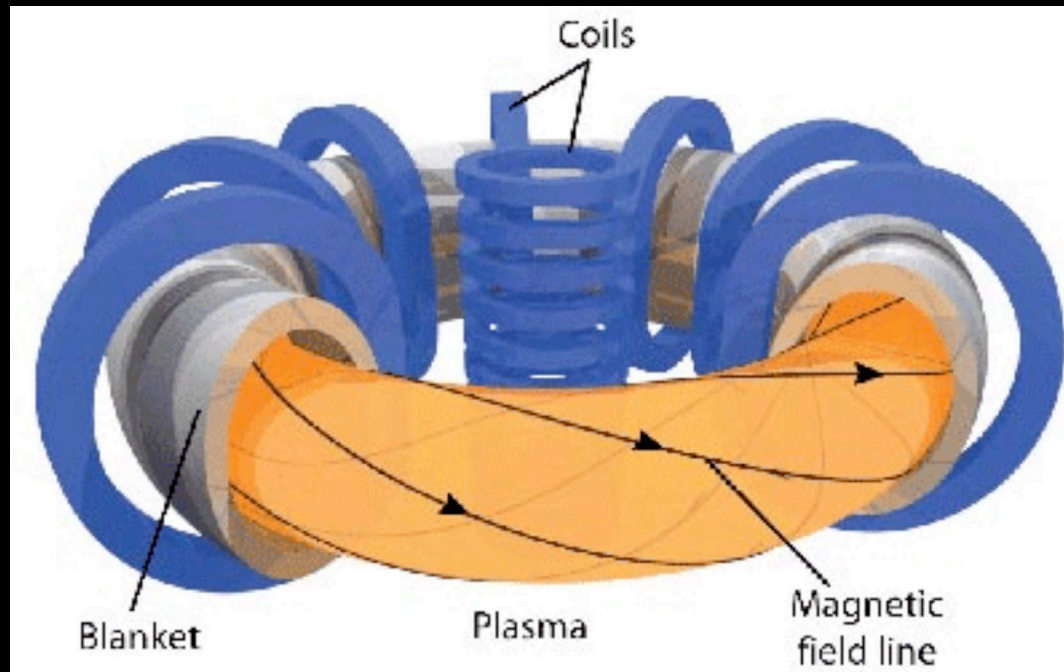


Magnetic field is used to confine a hot plasma...



Iron's melting point... $T \sim 1808 \text{ K}$

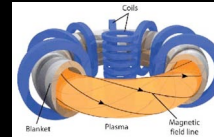
Tungsten's melting point... $T \sim 3695 \text{ K}$



Plasma... $T > 10000 \text{ K}$

Difference between solar plasma and laboratory plasma

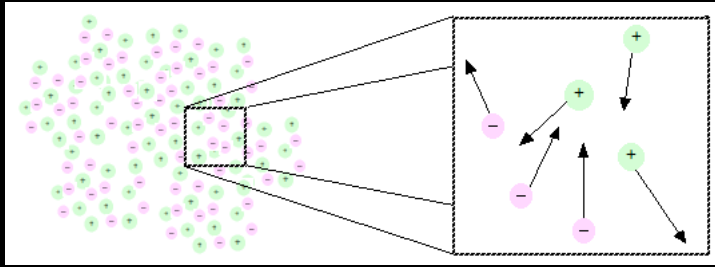
Macroscopic viewpoint (behavior of fluid elements)



	<i>Laboratory plasma</i>	<i>Solar plasma</i>
Basic state	Close to <i>Mechanical Equilibrium</i>	Essentially <i>Dynamic</i>
Flow	<i>Locally and/or Intermittently</i> may exist	<i>Globally and Continuously</i> exists (convective motions, solar winds)
Major force	Pressure gradient force $j \times B$ force	Pressure gradient force $j \times B$ force Gravitational force
System	<i>Artificially bounded</i> <i>Non-self-consistent</i>	<i>Naturally bounded</i> <i>Self-consistent</i>

Basic properties of plasmas

1. Local charge neutrality



The numbers of positive charges and negative charges *are almost the same* in every local region.

