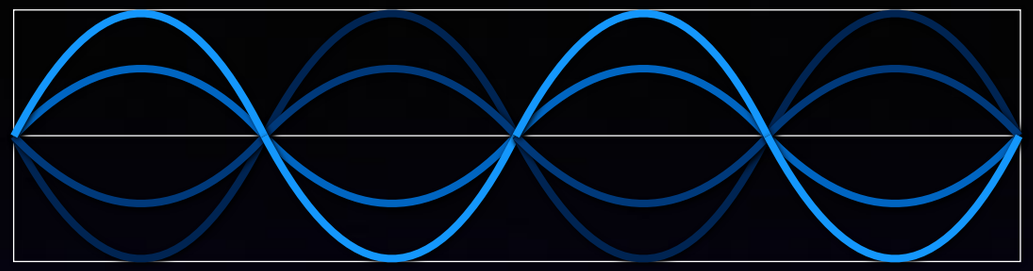
Previously in Molecularity…

Waves!



$$\psi(x,t) = A\sin\left(\frac{n\pi x}{d}\right),\ n = 4$$

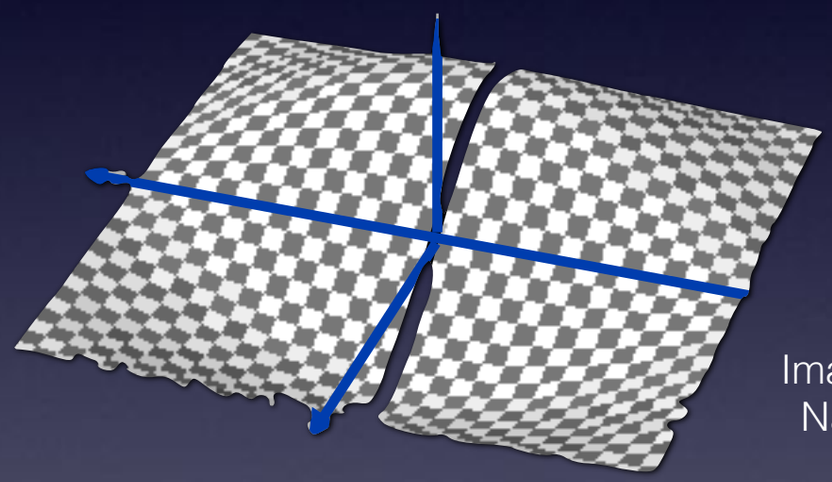
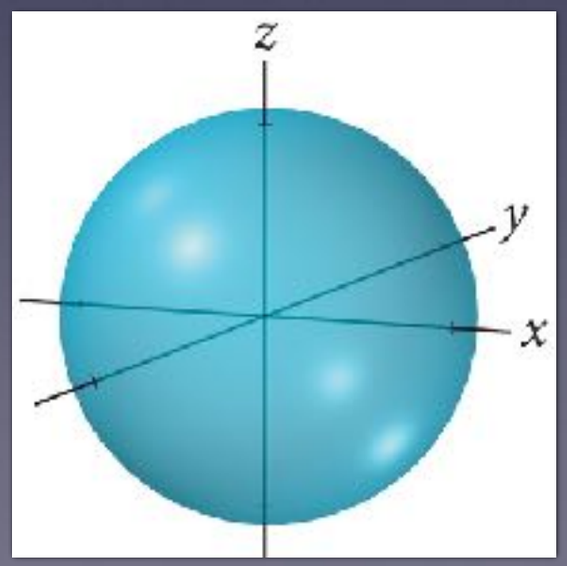


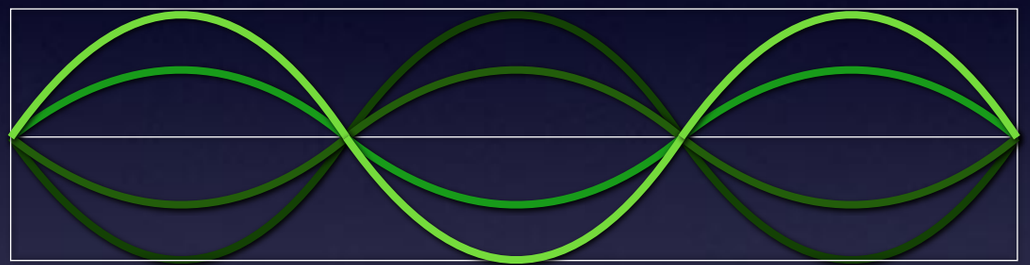
Image credit:
Nate Lewis



Tro, Fig. 7.24

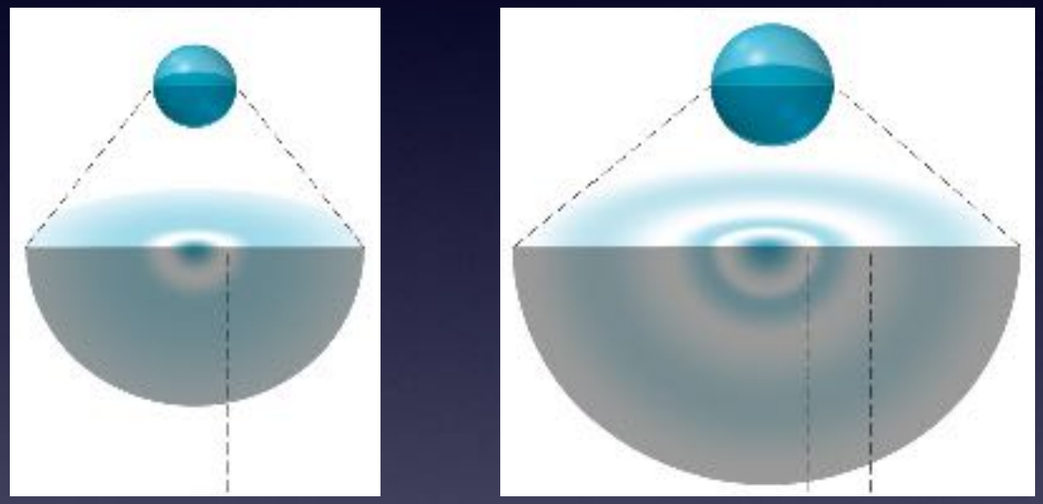
Principal quantum number, n

In one dimension:



$$\psi(x,t) = A\sin\left(\frac{n\pi x}{d}\right),\ n = 3$$

In three dimensions:



Tro

- Takes positive integer values n = 1, 2, 3, 4, .. , ∞
- Conveys information about orbital **size** and **energy**.

Where are we going today?

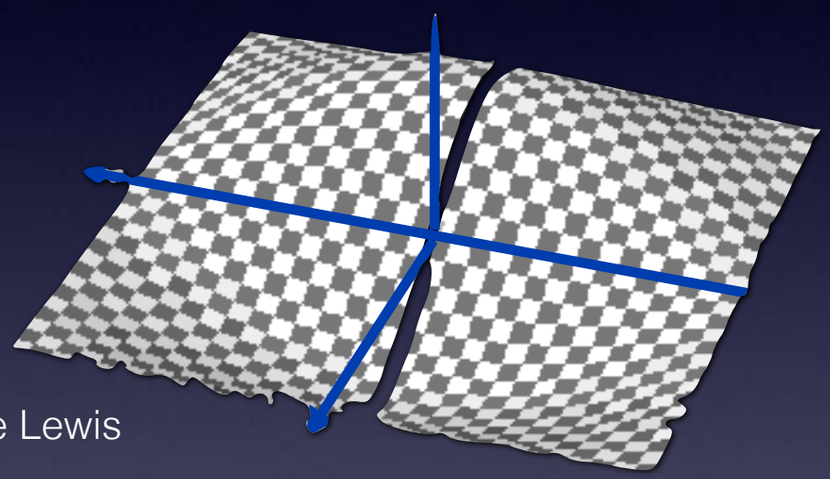
Ch1010-A17-A03 Lecture 6

- das Periodensystem
- § 2.6 Atomic orbitals:
  Shapes, sizes, smells, etc.
- § 3.3 Filling electrons in orbitals
- § 3.3 Orbital filling exceptions

http://stevedeace.com/wp-content/uploads/2012/11/

Angular momentum quant. num., l

In 2D:



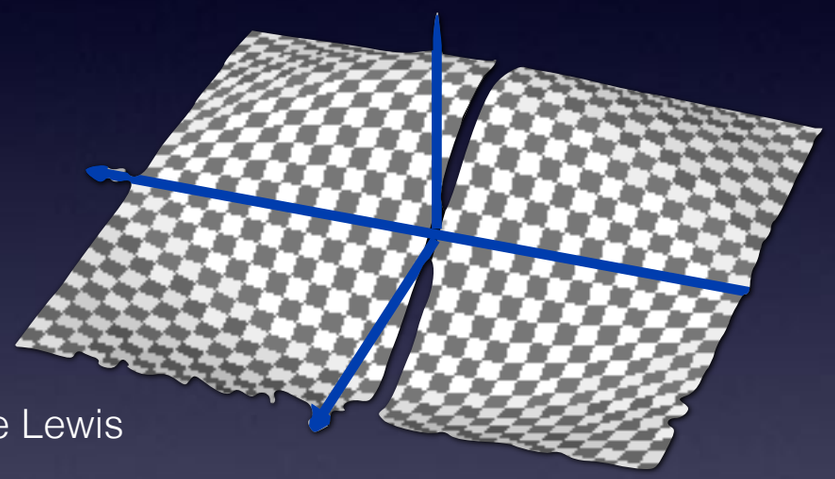
Nate Lewis

- For a given n value, l takes values from 0 to n – 1.

- Affects orbital **shape** and **energy** (but not as much as n)

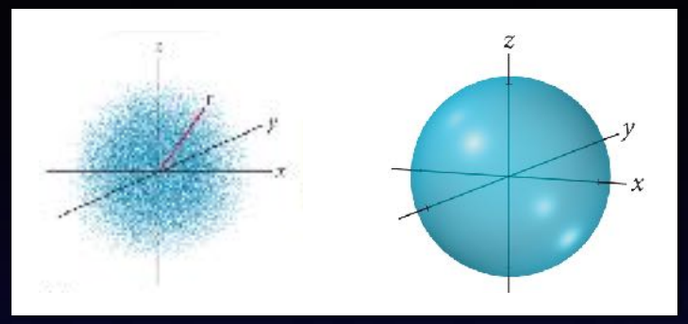
Angular momentum quant. num., l

In 2D:

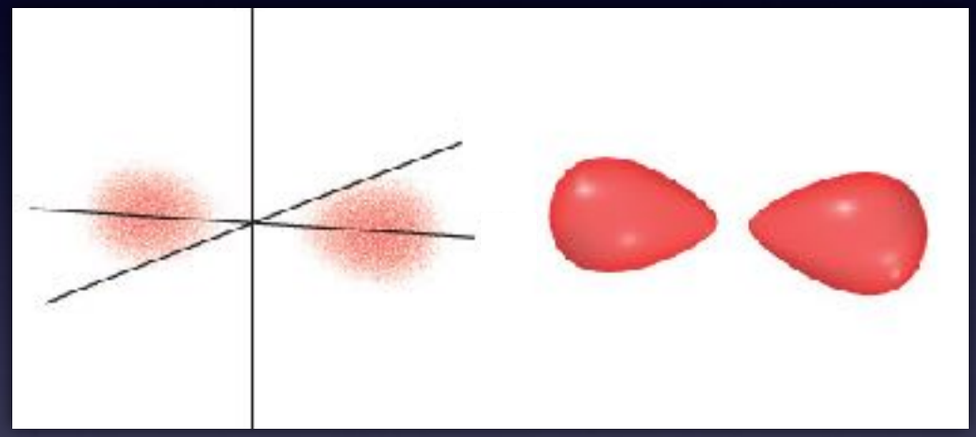


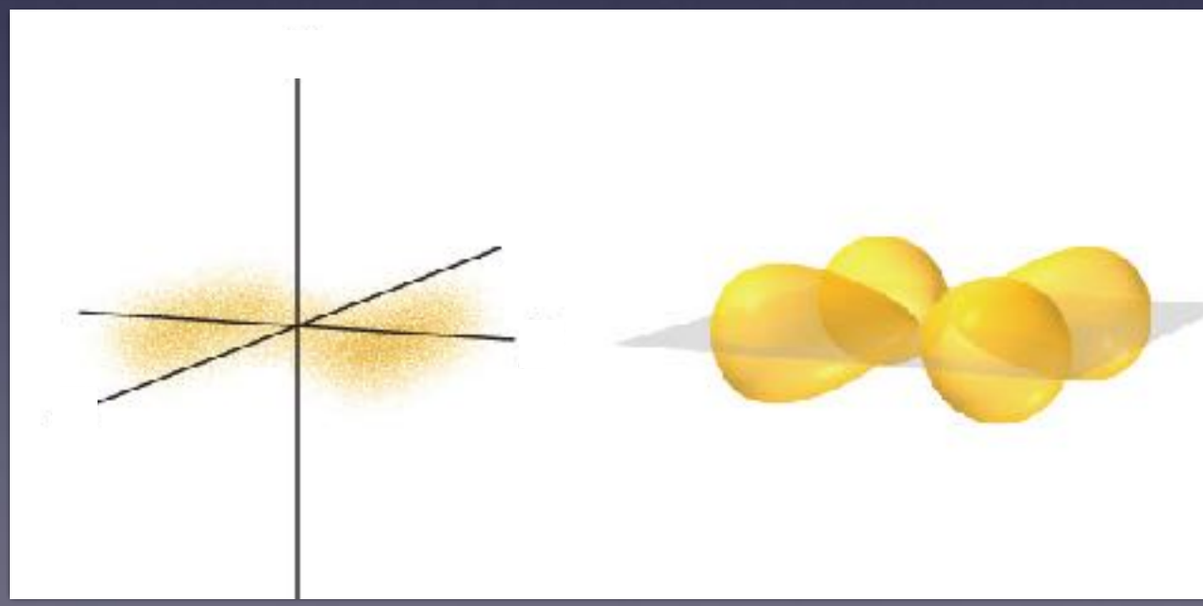
Nate Lewis

In 3D:



Tro

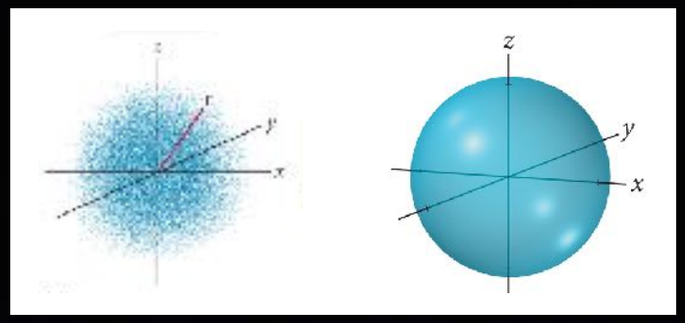




- For a given n value, l takes values from 0 to n – 1.

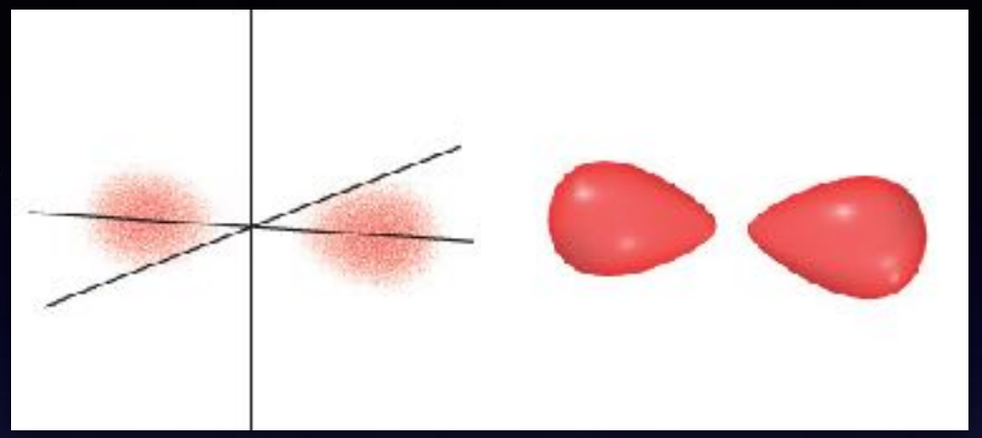
- Affects orbital **shape** and **energy** (but not as much as n)

l = 0, no angular nodes
"s–orbital"

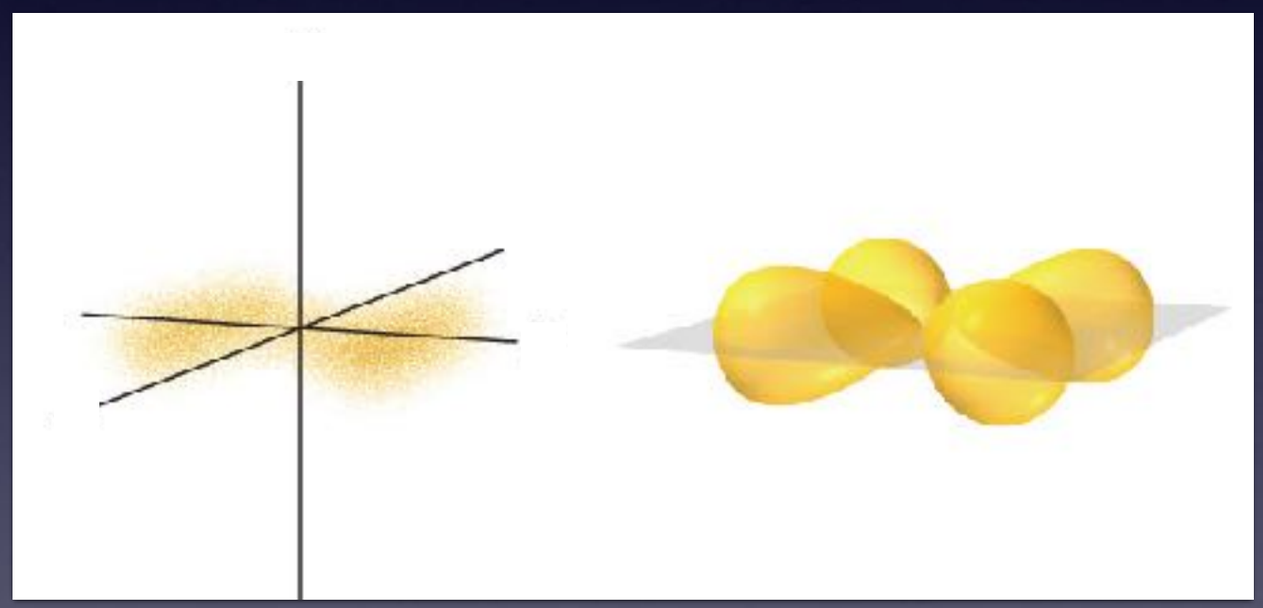


Tro

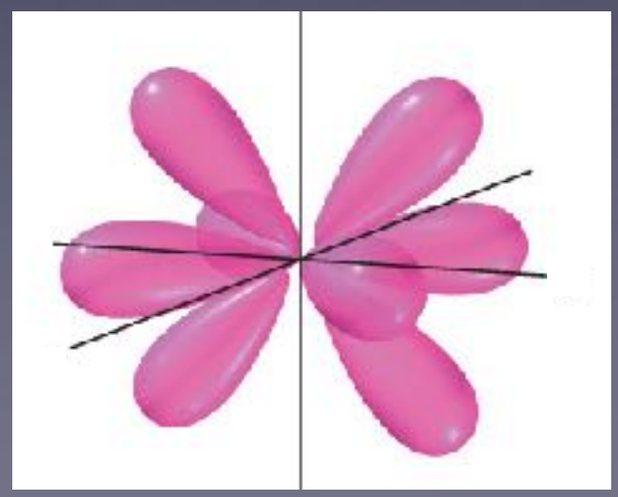
l = 1, one angular node
"p–orbital"



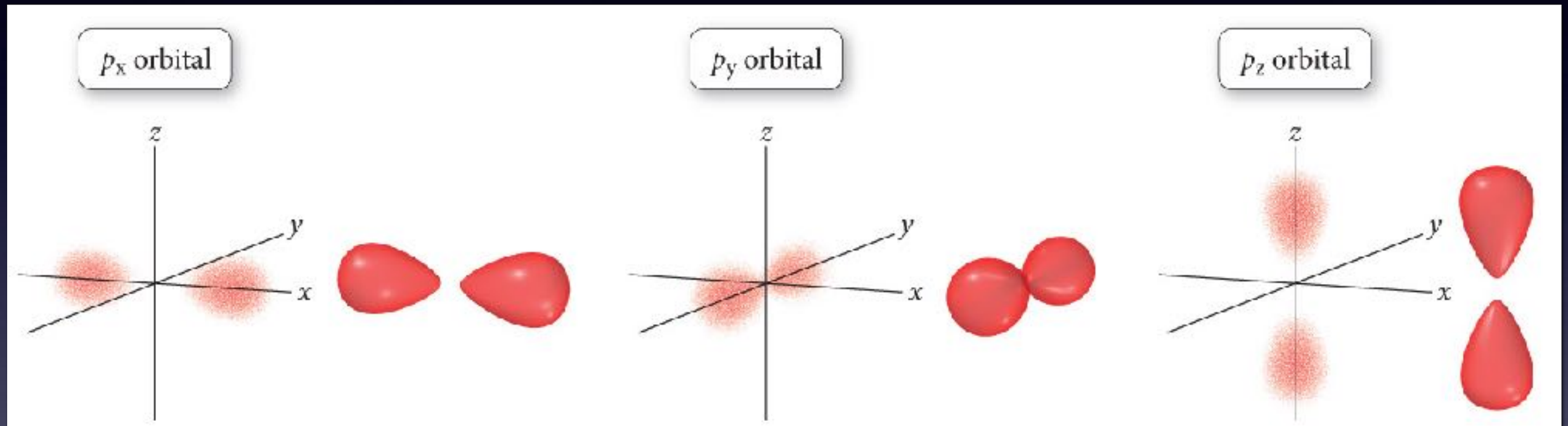
l = 2, two angular nodes
"d–orbital"



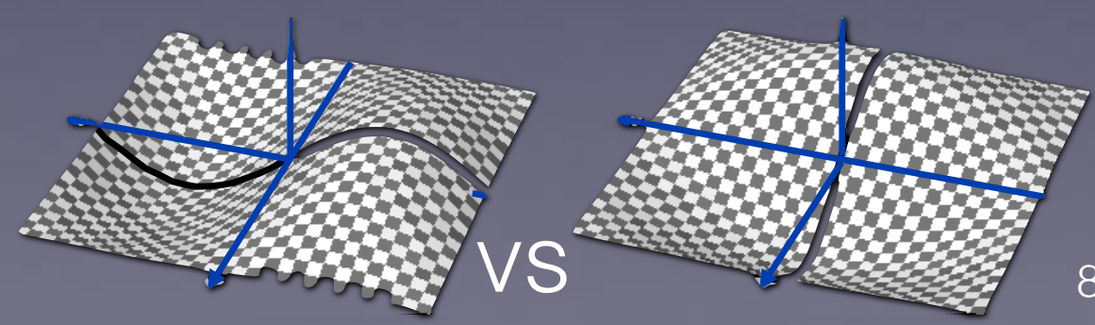
l = 3, three angular nodes
"f–orbital"



Magnetic quantum number, m_l



- For a given l, m_l takes values from $-l$ .. 0 .. $+l$.
- Conveys information about **orientation in space**.
- All orbitals of a given n and l but different m_l values are **degenerate**.



Now you try

- For n = 3…
  - How many different values can l take? What are they?
  - For each l, how many different values can m_l take? What are they?

Now you try

- For n = 3…
  - How many different values can l take? What are they?
  - For each l, how many different values can m_l take? What are they?
- On your own…
  - For each set of n, l, m_l, how many total nodes are there? How many radial nodes are there? How many angular nodes are there?

Practice with orbitals and nodes

- How many n = 4 orbitals exist?
  What are the possible l values?
  What are the possible m_l values for each l value?

- What set of n, l, and m_l values can **not** exist?

  A. $n = 2, l = 0, m_l = 0$

  B. $n = 1, l = 0, m_l = 0$

  C. $n = 2, l = 1, m_l = -1$

  D. $n = 3, l = 1, m_l = -2$

- Problems 3.75–84 in GKF. One of these will likely be on the exam…

Spin quantum number, m_s

- Electrons have half integer spins.
- When bound in atoms they can be either:
  - $m_s = +1/2$ (spin up)
  - $m_s = -1/2$ (spin down)

Keeping n, l, m_l, and m_s straight…

- n is the principal quantum number
  n = 1, 2, 3, 4, .. , ∞.

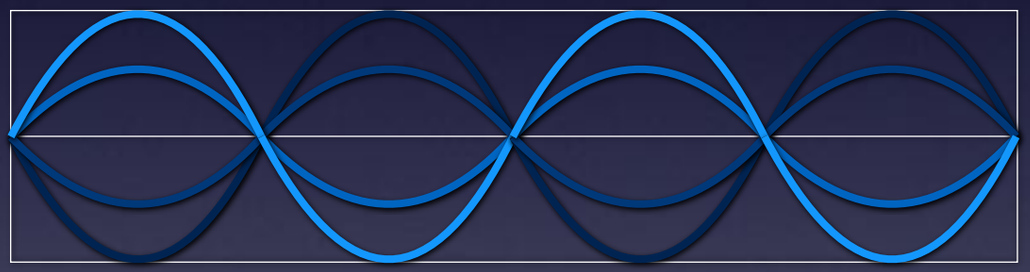
- l is the angular momentum quantum number
  l = 0, .. , n – 1.

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

- m_s is the spin quantum number
  m_s = ±1/2

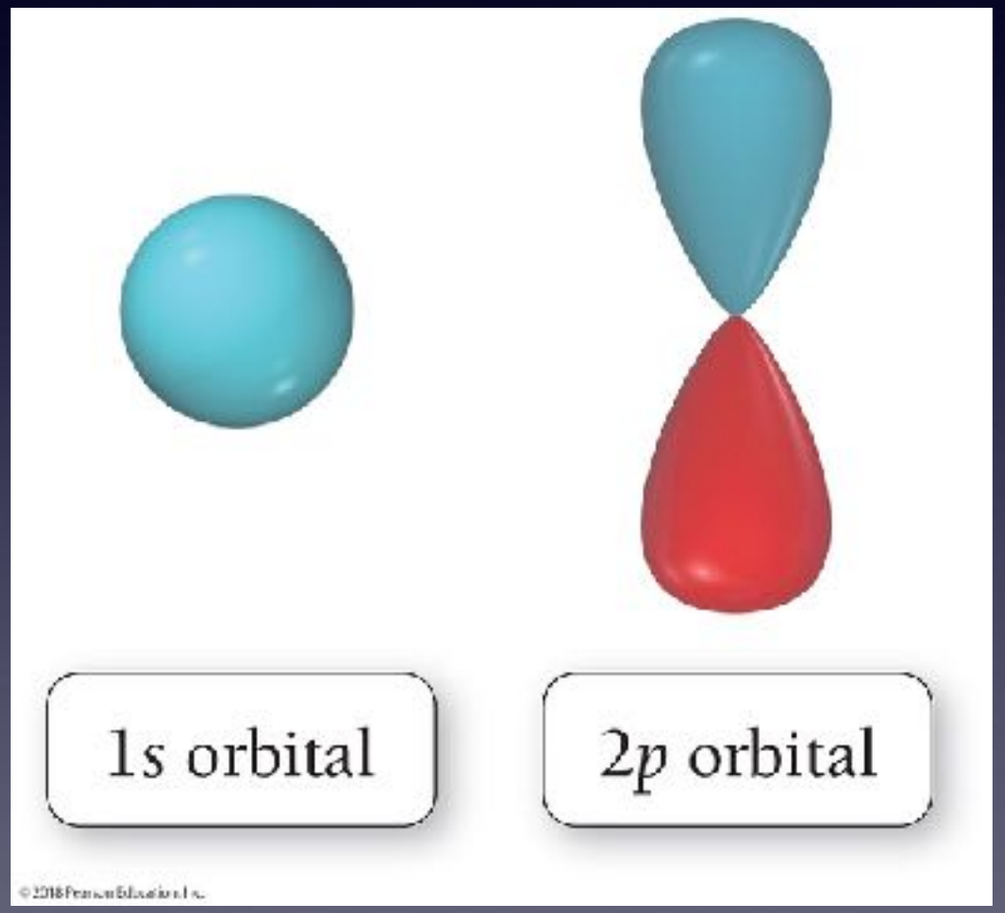
You are responsible for orbital phase!

