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Thermodynamics and Statistical Mechanics

Topic-Introduction of Statistical Mechanics

Learning Objectives

Statistical mechanics provides the basic idea of probability to the students. There are ways of calculating probability for various statistical system .

The course gives the insight of postulates of statistical physics.

Students will learn the different types of statistics distribution and particles. They will learn which particles follow which statistics and why.

The aim is to apply these statistical distribution in real life problems and understand their problems.

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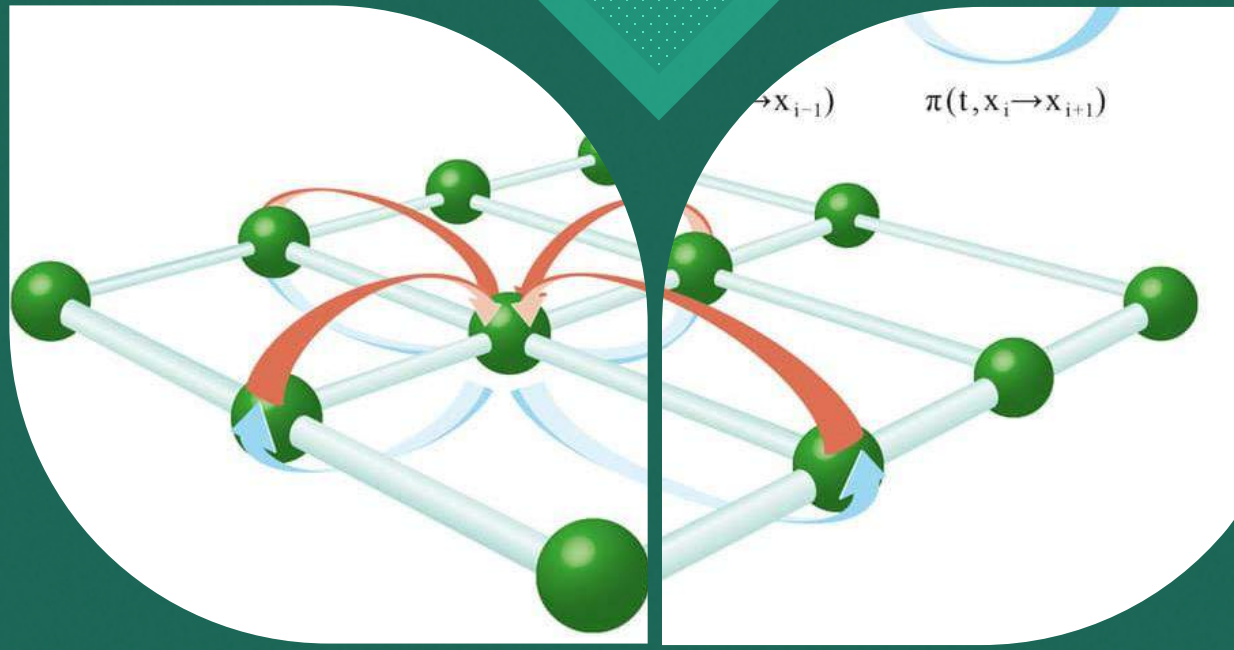
Topic to be cover

- What is Statistical Mechanics
- Need of Statistics in Physics
- Types of Statistics
- Classical Statistics-Maxwell Boltzmann Statistic
- Quantum Statistics-Bose Einstein Statistics
- Fermi Dirac Statistics

What is Statistical Mechanics

- Statistical mechanics is a valuable tool, which relates microscopic parameters to the macroscopic properties of a system that consists of a large number of molecules or particles.
- Statistics is that branch of science which deals with the collection, classification, and tabulation of numerical data as the basis of explanation ,description and comparison of various phenomenon.



