STATISTICAL MECHANICS

TOPICS COVERED

- Introduction to Statistical Mechanics

What is statistical mechanics??

- **Statistical mechanics is the way of relating the microscopic laws of physics to a description of nature on a macroscopic scale.**
- **SM is the study of the connection between micro-physics and macro-physics**

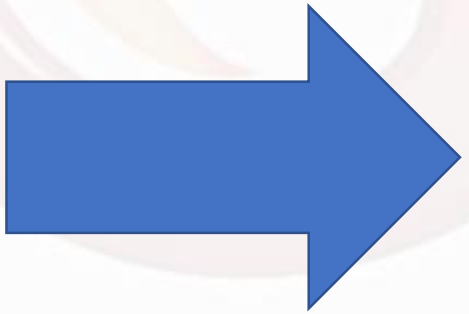
- Statistical Mechanics uses laws of probability to compute AVERAGE properties of both ordinary materials and of exotic elementary particles.
- A typical amount of material, let's say 1 gram, contains about $6x10^{23}$ molecules: Avogadro's number.

- It is impossible to follow a detailed history of what's happening to each of the molecule.

Quantum Mechanics of Atoms and Molecules

STATISTICAL MECHANICS (makes use of statistics and probability)

Macroscopic properties of a system of molecules as a whole



The flow chart shows you how statistical Mechanics forms a bridge between Quantum world and Macroscopic world

- Thermodynamics describes a system in terms of macroscopic quantities such as pressure, volume and temperature. Its laws are formulated solely in terms of these and it makes no reference to a system's microscopic constitution. For this reason TD is a `macro theory‘
- Thermodynamics describes a large class of phenomena we observe in macroscopic systems. The aim of statistical mechanics is to account for this behaviour in terms of the dynamical laws governing the microscopic constituents of macroscopic systems and probabilistic assumptions

CLASSICAL AND QUANTUM STATISTICS

Points Compared	Maxwell-Boltzmann	Bose-Einstein	Fermi-Dirac
Statistics Applicable	Classical	Quantum	Quantum
Nature of particles	Identical & distinguishable	Identical & indistinguishable	Identical & indistinguishable
Examples	Molecules of a gas	i)Photons in a cavity ii)phonons in a solid	Free electrons in conductors
Properties of particles	Any spin wave functions do not overlap	Spin=0.1.2.3.4.... Overlap of wave functions	Spin=1/2,3/2, 5/2.. Overlap of wave functions
Distribution function	$f(E) = Ae^{-E/KT}$	$f(E) = \frac{1}{Ae^{E/KT}.1}$	$f(E) = \frac{1}{1+e^{(E-E_f)/KT}}$

Comparison between different types of statistics followed by Classical and Quantum particles

REFERENCES

- A Textbook of Statistical Mechanics- Prof Suresh Chandra, CBS Publishers
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press
- Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
- Slide Share and Google images