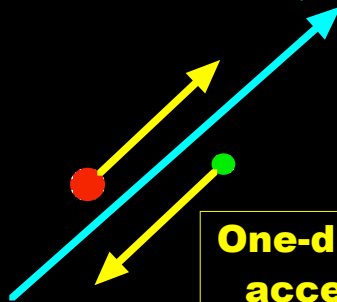
2. Interaction with electric field (**Coulomb force: $F_C = q E$**)

magenta... particle's property

red... ion (+)

green... electron (-)

Electric field
(uniform & steady)

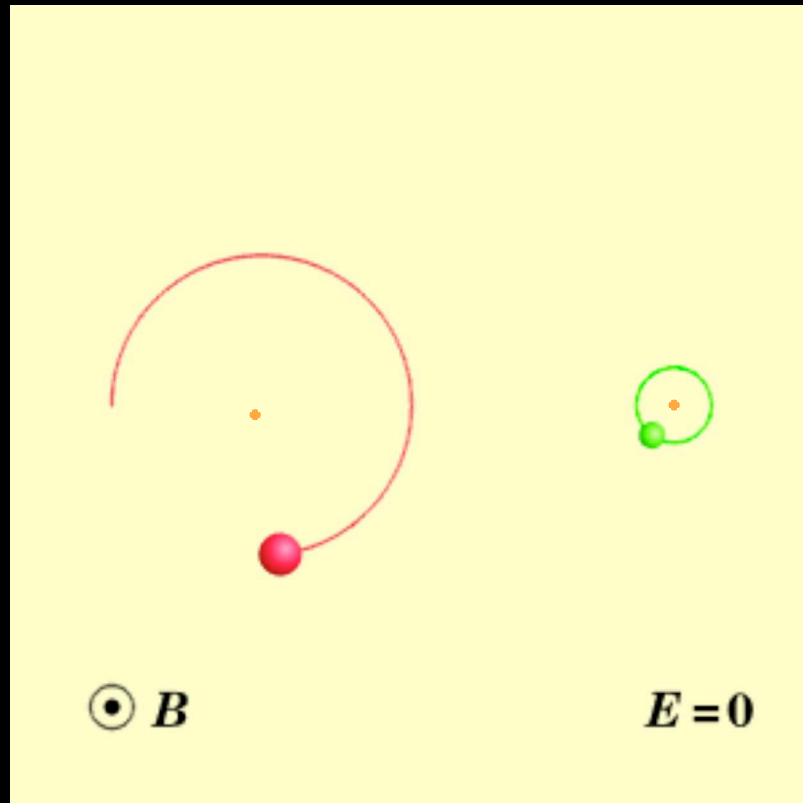


Charged particles are *accelerated along electric field*.

$$\frac{d\mathbf{v}}{dt} = \frac{q}{m} \mathbf{E}$$

Magnitude of v is changed.

3. Interaction with magnetic field (**Lorentz force:** $F_L = q \mathbf{v} \times \mathbf{B}$)

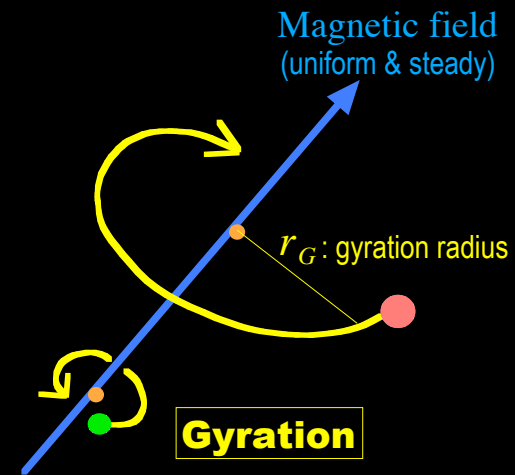


$B_{\perp}$ -plane

red... ion (+)

green... electron (-)

orange... gyration center



Charged particles *gyrate around magnetic field.*

$$\frac{d\mathbf{v}_{\perp}}{dt} = \frac{q}{m} \mathbf{v}_{\perp} \times \mathbf{B}$$

Direction of $\mathbf{v}$ is changed.

Gyration center does **not** move.