

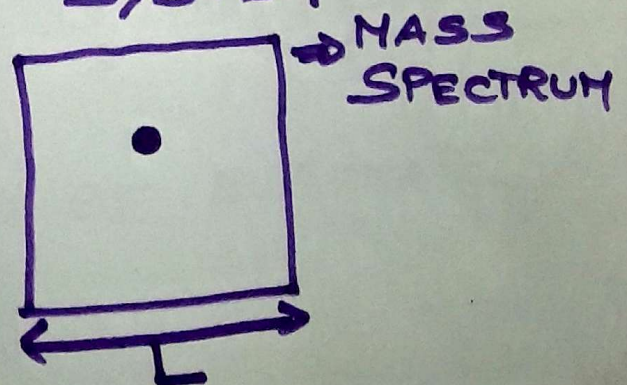
SPECTROSCOPY

KNOWN FACTS:

- ① ATOMS ARE MADE OF ELECTRONS, PROTONS, NEUTRONS
- ② NUCLEUS + ELECTRONS
 \Downarrow \Downarrow
 CENTER (ORBITS)
 • REVOLVE AROUND
 • CLOUD OF ELECTRONS
 • ORBITALS
- ③ ATOMS CAN BOND WITH OTHER ATOMS \rightarrow MOLECULES
 • DIFFERENT TYPES OF BONDS
 — x — x —

PROBLEM-I: • CONSIDER N IDENTICAL PARTICLES (ATOMS)
• ~~at~~ DILUTE THE SYSTEM

$L <$ interParticle Separation



→ POSSIBLE QUESTIONS

① WHAT IS THE MASS OF THE ATOM?

② IS THE ATOM STATIC OR DYNAMIC?

STATIC ÷ $\begin{cases} \rightarrow \text{CLASSICALLY POSSIBLE} \\ \rightarrow \text{QUANTUM MECHANICS?} \end{cases}$

→ WHERE IS IT LOCATED?

(ELECTRON MICROSCOPY;
~~CRYSTAL~~ CRYSTAL STRUCTURE;
X-RAY DIFFRACTION;

DYNAMIC ÷

→ HOW FAST DOES IT MOVE?

(FROM TEMPERATURE;

$\langle \text{KINETIC ENERGY} \rangle \Rightarrow \text{TEMPERATURE};$

t_1

t_2

\Rightarrow TIME RESOLUTION

\Rightarrow SPEED CAN BE ESTIMATED!

③ HOW ARE THE ELECTRONS DISTRIBUTED IN THE ATOM?

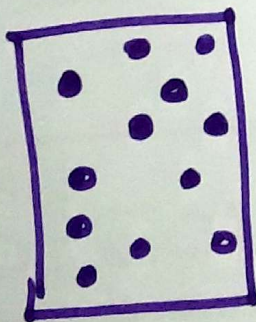
⇓
WILL IT CHANGE WITH THE POSITION OF THE ATOM?

④ WHAT IS THE SIZE OF THE ATOM?

SIZE OF THE NUCLEUS?

SIZE → CLASSICAL (van der Waals radius)
→ QM

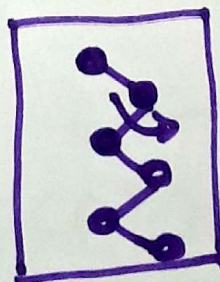
INCREASE COMPLEXITY:



N PARTICLE SYSTEM

⇒ ATOMIC

INTERACTIONS

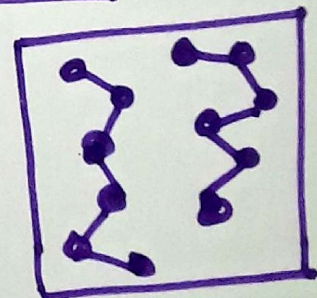


SINGLE MOLECULE
⇒ BONDS

⇒ STRENGTHS

⇒ RELATIVE

MOTION OF ATOMS



N MOLECULES
⇒ MOLECULAR INTERACTIONS

- ↙
- BOND VIBRATION
 - BEND VIBRATION
 - TORSIONAL MOTION
 - TRANSLATION
 - ROTATION

- ATOMIC/MOLECULAR STRUCTURE
- ATOMIC/MOLECULAR DYNAMICS
- ATOMIC/MOLECULAR INTERACTIONS



- STRENGTH OF MATERIALS
- DIFFERENT PHASES OF MATTER
(SOLID, LIQUID, GASES)
- TRANSITIONS BETWEEN DIFFERENT ~~PHASE~~ PHASES



PHYSICS, CHEMISTRY,
BIOLOGY, MATERIALS SCIENCE



SPECTROSCOPY

TO UNDERSTAND THE SYSTEM,
YOU MUST DISTURB/PERTURB
IT!

→ STUDY HOW THE
SYSTEM RESPONDS TO
THE PERTURBATION!