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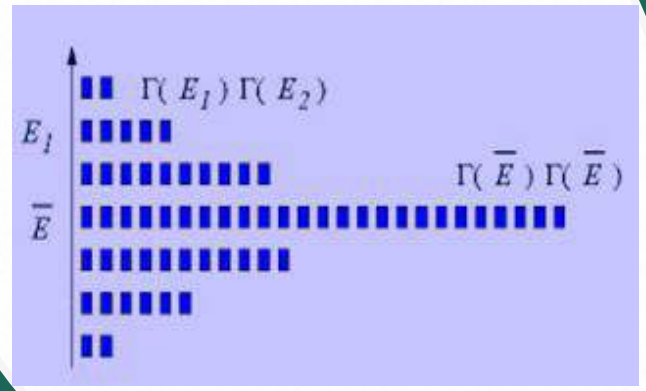
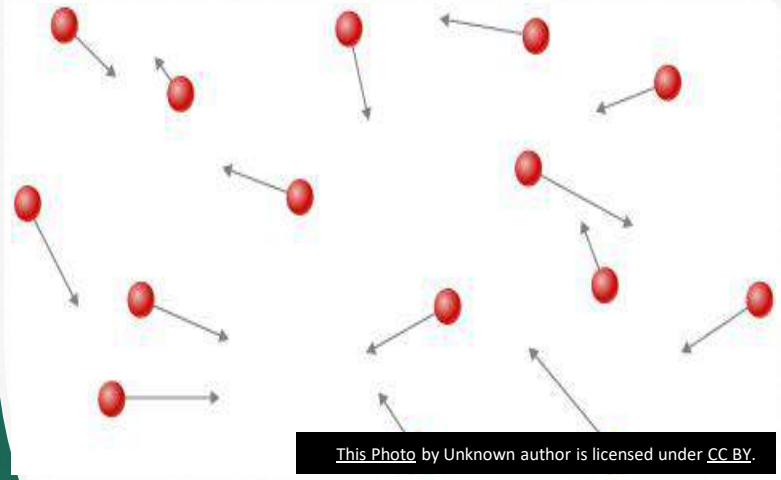
- When statistical concepts are applied to physics, the new branch that emerges is called statistical physics

- **Statistical mechanics** is necessary for the fundamental study of any physical system that has many degrees of freedom. The approach is based on **statistical** methods, probability theory and the microscopic physical laws. It can be used to explain the thermodynamic behavior of large systems.



Need of Statistics in Physics

- Statistical physics deals with macroscopic systems .i.e. The system consisting of a large number of individual particle such as atoms, molecules etc. It is not concerned with the behavior of the individual particles such as atoms, molecules etc.
- It is not concerned with the behavior of the individual particles of the system but takes into consideration the average or most probable properties of the system. As a system is a collection of a large number of particles of one type, we may have a system composed of atoms ,molecules ,protons, neutron or electrons.



