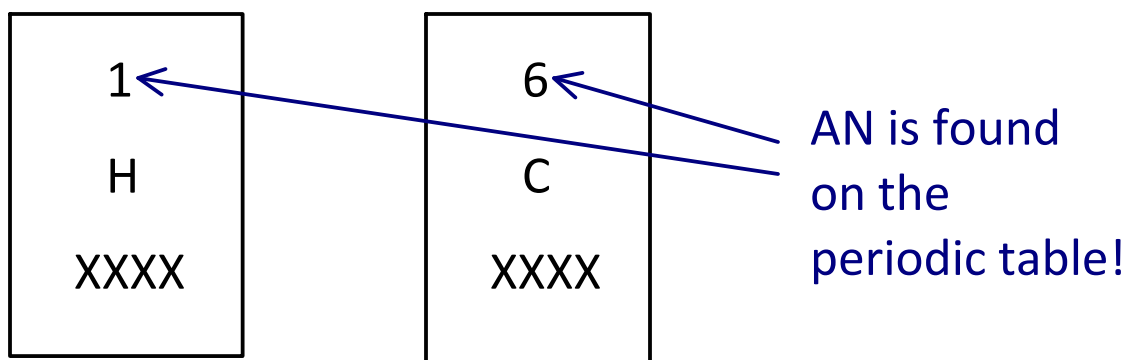
### 3 subatomic particles:

<u>charge</u>		
+	protons	$p^+$
0	neutrons	$n^0$
-	electrons	$e^-$

## Elements

The number of protons determines which element an atom is.

Atomic number (AN) = # p<sup>+</sup> in nucleus



Hydrogen has 1 protons in its nucleus.

Carbon has 6 protons in its nucleus.

## Periodic table

Dimitri Mendeleev discovered that elements with similar properties are found every 8 elements when put in order of atomic number.



He, Ne, and Ar are all unreactive gases (atomic numbers 2, 10, and 18)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar	K	Ca

Elements with similar properties recur in a regular pattern.

### A Simple Periodic Table

1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca						

Elements with similar properties fall into columns.

### Periodic table:

- Columns = groups or families (18 groups)
- Rows = periods (7)

# Sections of periodic table

Main group      row numeral, "A" in group #

Transition elements      "B"

Inner transition elements      below rest of table

**Metals:**      heat & conduct electricity, malleable, ductile  
shiny solids (except Hg)

**Nonmetals:**      dull brittle solids or gases  
insulators (electrical & heat)

**Metalloids:**      combination of properties

Si, Ge : semiconductors

V.e<sup>-</sup>: 1 2      3 4 5 6 7 8

Group #'s

### Periodic Table of the Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII B	VIII B	VIII B	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA	
1 H 1.008												B 10.81	C 12.01	N 14.01	O 16.00	F 19.00	He 4.003	
2 Li 6.939	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	
3 Na 22.99	4 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95	
4 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80	
5 Rb 85.47	38 Sr 87.62		39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.96	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
6 Cs 132.91	56 Ba 137.33	57-70 *	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7 Fr (223)	88 Ra (226)	89-103 **	103 Lr (257)	104 Rf (261)	105 Db (262)	106 Sg (271)	107 Bh (272)	108 Hs (270)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Uuh (292)	117 Uuq (294)	118 Uuo (294)
			57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (147)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04		
			89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)		

inner trans. elements

Reference: <http://www.webelements.com>

Fe : transition metal      Se : main group nonmetal

Some important groups (columns)

IA: alkali metals  $\text{Li, Na, K, ...}$   
all reactive with water.

IIA: alkaline earth metals

burn w/ bright white flame

VIIA: halogens

$\text{F}_2$  &  $\text{Cl}_2$  (gas)  $\text{F}-\text{F}$

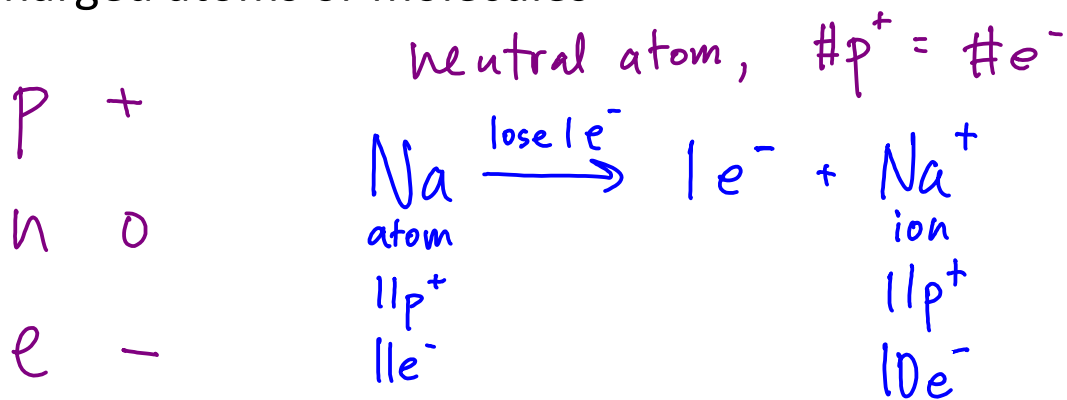
$\text{Br}_2$  (liquid)

$\text{I}_2$  (solid)

VIIIA: noble gases unreactive (inert) gases

# Ions

**Ions:** charged atoms or molecules



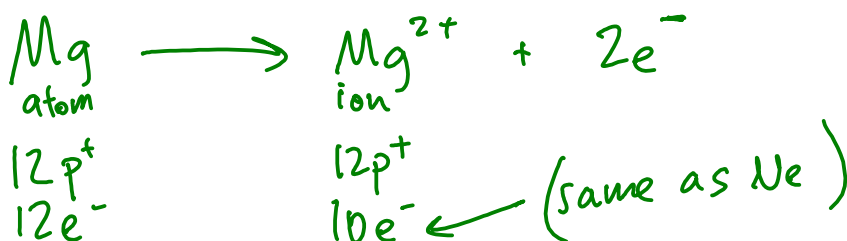
Stable <sup>main group</sup> ions have the same # electrons as the...  
^  
nearest noble gas.

**Valence electrons:** outermost electrons  
responsible for reactivity

# v.e. same as group # (roman numeral)

Main-group metals: lose their valence electrons to form positive stable ions

	<u>IA</u>	<u>IIA</u>	<u>IIIA</u>
stable:	Li <sup>+</sup>	Be <sup>2+</sup>	
ions:	Na <sup>+</sup>	Mg <sup>2+</sup>	Al <sup>3+</sup>
	K <sup>+</sup>	Ca <sup>2+</sup>	Ga <sup>3+</sup>





# Ions

Metallic elements are... neutral on periodic table

Metals in compounds are... + stable ions

Nonmetals: gain  $e^-$  to form stable ions

Ve:	5	6	7	8
	<u>VA</u>	<u>VIA</u>	<u>VIIA</u>	VIIIA
	$N^{3-}$	$O^{2-}$	$F^-$	noble gases
	$P^{3-}$	$S^{2-}$	$Cl^-$	
		$Se^{2-}$	$Br^-$	
			$I^-$	

