E-Content of PLASMA

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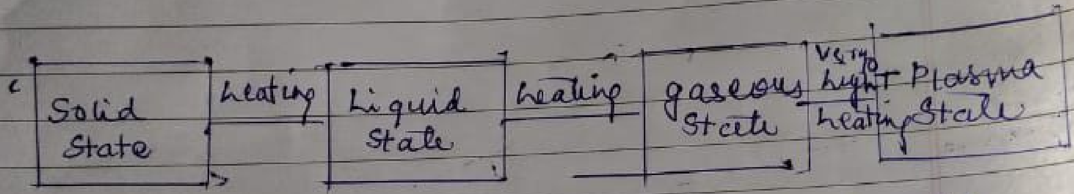
Introduction of Plasma.

Matter is classified in terms of four states: Solid, liquid, gaseous and Plasma. The binding forces are relatively strong in a solid, weak in a liquid and almost absent in a gaseous state. By heating solid it becomes liquid state, there after heating liquid becomes gas. Further heating at high temperature gaseous state becomes Plasma state.



By transition from solid to liquid, liquid to gas. This leads to phase transition which occurs at a constant temperature for a given pressure. The fourth state of matter is Plasma in which molecular gas dissociate into atomic gas. At sufficiently high temperature thermal energy exceeds molecular binding energy of atom and possesses enough Kinetic energy and ~~then~~ atoms are dissociated into electron and ionized gas which is the Plasma state. The transition from gas to a plasma is not a phase transition, it occurs due to high temperature

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In the absence of external disturbances a plasma ~~is~~ a plasma a plasma is macroscopically neutral this means that under equilibrium conditions with no external forces present. in a volume of the plasma, the net electric charge is zero In the microscopic space charge fields cancel each other and the net space charge exits over a macroscopic region

In this macroscopic space charge fields cancel each other and ~~not~~ no net space charge exits over a macroscopic region

In this macrospic neutrality was not maintained, the potential energy associated with the resulting coulomb forces could be ~~are~~ enormous compared to the thermal particle kinetic energy consider ~~a~~ plasma with a charged particle number density of $10^{20}\ m^{-3}$ and suppose the electron number density n_e is a spherical volume of 10^{-3} m radius r were to differ by 1% from positive ion density (n_i) the total net charge inside the sphere

$$q = \frac{4}{3}\pi r^3 (n_i - n_e) e$$

& the electric potential at surface of the sphere

$$\phi = \frac{1}{4\pi\epsilon_0}\frac{q}{r} = \frac{r^2}{3\epsilon_0}(n_i - n_e)$$

Plasma is defined as

Plasma is a collection of charged and neutral particles which exhibit the collective behaviour and obey condition quasi neutrality

The meaning of quasi neutrality that the number density of ion (n_i) and the density of electron (n_e) in a plasma is approximately equal

i.e $n_i \approx n_e$. Example of Debye shielding where Debye length

$$\lambda_D = \left(\frac{\epsilon_0 KT}{n_0 e^2}\right)^{\frac{1}{2}}$$

Collective behaviour - Plasma is the state of matter unlike gas. Because when plasma particles moves around they can generate local concentration of +ve and -ve charge which gives rise to electric field. These electric field affects the motion of other charge particle who are far away. Also charge particles move it generate field. It means motion of each charge particles produce magnetic field then all plasma particle are affected by electric and magnetic field of other particle of plasma. Hence behaviour of plasma particles are same. This is called collective behaviour. Example is Plasma Oscillation

$$\omega_e = \left(\frac{n e^2}{\epsilon_0 m}\right)^{1/2} \quad \Omega_c = \left(\frac{n e^2}{\epsilon_0 M}\right)^{\frac{1}{2}}$$

ω_e = frequency of electron
e = charge of electron
m = mass of electron

In second case

Ω_c = frequency of ion
e = charge of ion
M = Mass of ion

Example of Plasma

1. Sun - plasma at temp 10^{80} K.
2. Earth ionosphere
3. Lightening
4. Aror Bureales