

Previously in Molecularity...

Blocks in the periodic table

1	H	Hydrogen 1.008																			2	He	Helium 4.003																														
3	Li	Lithium 6.941	4	Be	Boron 9.012																	10	Ne	Neon 20.180																													
11	Na	Sodium 22.990	12	Mg	Magnesium 24.305																	18	Ar	Argon 39.948																													
19	K	Potassium 39.098	20	Ca	Sodium 39.078	21	Sc	Titanium 44.956	22	Ti	Lithium 47.88	23	V	Manganese 50.942	24	Cr	Chromium 51.986	25	Mn	Manganese 54.938	26	Fe	Iron 55.933	27	Co	Cobalt 58.933	28	Ni	Nickel 58.693	29	Cu	Copper 63.546	30	Zn	Zinc 65.39	31	Ga	Gallium 69.732	32	Ge	Silicon 72.61	33	As	Phosphorus 30.974	34	S	Sulfur 32.066	35	Cl	Chlorine 35.453	36	Kr	Krypton 84.80
37	Rb	Rubidium 84.468	38	Sr	Sodium 87.62	39	Y	Yttrium 88.906	40	Zr	Zirconium 91.224	41	Nb	Niobium 92.908	42	Mo	Molybdenum 95.94	43	Tc	Technetium 98.00	44	Ru	Ruthenium 101.00	45	Rh	Rhodium 102.908	46	Pd	Palladium 106.42	47	Ag	Silver 107.888	48	Cd	Cadmium 112.411	49	In	Inidium 114.818	50	Sn	Tin 118.71	51	Sb	Antimony 121.780	52	Te	Tellurium 127.6	53	I	Iodine 126.904	54	Xe	Xenon 131.29
55	Cs	Cesium 132.905	56	Ba	Boron 137.327	57-71	Hf	Hafnium 178.49	72	Ta	Tantalum 180.948	73	W	Tungsten 183.85	74	Re	Rhenium 186.207	75	Os	Osmium 190.23	76	Ir	Iridium 192.22	77	Pt	Palladium 195.08	78	Au	Gold 196.967	79	Hg	Mercury 200.59	80	Tl	Thallium 204.383	81	Pb	Lead 207.2	82	Bi	Bismuth 208.980	83	Po	Potassium [208.982]	84	At	Astatine 209.987	85	Rn	Radon 222.018			
87	Fr	Francium 223.020	88	Ra	Radium 226.025	89-103	Rf	Rutherfordium [261]	104	Db	Dubnium [262]	105	Sg	Sesquibismuth [263]	106	Bh	Bohrium [264]	107	Hs	Hassium [269]	108	Mt	Mollibdenum [268]	109	Ds	Darmstadtium [269]	110	Rg	Roentgenium [272]	111	Cn	Copernicium [277]	112	Uut	Ununtrium unknown	113	Fl	Flerovium [289]	114	Uup	Ununpentium unknown	115	Lv	Livermorium [298]	116	Uus	Ununseptium unknown	117	Uuo	Ununoctium unknown	118		
55-57	La	Lanthanum 138.906	58	Ce	Cerium 140.115	59	Pr	Praseodymium 140.908	60	Nd	Neodymium 144.24	61	Pm	Promethium 144.913	62	Sm	Samarium 150.36	63	Eu	Europium 151.983	64	Gd	Godolinium 157.25	65	Tb	Terbium 158.925	66	Dy	Dysprosium 182.50	67	Ho	Holmium 164.930	68	Er	Erbium 187.28	69	Tm	Thulium 169.904	70	Yb	Ytterbium 173.04	71	Lu	Lutetium 174.967									
85-89	Ac	Actinium 227.028	90	Th	Thorium 232.038	91	Pa	Protactinium 231.036	92	U	Uranium 238.028	93	Np	Neptunium 237.048	94	Pu	Plutonium 244.064	95	Am	Americium 243.061	96	Cm	Curium 247.070	97	Bk	Berkelium 247.070	98	Cf	Californium 251.080	99	Es	Einsteinium [254]	100	Fm	Fermium [257.085]	101	Md	Mendelevium [258.1]	102	No	Nobelium [259.101]	103	Lr	Lawrencium [262]									



- Given an element, can you give its e⁻ config? (will only ask through Ba)
 - Do you understand the exceptions?

Fredrich Hund

upload.wikimedia.org
Hund%2CFriedrich_1920er_Göttingen.jpg

A photograph of a silver fork standing upright in a field of lavender flowers. The fork's tines are pointing downwards and to the left. The background is a dense field of lavender, with a few green leaves visible above the fork. The lighting suggests it is either morning or late afternoon.

Where are we going today?

Ch1010-A17-A03 Lecture 9

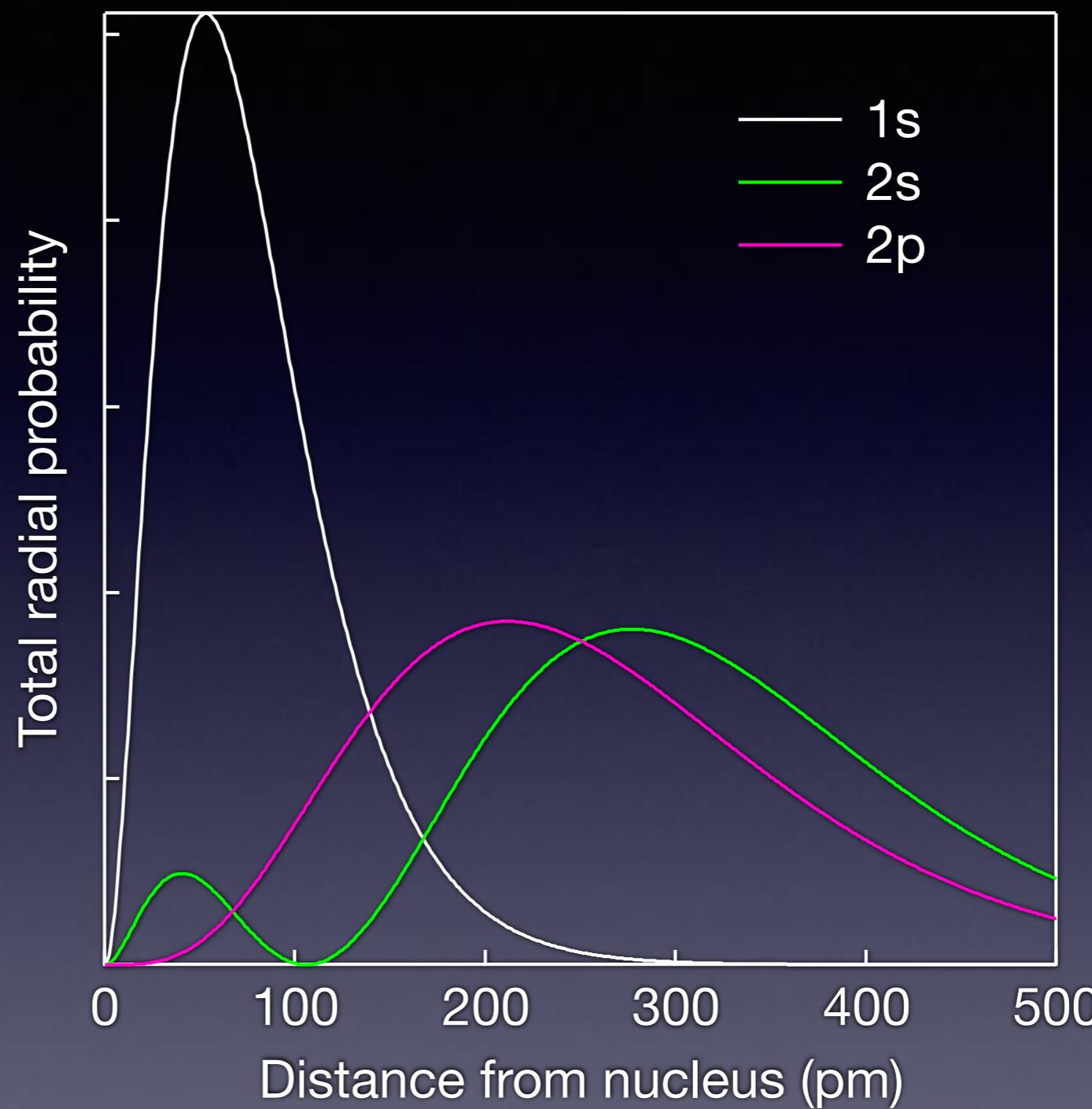
- §3.? Periodic trends in size
- §3.? Ionization Energy
- §3.? Electron Affinity
- §4.4 Electronegativity

Periodic trend in size

Increasing or decreasing?

Increasing or decreasing?

1	H	Hydrogen	1.008
3	Li	Lithium	6.941
11	Na	Sodium	22.990
19	K	Potassium	39.098
37	Rb	Rubidium	84.468
55	Cs	Cesium	132.905
87	Fr	Francium	223.020



What might this tell us about atomic radius?

Now you try...

Order the following atoms in order of increasing atomic radius, and *briefly* explain why.

Aluminum
Boron
Gallium
Indium

Periodic trend in size

Increasing or decreasing?

The periodic table displays the following trends in size:

- Vertical Trends:** Within a group (column), atomic radius decreases from top to bottom due to increasing nuclear charge which pulls the electrons closer. Conversely, ionic radius increases from top to bottom.
- Horizontal Trends:** Across a period (row), atomic radius generally decreases from left to right as the number of protons in the nucleus increases, causing a stronger pull on the valence electrons.
- Diagonal Trends:** Trends in size are less pronounced along the diagonal lines of constant electronegativity or ionization energy.

Increasing or decreasing?

Periodic trend in size

Increasing or decreasing?

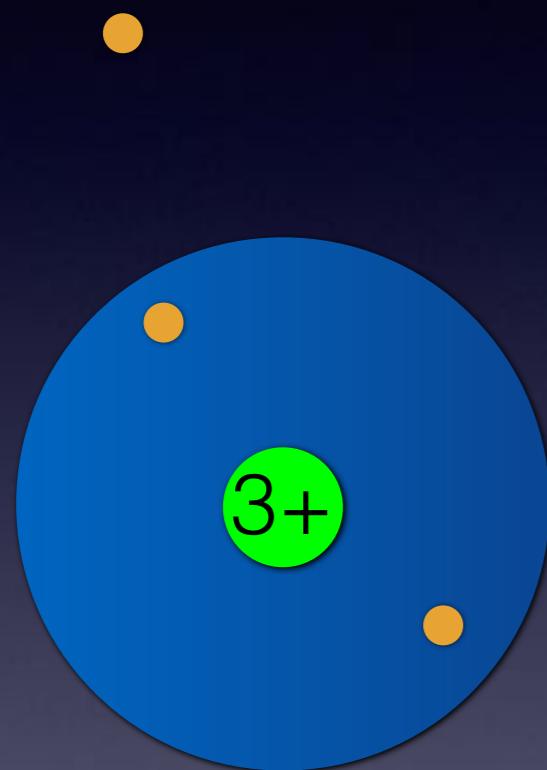
Increasing or decreasing?

Periodic trend in size

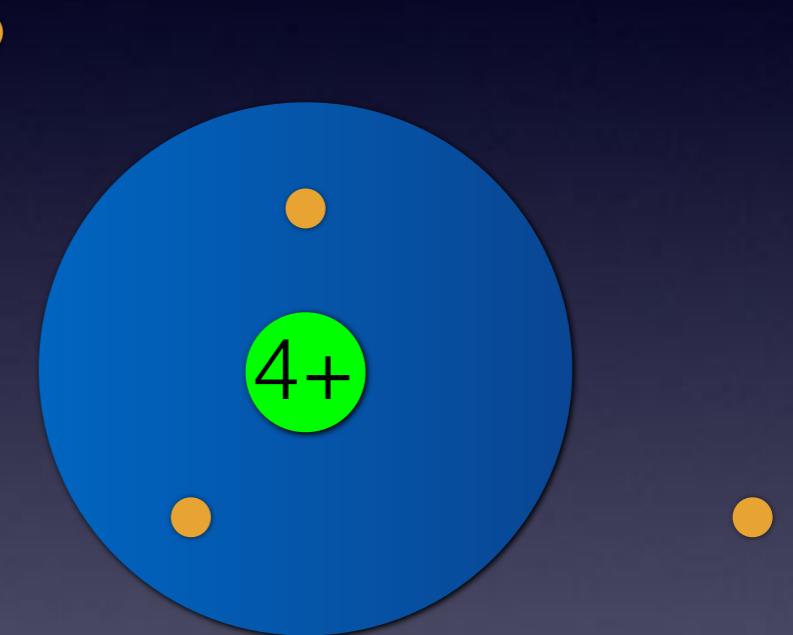
Increasing or decreasing?

