Physics 1214 — Chapter 29: Atoms, Molecules, and Solids — 04/22

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1 Electrons in Atoms

wave function, Ψ: a function of all space coordinates containing all dynamic information about a particle.
Schrödinger equation: a differential equation modeling the evolution of a particle which the wave function is one of the set of solutions.

Permitted values of angular momentum

The possible values of angular momentum of the electron in a hydrogen atom are

$$L = \sqrt{l\,(l+1)}\frac{h}{2\pi} \quad (l = 0, 1, 2, ..., n-1).$$

the component of $\vec{L}$ in a given direction–say, the z component L_z, can have only the set of values

$$L_z = m_l \frac{h}{2\pi} \quad (|m_l| = 0, 1, 2, ..., l).$$

That is, m_l is a positive or negative integer or zero, with magnitude no greater than l.

Quantum numbers:

- ***principal quantum number(***n***)***: energy level
- ***angular momentum,*** (l):
- ***magnetic quantum number*** (m_l): slight shifts (or splits) in energy levels when atom is placed in a magnetic field.
- ***electron spin*** (s): analogous to spinning on an axis

central-field approximation: modeling schemes assumes that each electron moves under the influence only of the electric field of the nucleus.
ground state: lowest energy state

The Pauli exclusion principle

No two electrons in an atom can occupy the same quantum-mechanical state. Alternatively, no two electrons in an atom can have the same values of all four of their quantum numbers.

Angular momentum

value	state
$l = 0$	s
$l = 1$	p
$l = 2$	d
$l = 3$	f
$l = 4$	g

shell: a region of space around the nucleus in the form of a spherical shell that corresponds with an energy level, n; states with the same n, but different l form subshells.
Mathematica Demonstrations: Atomic Electron Configurations
Mathematica Demonstrations: Periodic Table in 3D
Mathematica Demonstrations: Build Your Own Atoms

2 Atomic Structure

atomic number (Z): the number of electrons in an atom in its normal (electrically neutral) state.
periodic table of elements: a table organized to illustrate the properties of the known elements.
x-ray energy levels: corresponds to vacancies in the inner shells of a complex atom.

3 Diatomic Molecules

ionic bond: also called the electrovalent or heteropolar bond is and interaction between two ionized atoms.
ionization energy: energy required to remove an electron from an atom.
electron affinity: the energy available or attractive potential energy of an atom to attract an electron.
covalent bond: homopolar, nearly symmetric participation of the two atoms in sharing an electron.
molecular bonds: the spectrum of bonds between the two extremes of atomic bonding.
polar molecules: many molecules having dissimilar atoms may have electric dipole moments and are thus polar.
van der Waals bond: an interaction between the electric dipole moments of two atoms or molecules.
hydrogen bond: a weak bond, analogous to the covalent bond, in which an electron pair binds two positively charged structures.

4 Structure and Properties of Solids

long-range order:
crystal structure:
lattice structure:
short-range order:
ionic crystals:
covalent crystal:
metallic crystal:

5 Energy Bands

energy bands:
valence band:
conduction band:
energy gap:

6 Semiconductors

semiconductor:
hole:
intrinsic conductivity:
n-type semiconductor:
p-type semiconductor:

7 Semiconductor Devices

p-n junction:
diode:
forward bias:
reverse bias:
light-emitting diode (LED):
transistors:
emitter:
collector:
base:
power amplifier:
integrated circuit:
chip:

8 Superconductivity

superconductivity:
critical temperature: