Previously in Molecularity…

Keeping n, l, m_l, and m_s straight…

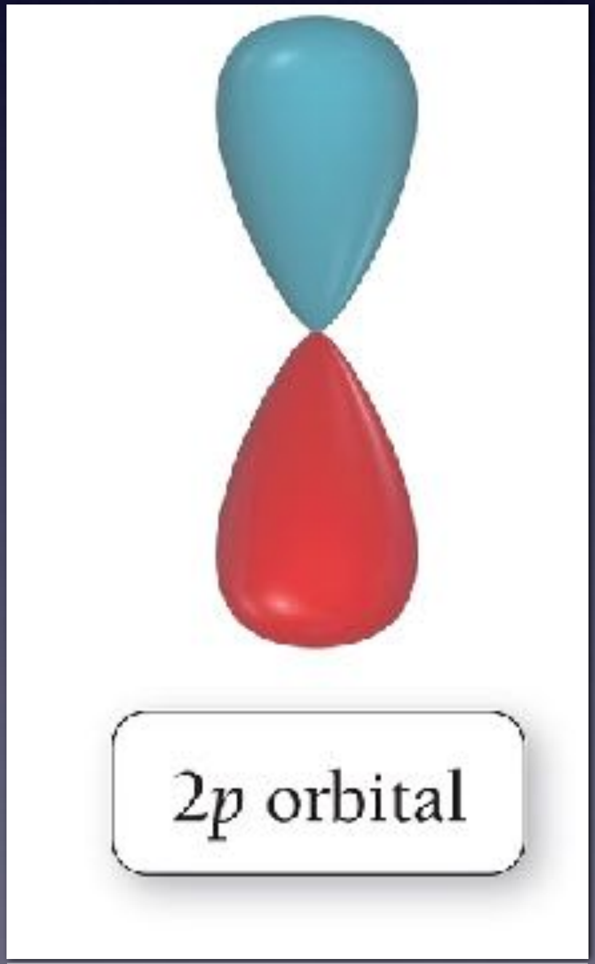
- n is the principal quantum number
  $n = 1, 2, 3, 4, .. , \infty$.

- l is the angular momentum quantum number
  $l = 0, .. , n - 1$.

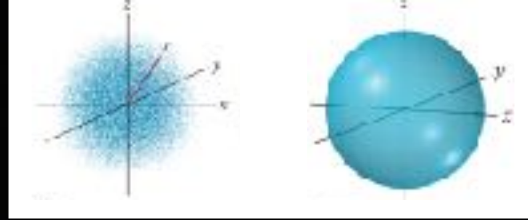
- m_l is the magnetic quantum number
  $m_l = -l, .. , 0, .. , +l$.

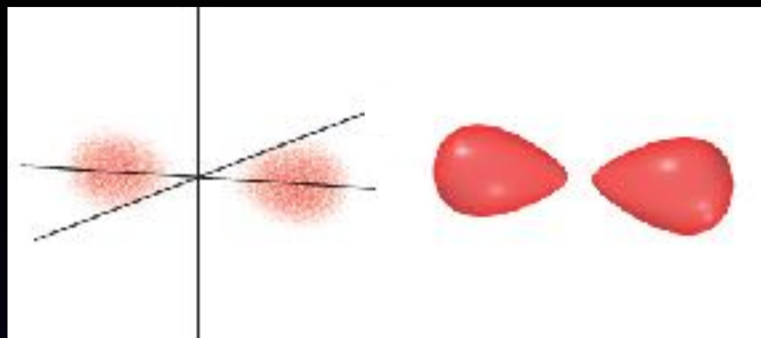
- m_s is the spin quantum number
  $m_s = \pm 1/2$

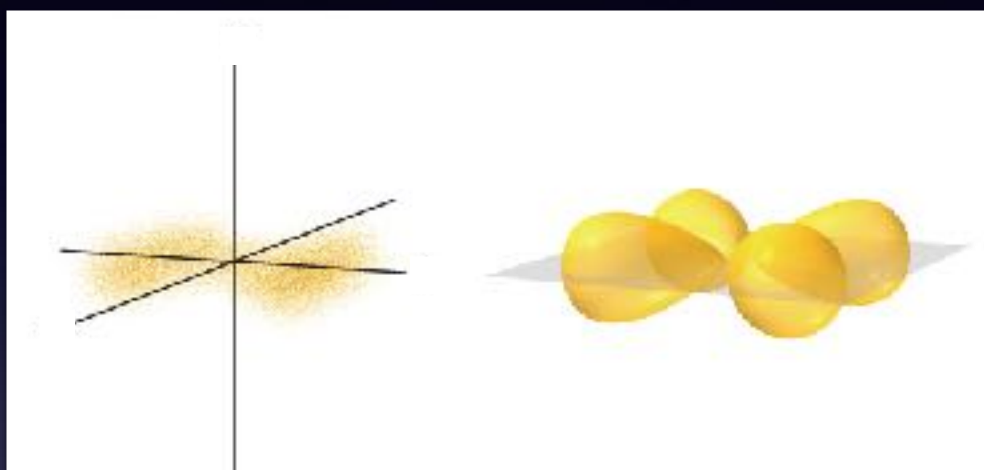
Don't forget phase!