Increasing or decreasing?

Screening... consider Li vs Be

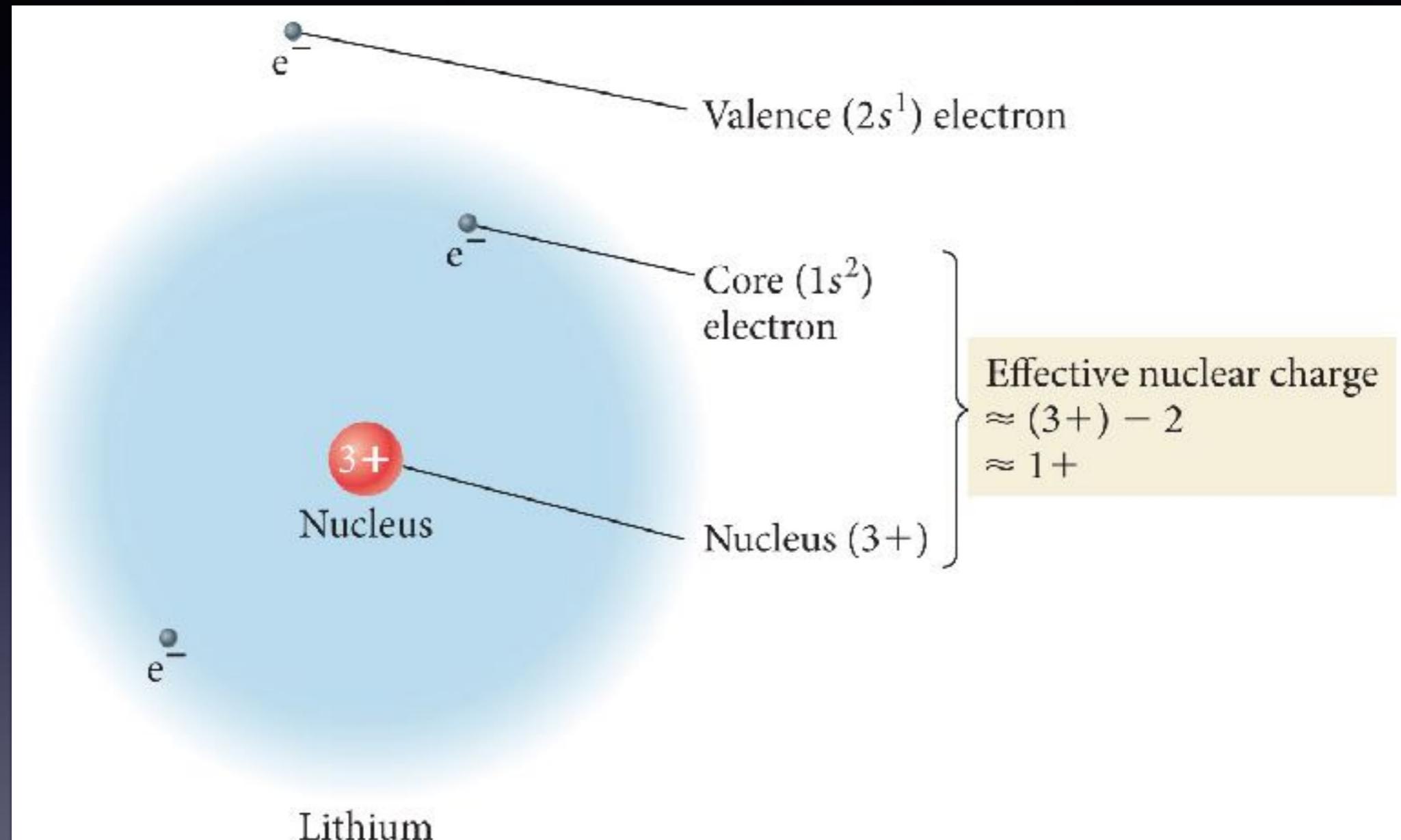


$1s^2 2s^1$



$1s^2 2s^2$

Screening and “effective” nuclear charge

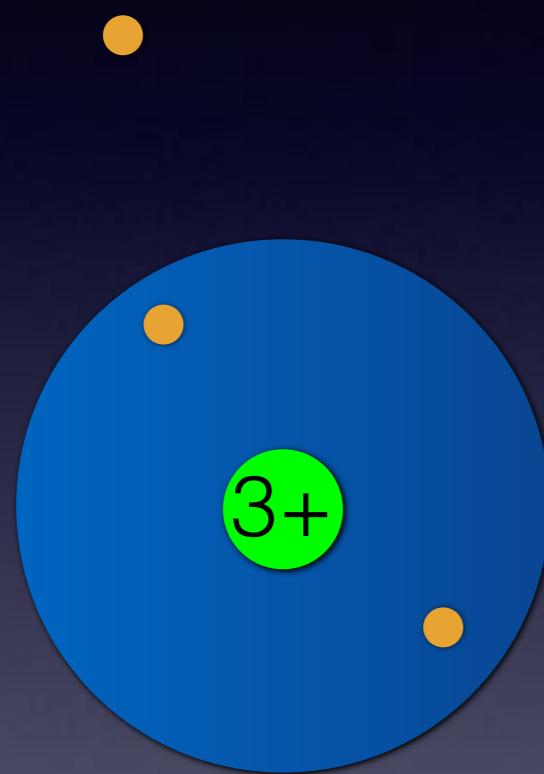


$$\text{Effective nuclear charge} \rightsquigarrow Z_{\text{eff}} = Z - S \rightsquigarrow \text{Actual nuclear charge}$$