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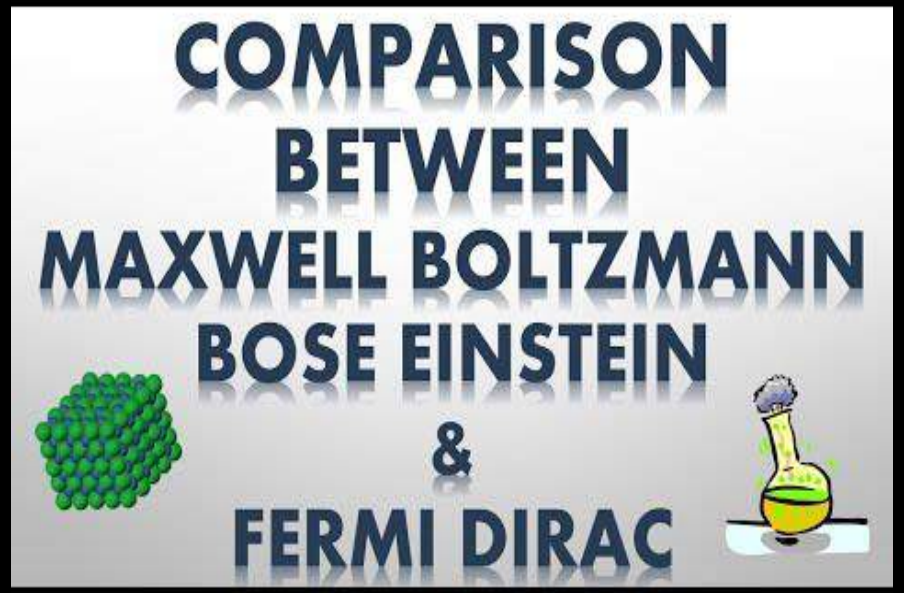
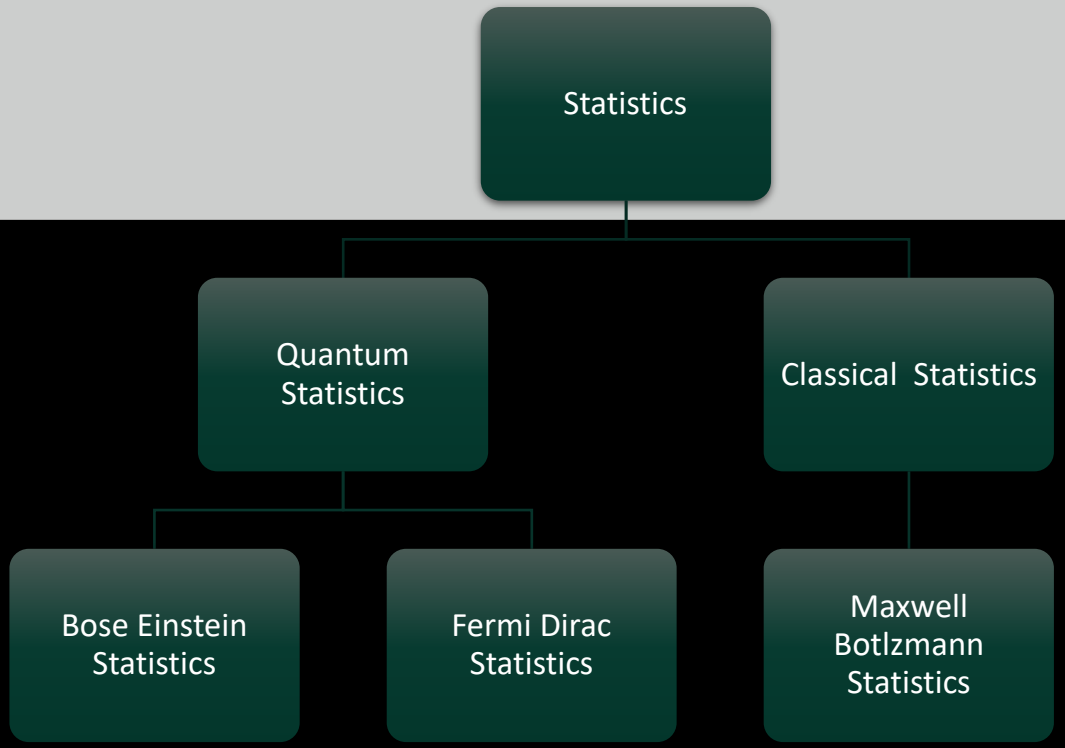
- The ordinary laws of mechanics are the only tool to explain physical phenomena. Where the system contains a large number of particles, ordinary laws of mechanics could not be used. Particularly that of electrons .Such problems are however ,successfully solved by statistical mechanics. The large number of particles in the physical system considered, the more nearly correct are the statistical predictions.

Types of Statistics





Three statistics depending upon three different kinds of particles

- Maxwell-Boltzmann statistics: This is applicable to the identical, distinguishable particles of any spin. The molecules of a gas are the particles of this kind.
- Bose-Einstein Statistics: is is applicable to the identical, indistinguishable particles of zero or integral spin. These particles are called bosons. The examples of bosons are helium atoms at low temperature and the photons.
- Fermi-Dirac Statistics: This is applicable to the identical, indistinguishable particles of half-integral spin. These particles obey Pauli exclusion principle and are called fermions. The examples of fermions are electrons ,protons, neutrons etc.

Now its time to assessment

We saw about statistical mechanics and need of statistics in physics.

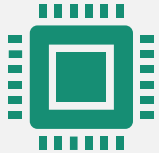
Statistics concern with the behavior of _____Particles.

Statistical Mechanics relates_____Parameters of the system.

Learning Outcomes

Understand the combinatoric studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.

Comprehend and articulate the connection as well as dichotomy between classical statistical mechanics and quantum statistical mechanics.



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References

Interface Science and Technology, 2004

Statistical mechanics - Wikipedia


THANK YOU