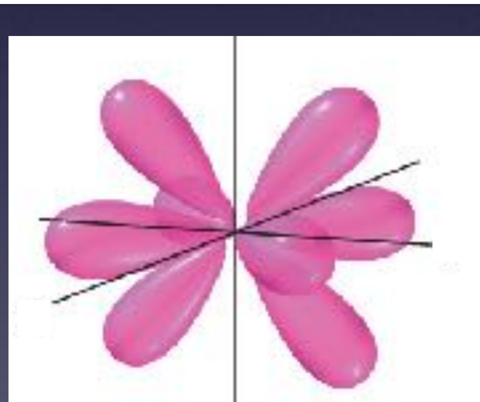


Tro



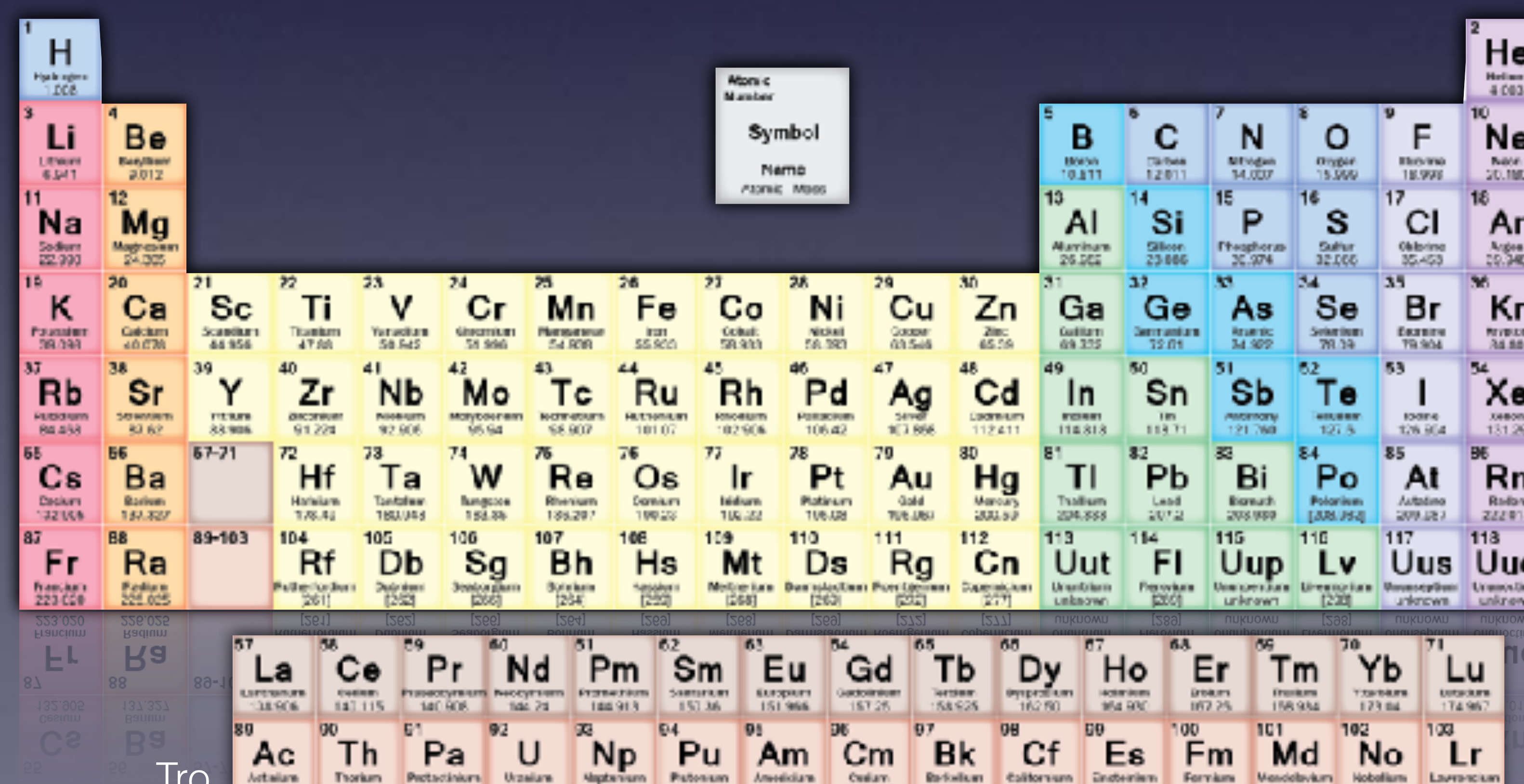






How do we go from here?

To here?



Tro

Where are we going today?

Ch1010-A17-A03 Lecture 7

- das Periodensystem
- §3.3 Filling electrons in orbitals
- §3.3 Orbital filling exceptions

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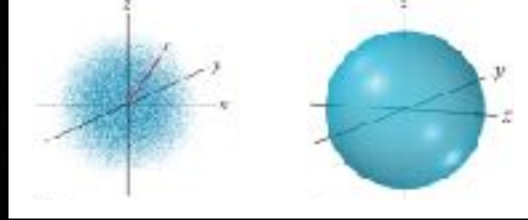
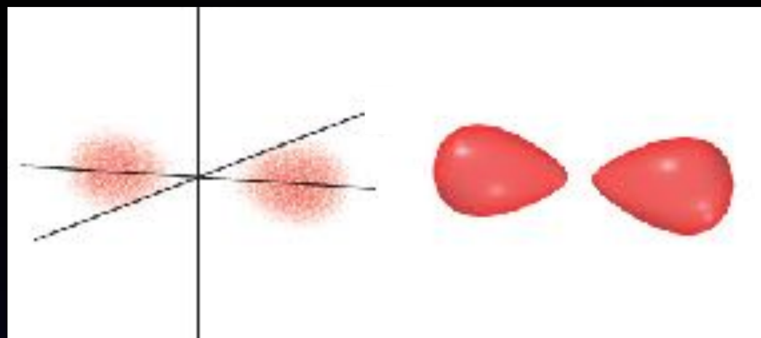
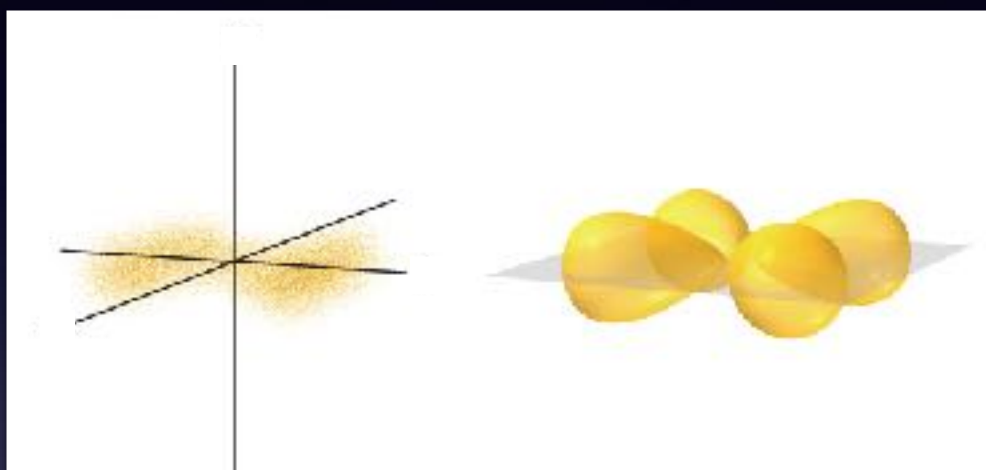
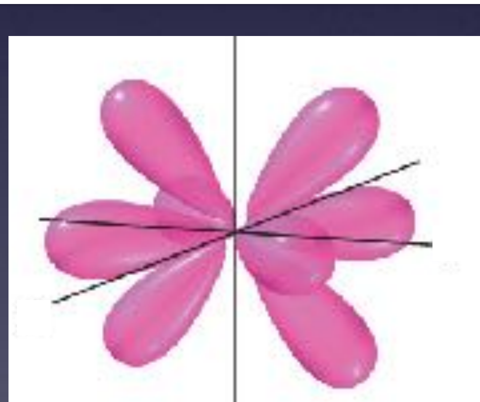
Tro





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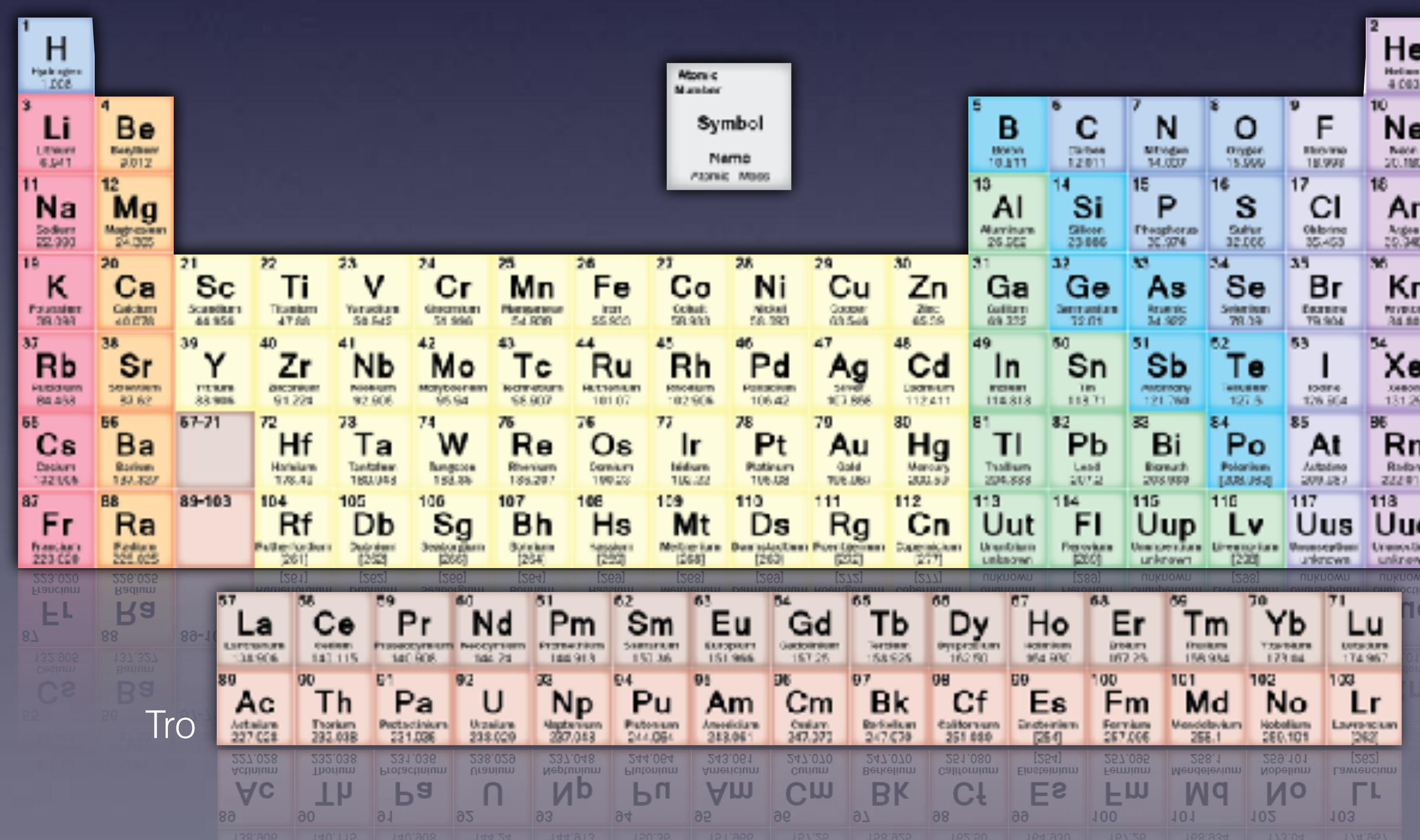


Tro

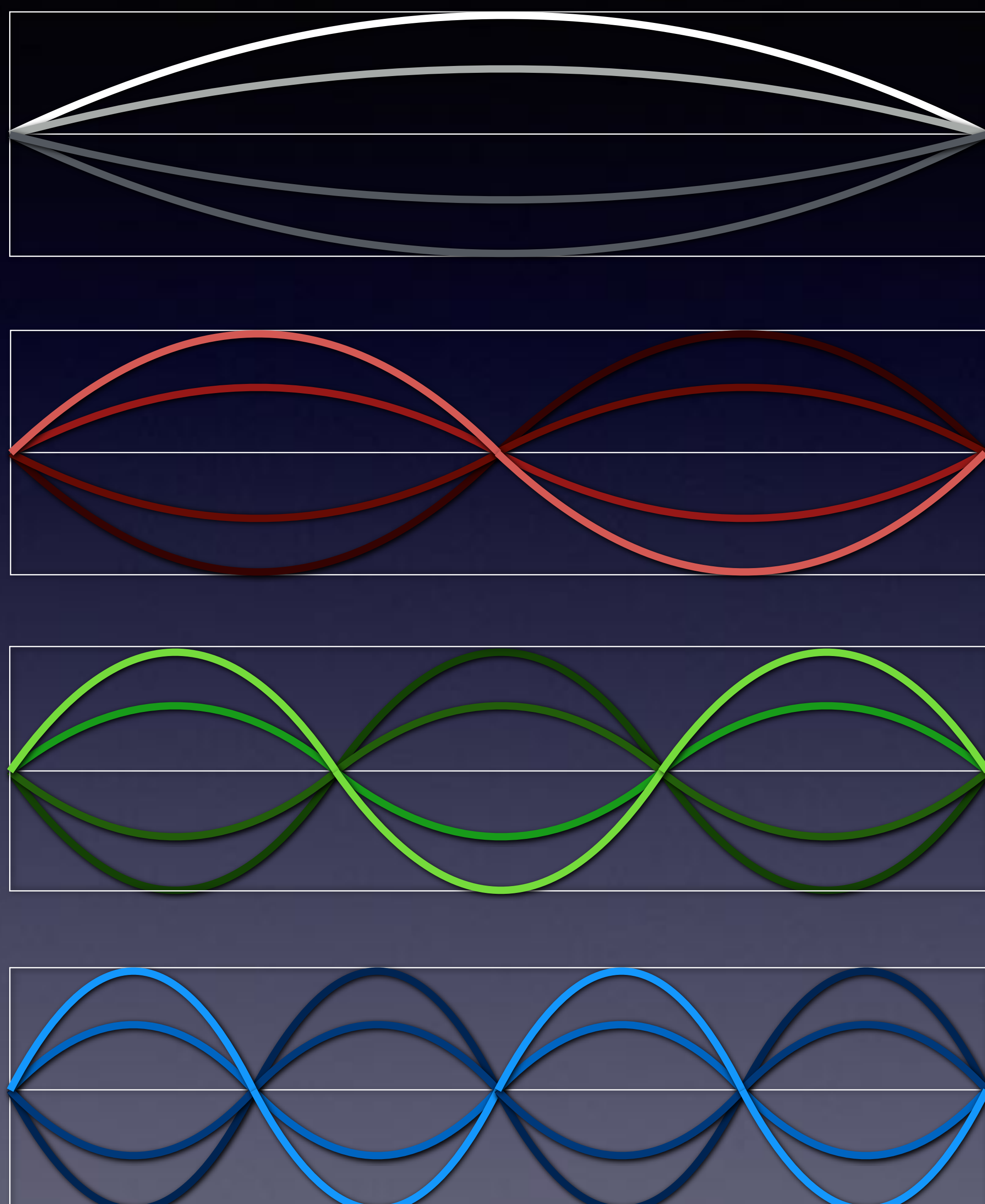
Filling up orbitals with electrons

- Two electrons per orbital (spin).
- No two electrons in an atom can have the same four quantum numbers.
- In what order do electrons fill up orbitals?
- They fill up in order of energy, but…
- …how do orbitals differ in energy?

