CHAPTER II  IMP'S + SOLIDS

PHASE CHANGES ⇒ ΔG, ΔS "entropy"

SOLID → lowest S ⇒ most orderly arrangement

SOLID ⇌ LIQUID ⇌ GAS

T = average KE = \frac{1}{2}mv^2

HOTTEST = FROZEN

ATTRACTION FORCES

INTRA MOLECULAR

- Bonds
  - held atoms together to make compounds
  - chemical properties
    - ionic
    - covalent
    - metallic

INTER MOLECULAR (IMP's)

- in between molecules
- "sticky forces"
  - Coulombic
  - Physical Pops
  - weaker than bonds
CHAPTER 11  IMFs + SOLIDS

Phase Changes \( \Rightarrow \Delta E, \Delta S \) "Entropy"

**Solid** \( \rightarrow \) lowest \( S \) \( \Rightarrow \) most orderly arrangement

\[
\begin{align*}
\text{Solid} & \quad \longleftrightarrow \quad \text{Liquid} & \quad \longleftrightarrow \quad \text{Gas} \\
S & \quad \uparrow & \quad S & \downarrow
\end{align*}
\]

\( T \propto \text{average KE} = \frac{1}{2} m v^2 \)

Hotter = Faster

**Attractive Forces**

- **Intra Molecular Bonds**
  - Hold atoms together to make compounds
  - Chemical Properties
    - Ionic
    - Covalent
    - Metallic

- **Inter Molecular (IMFs)**
  - in between molecules
  - "Sticky Forces"
    - Coulombic
    - Physical props
      \( \rightarrow \) weaker than bonds
1) Ion - Dipole
   - mixture of ions + polar molecules
   - aqueous soln's of ionic compounds

   strength depends on
   - magnitude of charges (Q)
   - size of ions (r)

   \[ F = k \frac{Q_1 Q_2}{r^2} \]

   \[ \text{H}_3\text{O}^+ \rightarrow \text{H}_2\text{O} \quad \text{M}^+ (aq) + \text{X}^- (aq) \]

   - waters of hydration

2) van der Waals Forces
   - London (Dispersion) Forces LDF's
   - Dipole - Dipole
   - H-Bonds

A) Dipole - Dipole → polar molecules
   - the larger the dipole moment ($\mu$)
   - the stronger the interaction
B) London (dispersion) forces  LDFT's

→ induced dipole interaction

→ a charge (ion, dipole) distorts the electron cloud of a nearby molecule
→ the nearby molecule becomes temporarily polar

* Weakest LDF among similar sized molecules

Strongest → Big Atoms
Big Molecules (many atoms)

"Polarizability" = more e- → more polarizable → Stronger

LDFT

c) H-Bond

→ a special case of dipole - dipole

\[ N - H \ldots \]
\[ O - H \ldots \quad N, O, F \]
\[ F - H \quad \uparrow \quad H \text{ Bond} \]

\[ N - H \]

\[ N - H \]

\[ N \quad (pr) \quad N \]

H-Bond