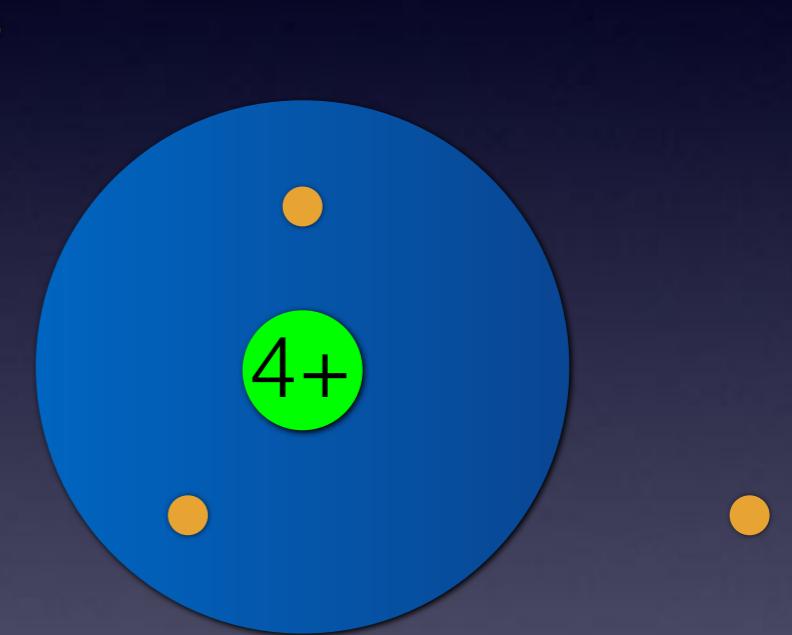
Charge that is screened

$$E = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r}$$

Screening... consider Li vs Be

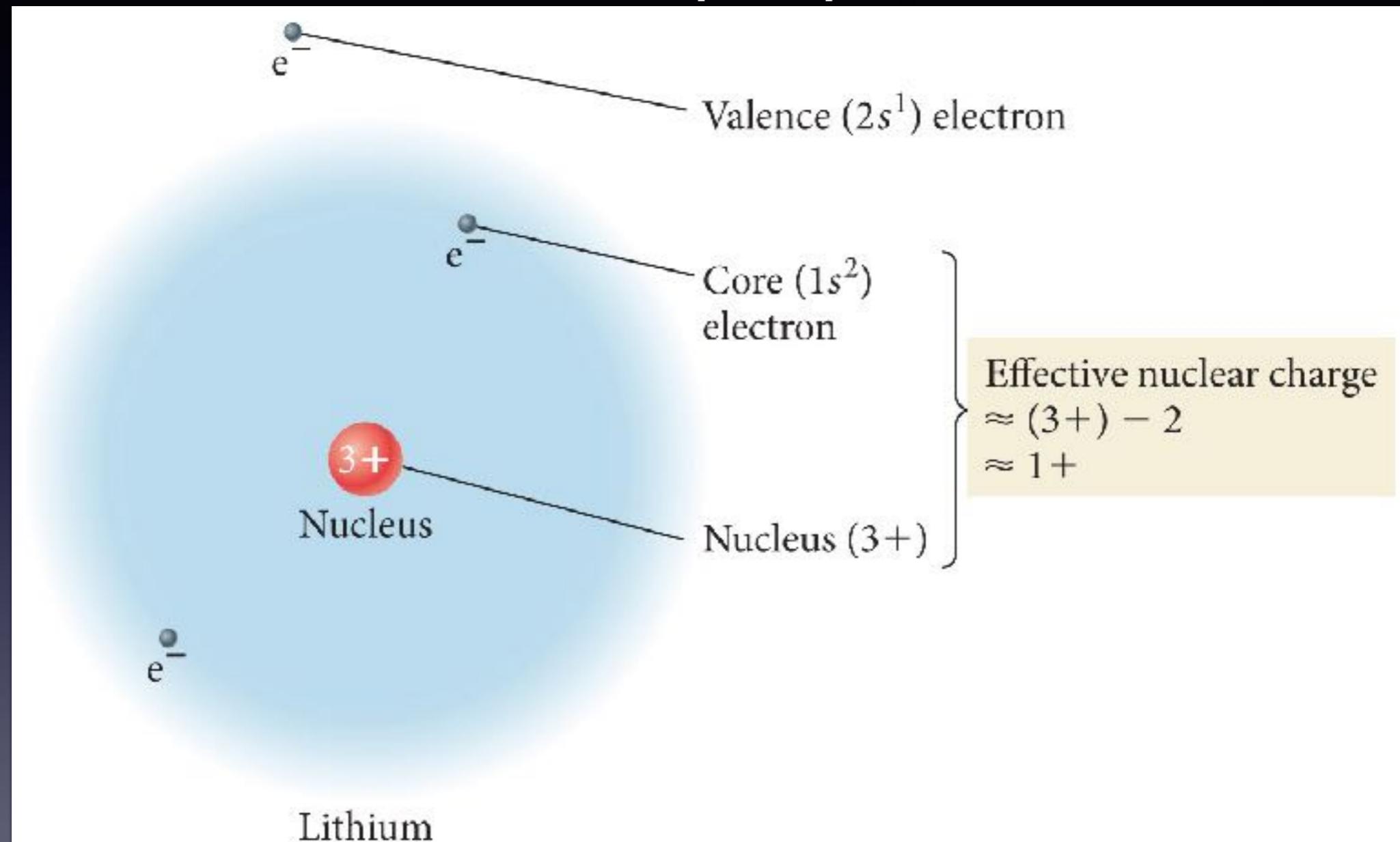


“Last” electron added
feels $Z_{\text{eff}} \sim 1$



“Last” electron added
feels $Z_{\text{eff}} \sim 2$

Minute paper...



Consider the $n = 2$ block (Li, Be, B, C, N, O, F, Ne) 1 atom at a time...
Does adding 1 electron and 1 proton make an atom larger or smaller?

Minute paper...

Consider the $n = 2$ block (Li, Be, B, C, N, O, F, Ne) 1 atom at a time...
Does adding 1 electron and 1 proton make an atom larger or smaller?

Smaller.

Why? Adding 1 electron and 1 proton increases Z by 1 and Z_{eff} by *almost* 1.

$$Z_{\text{eff}} = Z - S$$

$$E = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r}$$

Shielding and atomic radius

	1s	2s	2p		
Carbon					77 pm radius
Nitrogen					
Oxygen					
Fluorine					
Neon					

Shielding and atomic radius

	1s	2s	2p		
Carbon					
Nitrogen					
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Neon					

Shielding and atomic radius

	1s	2s	2p	
Carbon			  	77 pm radius
Nitrogen				70 pm
Oxygen				73 pm
Fluorine				
Neon				