1D case



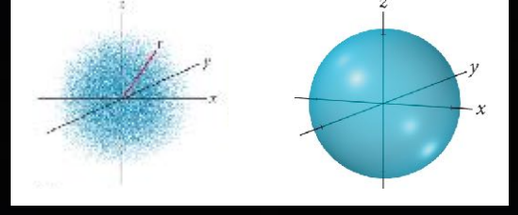
$$\psi(x,t) = A\sin\left(\frac{n\pi x}{d}\right),\ n = 4$$

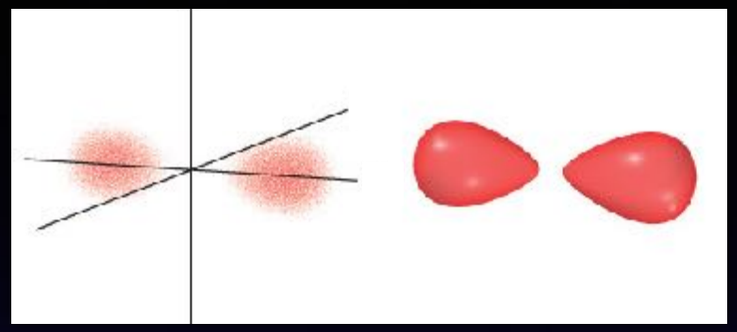
3D case

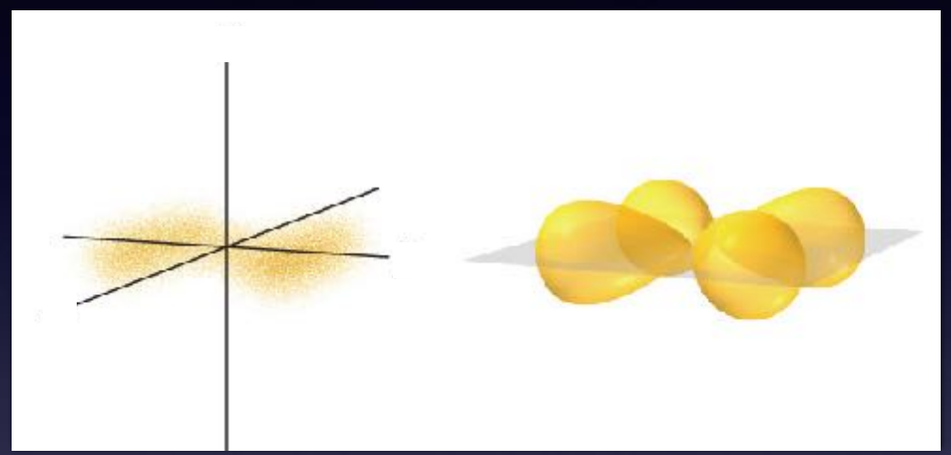


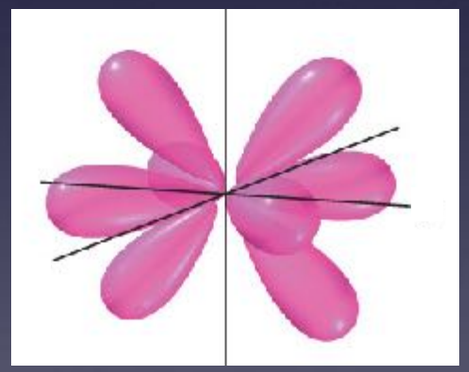
Tro §2.6

Tro



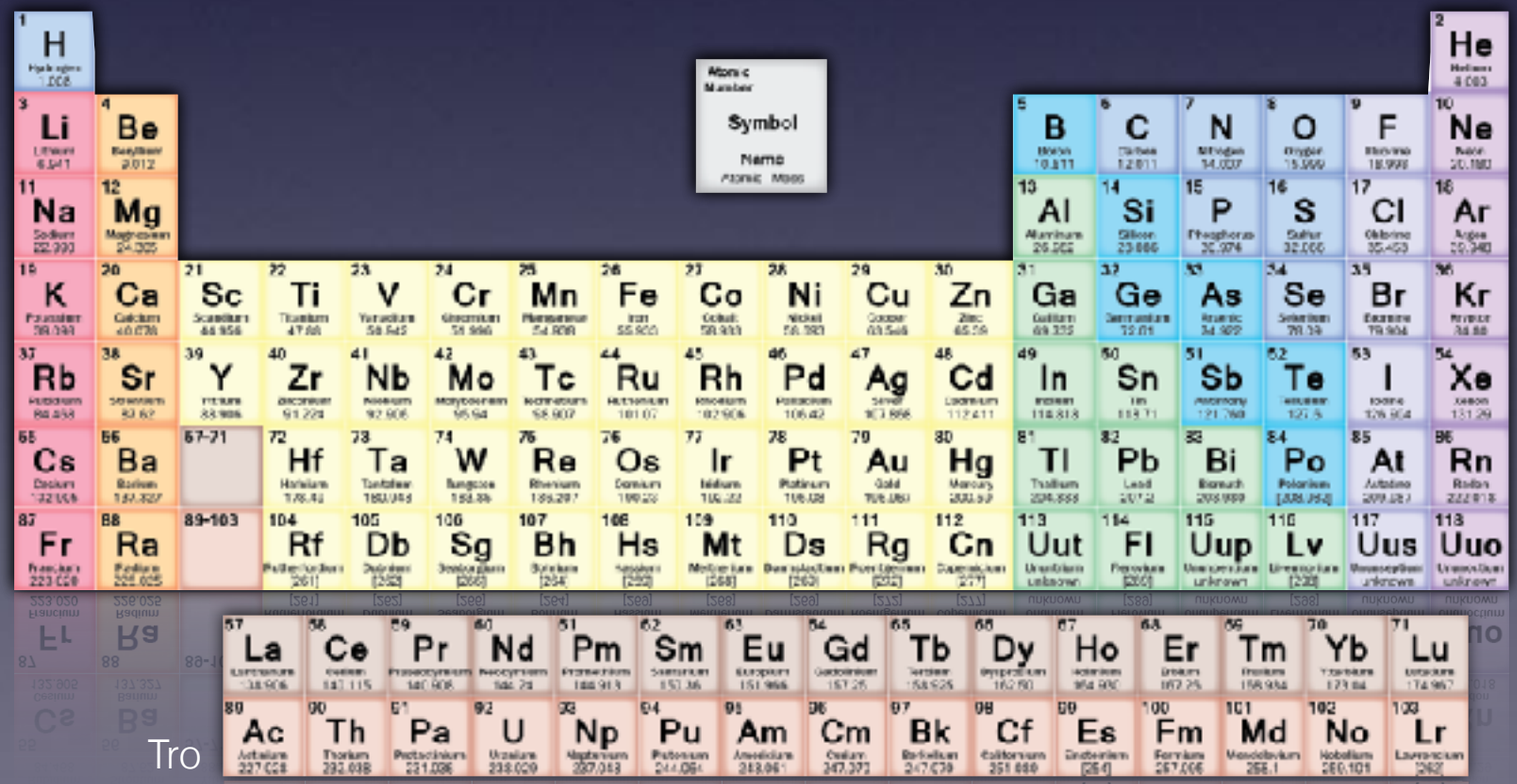






How do we go from here?

To here?



Tro

Chapter 2 Summary, Expectations

- § 2.2 The nature of light
  E vs nu vs lambda, electromagnetic spectrum

- § 2.2 Photoelectric effect