Wolfgang Pauli

upload.wikimedia.org
Pauli.jpg

1-D case



3-D case

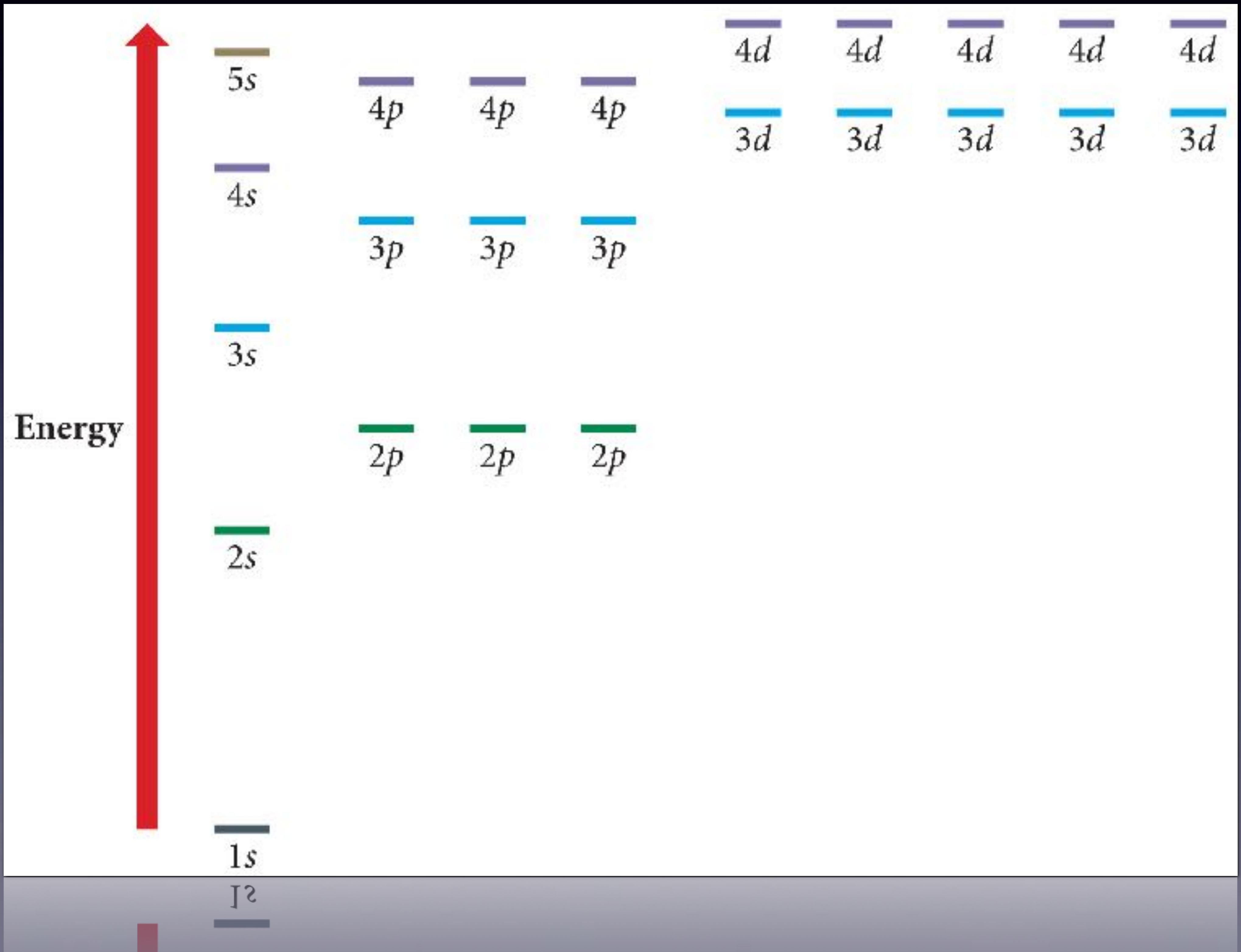
1s			
2s	2p		
3s	3p	3d	
4s	4p	4d	4f
5s	5p	5d	5f

How do l & m_l

and other electrons

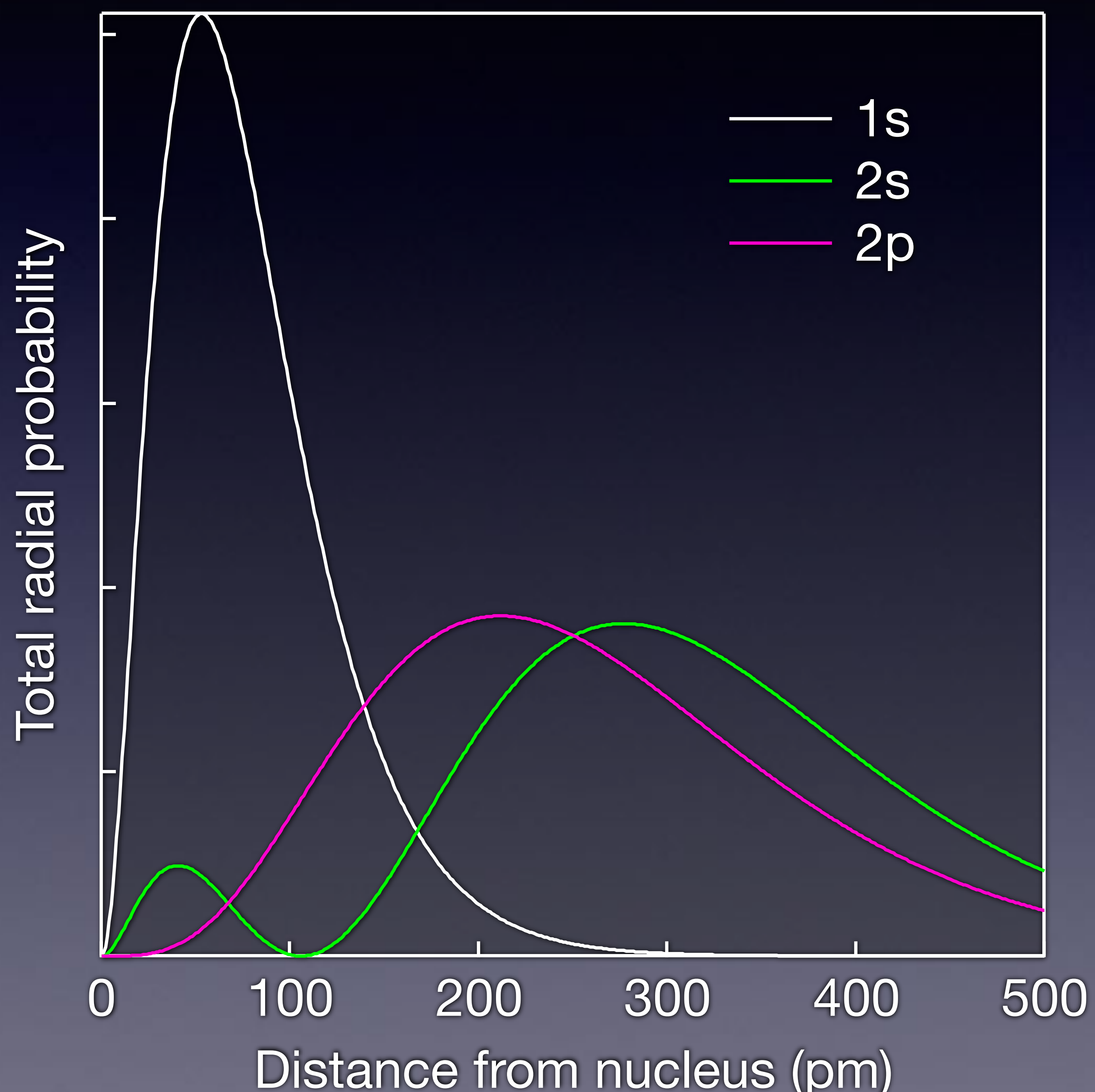
affect energy?

