Sem- IV (1)
Unit-2 ~ Dr. S. Roy

Introduction To Ideal MHD systems

The plasma may be considered as consisting of mainly three types of charged fluids i.e electrons, positive ions and the neutral particles. The three fluids interact with each other by virtue of electron-ion, electron-neutral and ion-neutral collisions. Among these interactions, electron-ions interaction is most important one.

When a such a charged fluid moves in a magnetic field, then electric currents are induced in the fluid as a result of its motion. This induced current will modify the field. At the same time the flow of charged ~~flow~~ fluid across the magnetic field will produce mechanical force and this mechanical force modify the motion of the fluid. In this way a coupling occurs between hydrodynamic motion and electromagnetic phenomena. Magnetohydrodynamics deals such type of interaction between the motion of the fluid and field. The effect of coupling between electromagnetic and hydrodynamic phenomena increases with linear dimension in which interaction is taking place.

If the plasma is considered as a single conducting fluid, then for continuous medium, the equation of continuity is taken as

$$\frac{\partial \rho}{\partial t} + \vec{\nabla}_r \cdot (\rho \vec{u}) = 0$$

If the plasma is considered as a mixture of two or probably three fluids, the we have to take three equations of continuities as

$$\frac{\partial n_e}{\partial t} + \vec{\nabla}_r \cdot (n_e \vec{u}_e) = 0$$

$$\frac{\partial n_i}{\partial t} + \vec{\nabla}_r \cdot (n_i \vec{u}_i) = 0$$

and $$\frac{\partial n_0}{\partial t} + \vec{\nabla}_r \cdot (n_0 \vec{u}_0) = 0$$

Here
e-stands for electron
i " " ion
o " " neutral particle density.

Using these above three equations we can describe the two-fluid model of MHD. ~~In the case of more than~~ And, one found that one-fluid mode is the special case of the two-fluid model of MHD.