  Recitation worksheet has good practice problems

- § 2.3 Atomic spectroscopy and the Bohr model

- § 2.4 de Broglie wavelength, and uncertainty principle

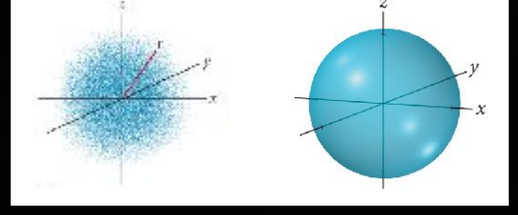
Chapter 2 Summary, Expectations

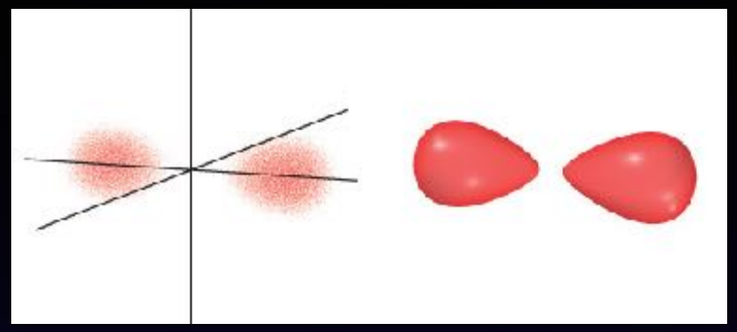
- § 2.5 Atomic spectroscopy explained
- Waves and nodes

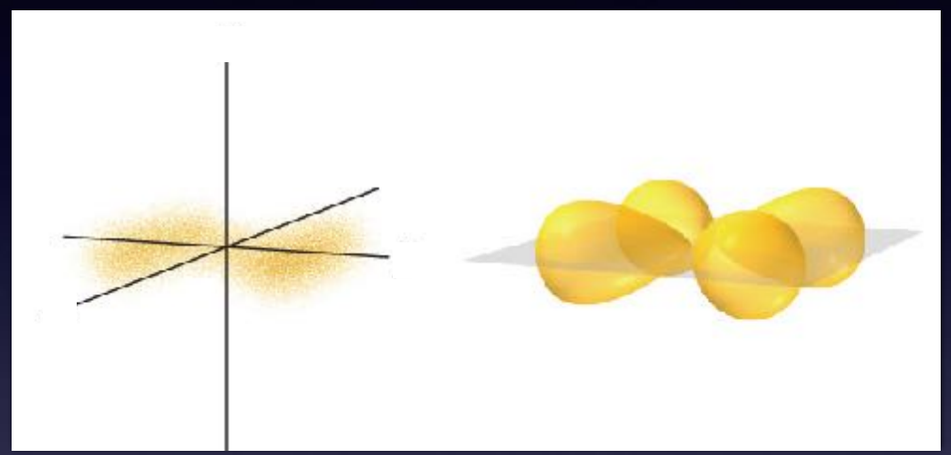
- § 2.6 Shapes of atomic orbitals
  (back to §2.5 for s, p, d, f as I prefer my order better.)