General energy ordering… why?

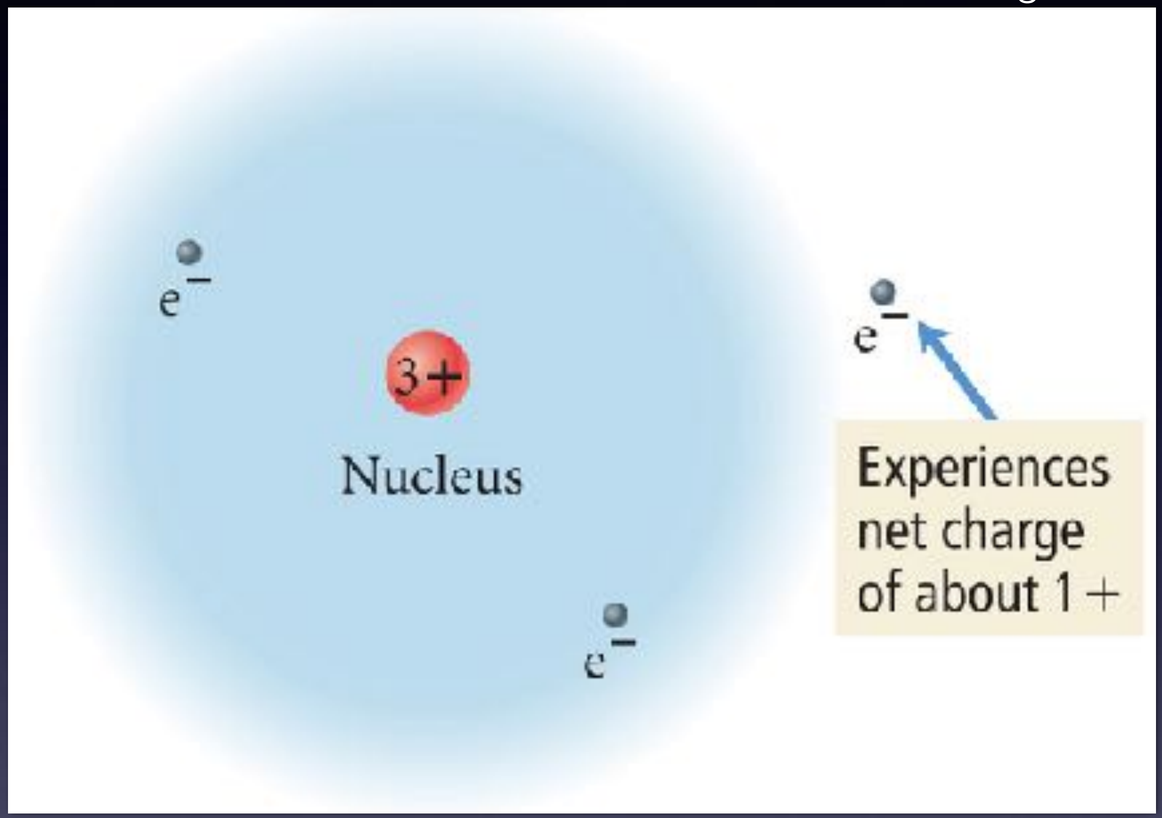


Tro
Fig. 8.5

Shielding



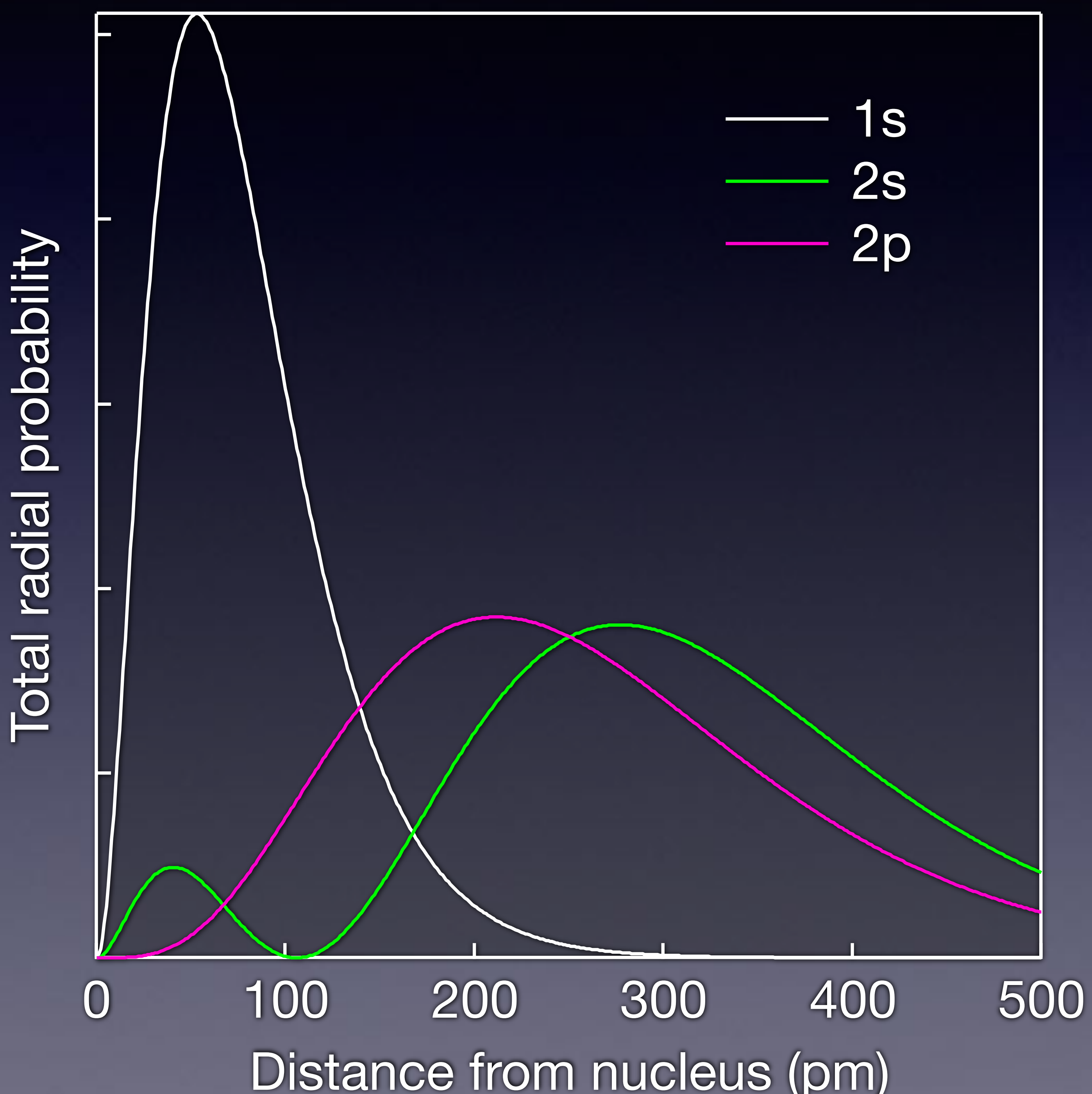
Tro Fig. 3.5a



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

Potential energy

Shielding



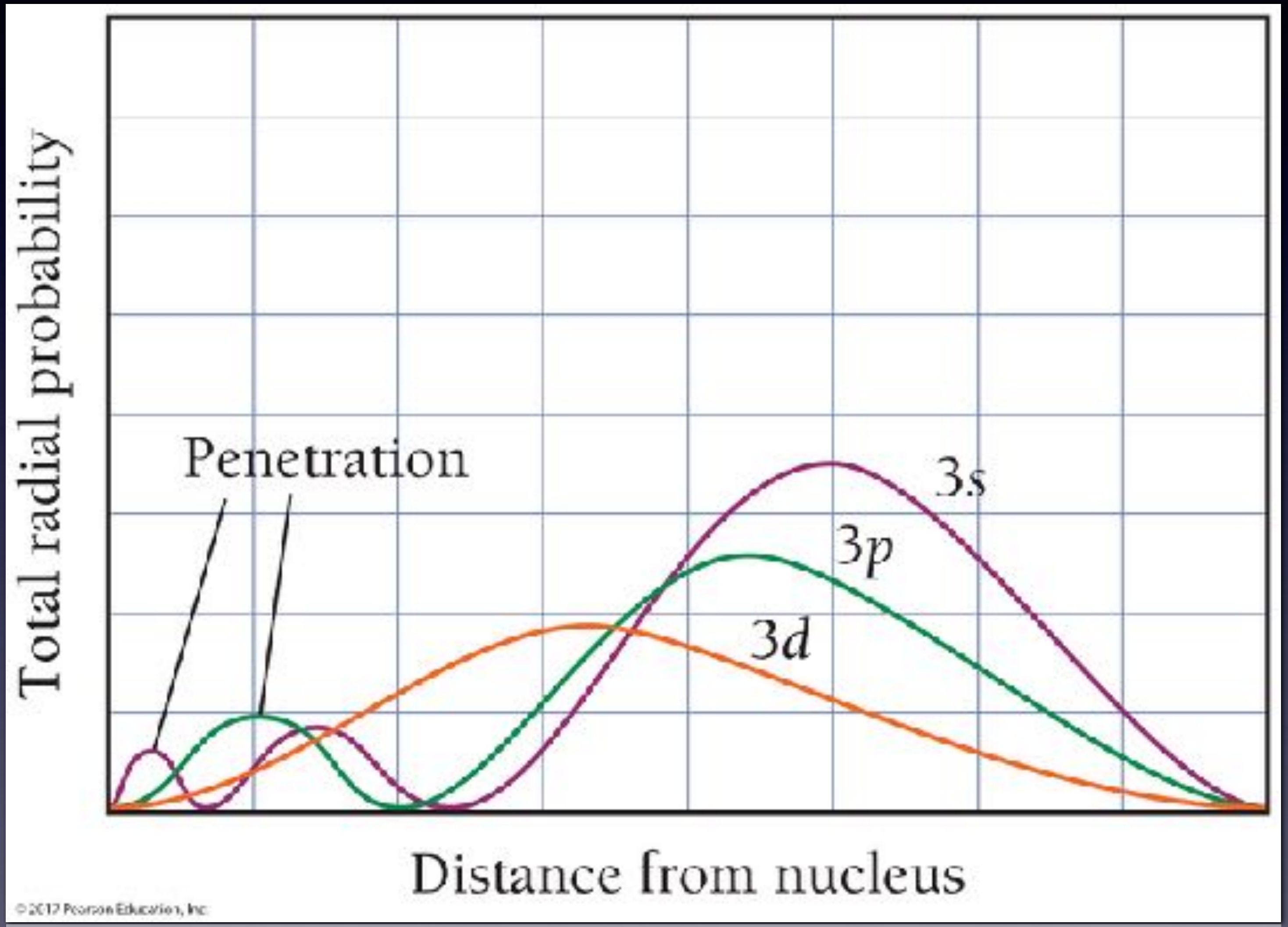
- On *average*, an e^- in a 3s orbital spends its time further away from the nucleus than a 3p e^-