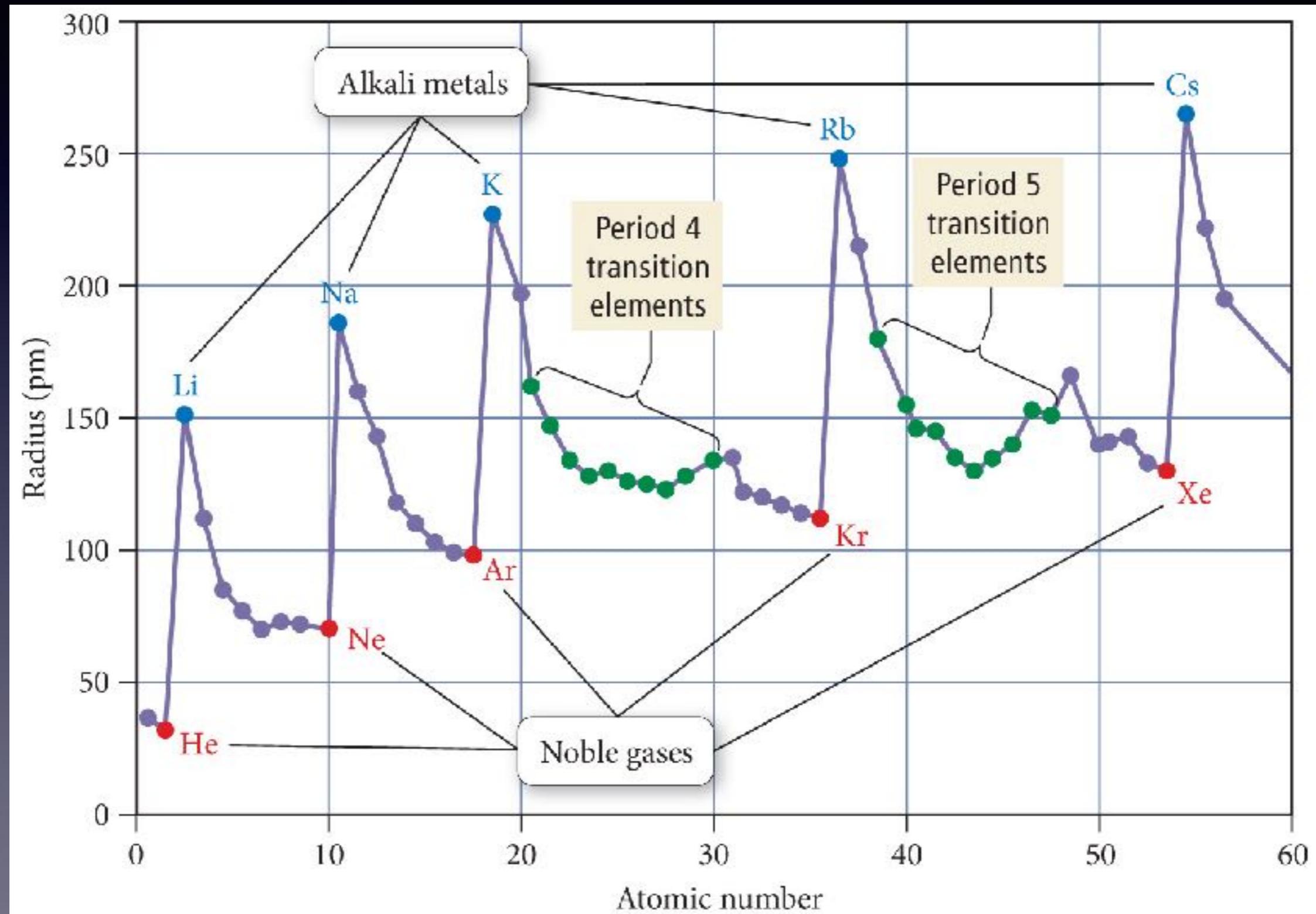
Shielding and atomic radius

	1s	2s	2p	
Carbon			  	77 pm radius
Nitrogen				70 pm
Oxygen				73 pm
Fluorine				72 pm
Neon				

Shielding and atomic radius

	1s	2s	2p	
Carbon			  	77 pm radius
Nitrogen				70 pm
Oxygen				73 pm
Fluorine				72 pm
Neon				70 pm

Periodic trends in atomic radius



Tro
Fig. 8.7

A photograph of a silver fork standing upright in a field of lavender flowers. The fork's tines are pointing downwards, and its handle is pointing upwards. The background is a dense field of lavender, with some green leaves visible at the top left.

Where did we go today?

Ch1010-A17-A03 Lecture 9

- §3.6 Periodic trends in size

Next time...

- §3.7 Ionization Energy
- §3.8 Electron Affinity
- §4.4 Electronegativity