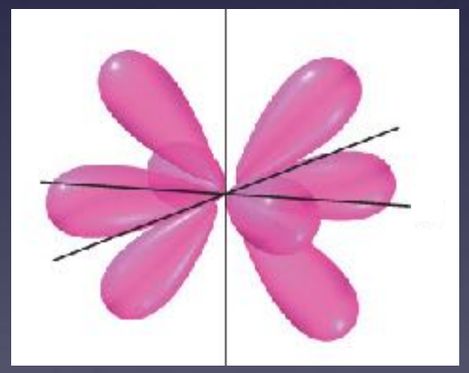
- Read the chapter,
  work any extra problems at the back of the book,
  work the recitation problem and bring any questions to me!

Tro









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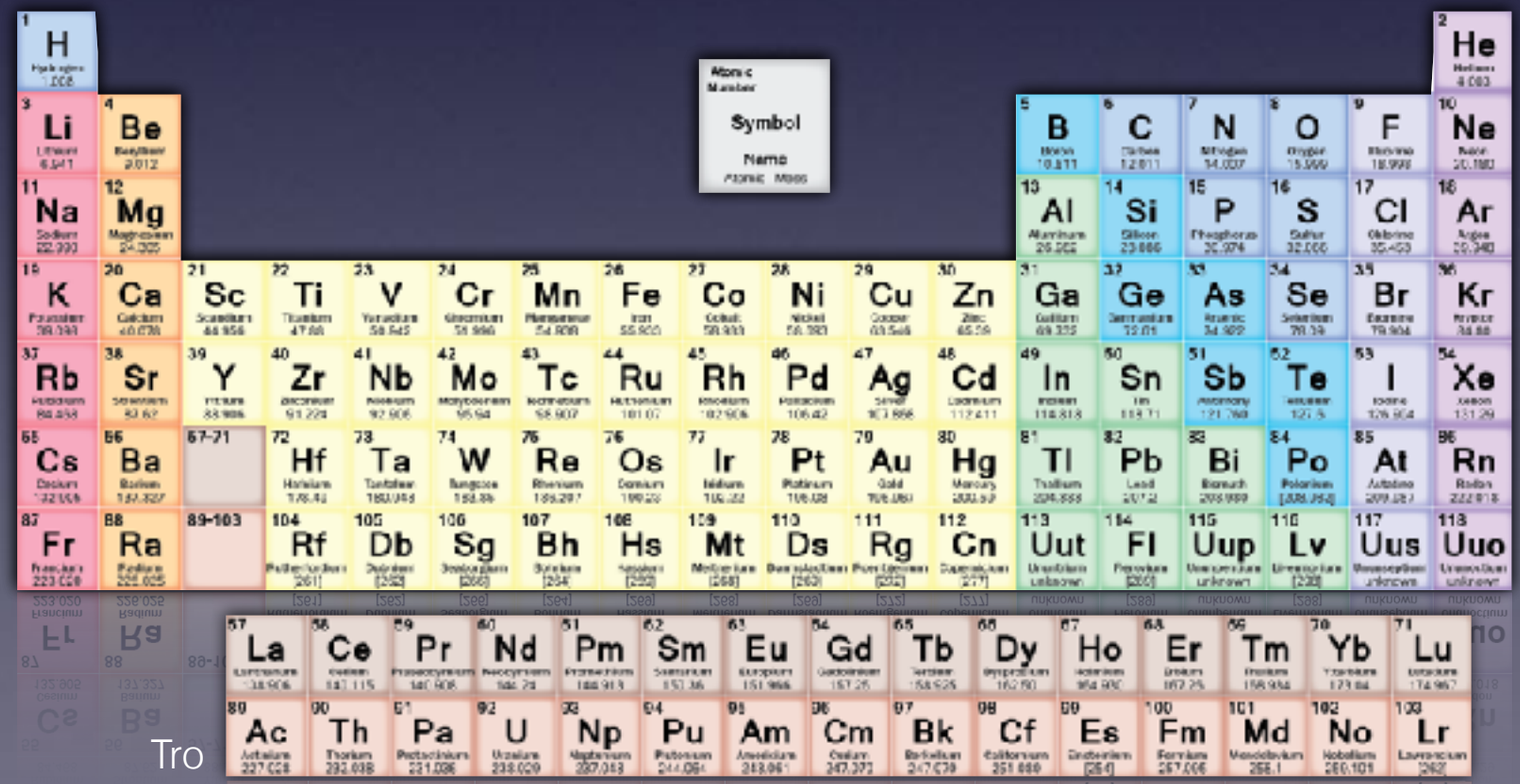

Tro

Where did we go today?

Ch1010-A17-A03 Lecture 6

- 2.6 Atomic orbitals:
  Shapes, sizes, smells, etc.
- § 3.3 Filling electrons in orbitals

Next time…

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

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