  …however…

- The 3s orbital is lower in energy than the 3p orbital.

On your own… the n = 3 orbitals

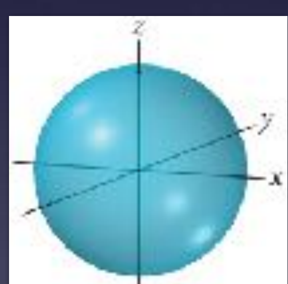
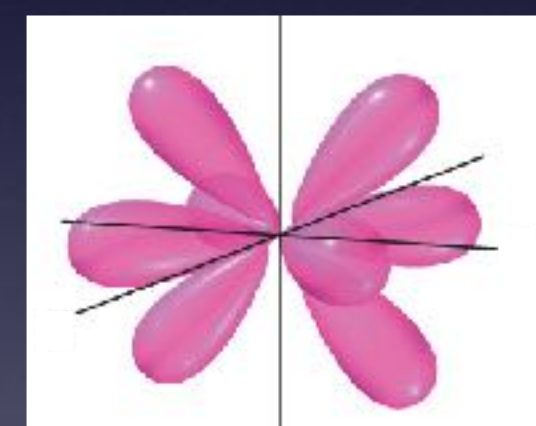
$$\mathbf{E} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r}$$



Estimate the ordering in energy: 3s, 3p, 3d. Why?

General rules for multielectron atoms

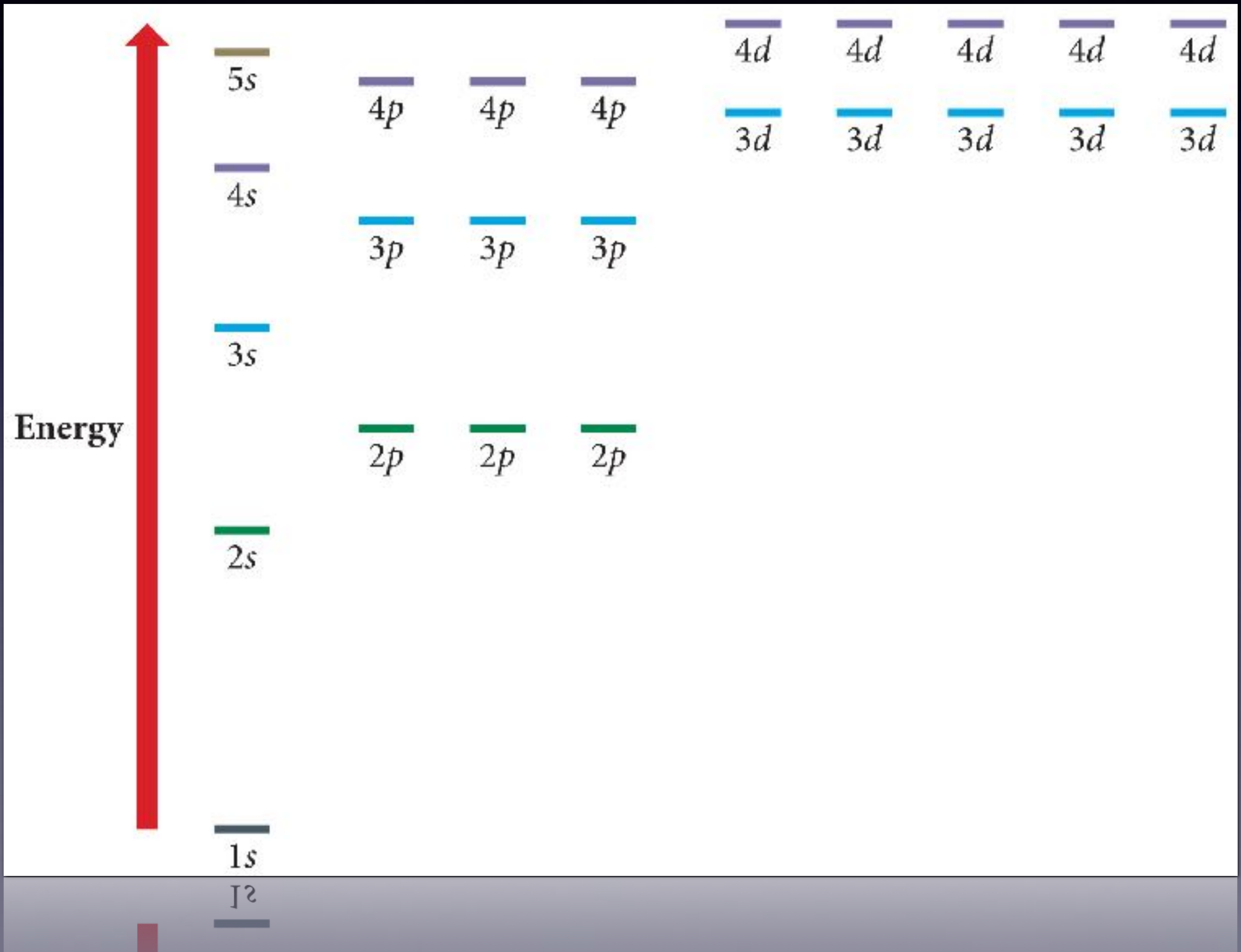
- Principal quantum number, n, determines **most** of the energy.
- Angular momentum QN, l, determines **less** of the energy.

s < p < d < f

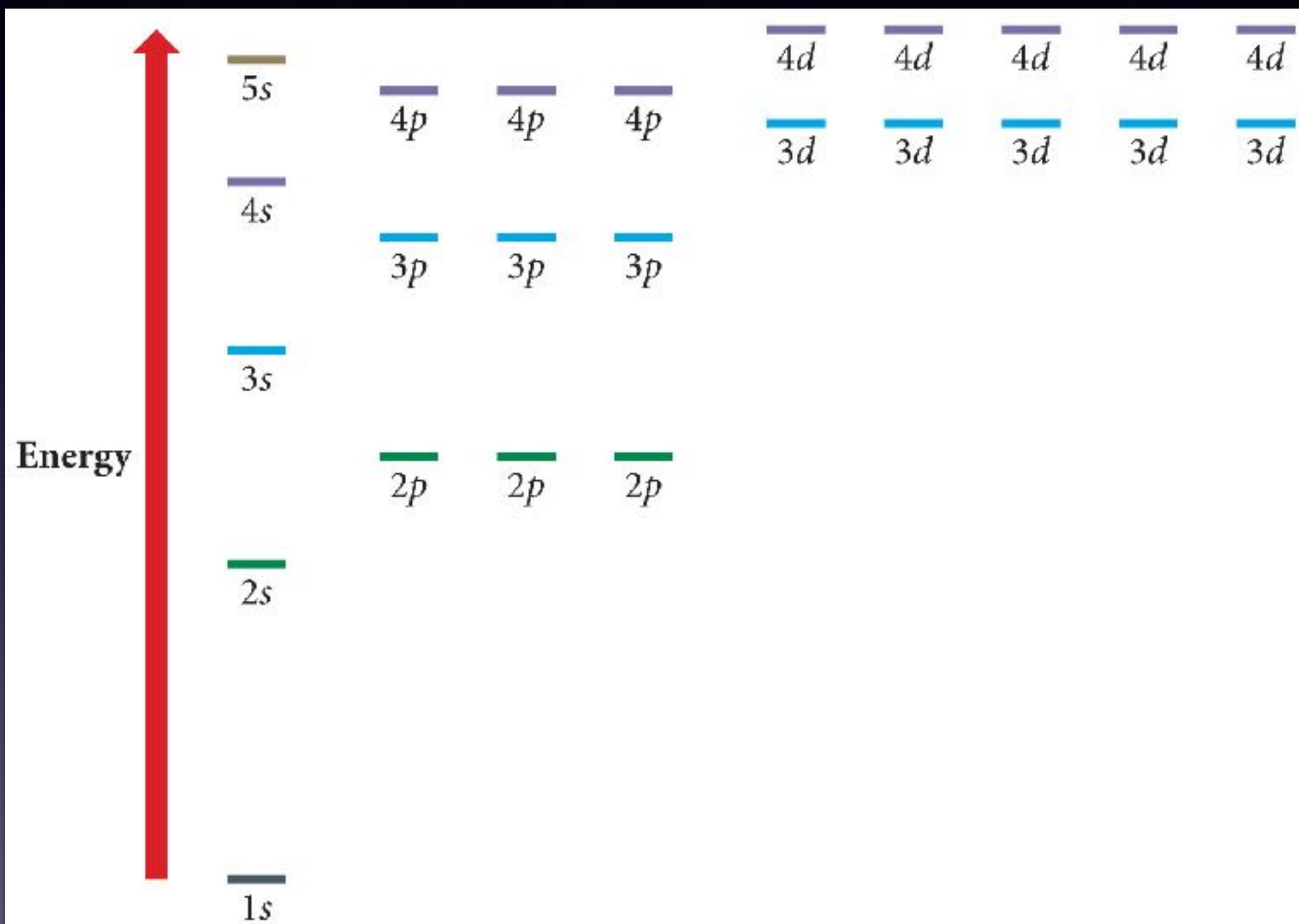
- Orbitals with the same magnetic QN, m_l, are degenerate!

General energy ordering… why?



Tro
Fig. 8.5

General energy ordering… why?

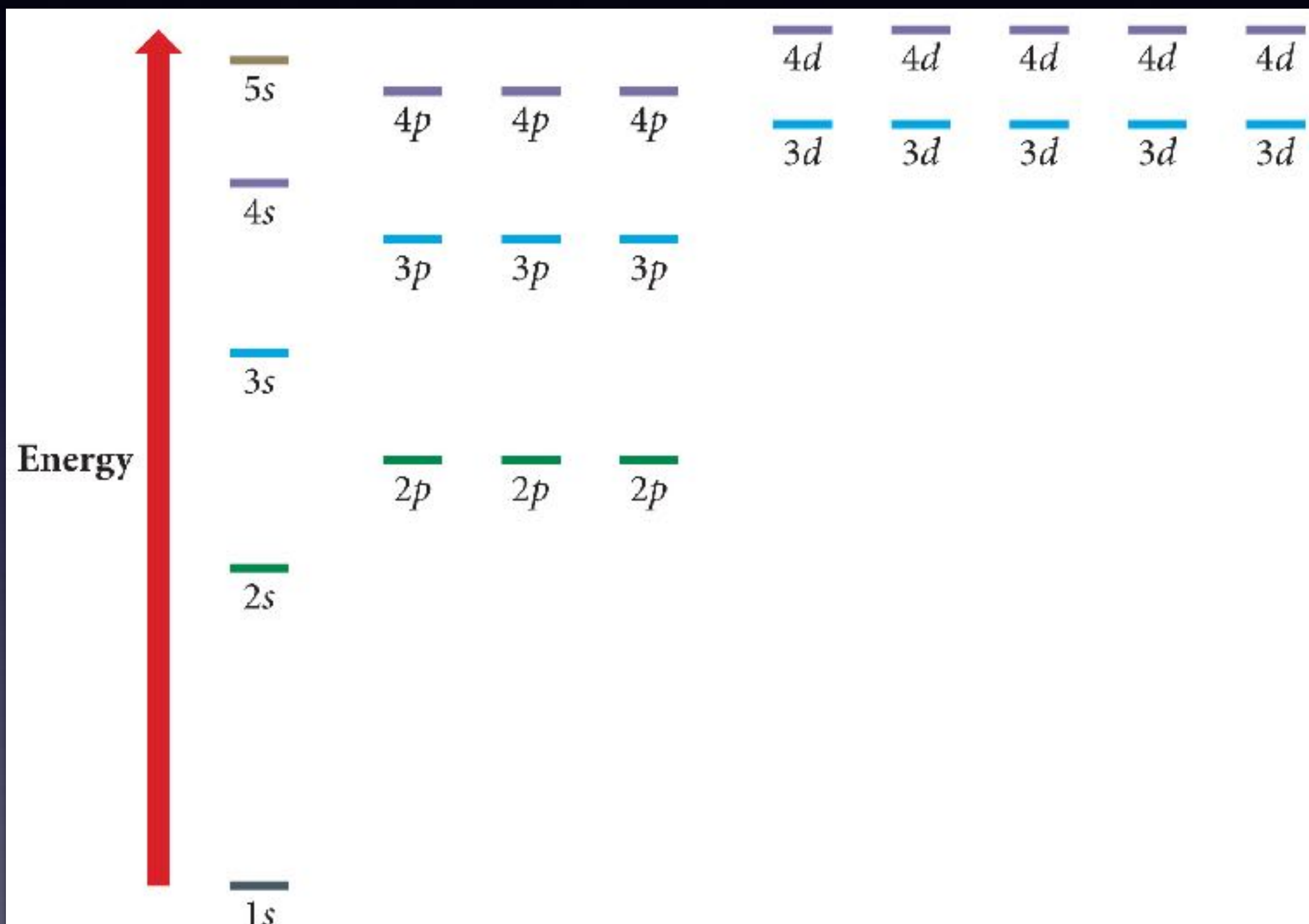


Tro
Fig. 8.5

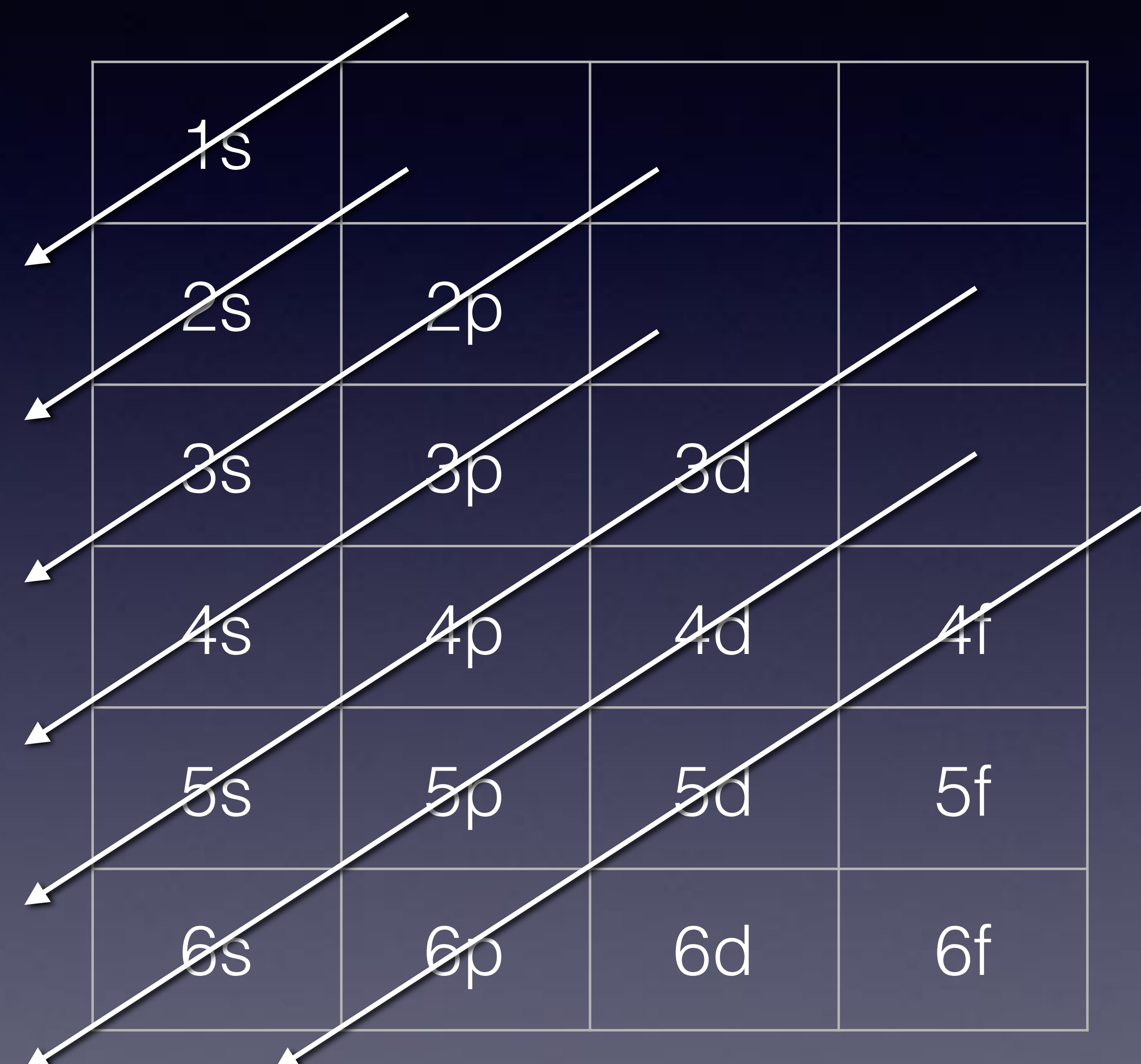
1s			
2s	2p		
3s	3p	3d	
4s	4p	4d	4f
5s	5p	5d	5f
6s	6p	6d	6f

Each orbital gets two electrons (spin “up” & spin “down”)

General energy ordering… why?



Tro
Fig. 8.5



1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, …

Where did we go today?

Ch1010-A17-A03 Lecture 7

- §3.3 Filling electrons in orbitals
- §3.3 Orbital filling exceptions

Next time…

- §3.5: Relating filling to periodic table
- §3.6: Periodic trends in atomic size

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