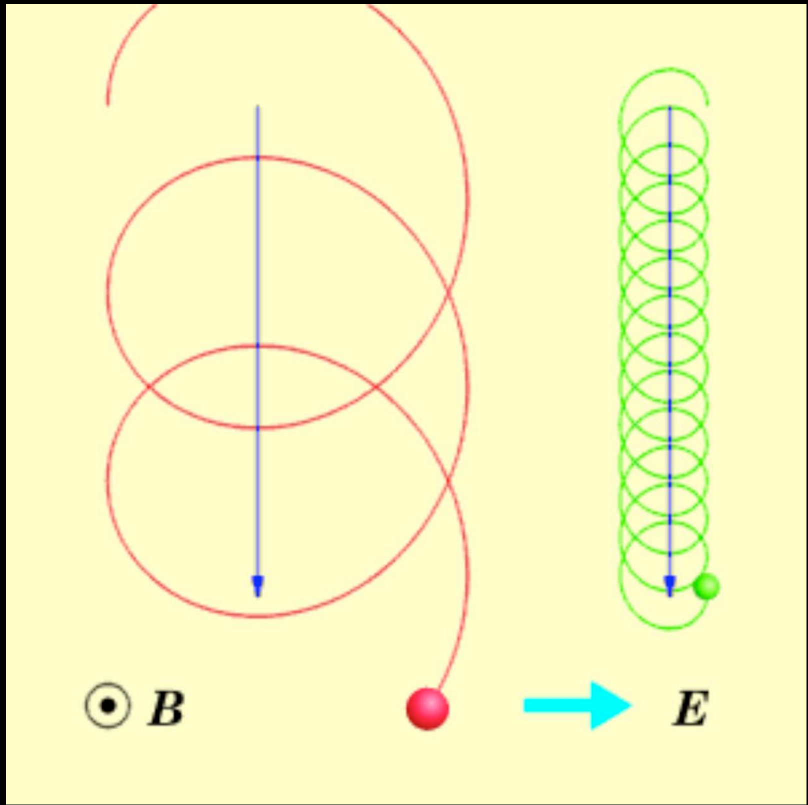
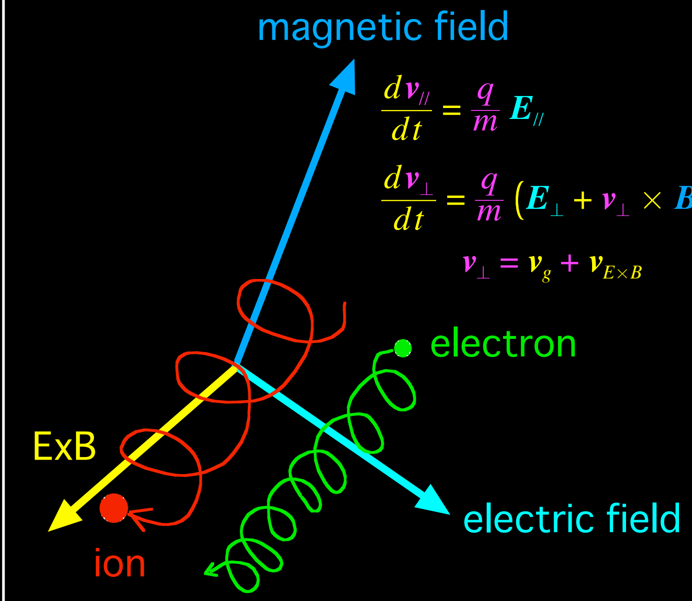
4. Interaction with electric field and magnetic field



B⊥-plane



$$\frac{d\boldsymbol{v}_{//}}{dt} = \frac{q}{m} \boldsymbol{E}_{//}$$

$$\frac{d\boldsymbol{v}_{\perp}}{dt} = \frac{q}{m} (\boldsymbol{E}_{\perp} + \boldsymbol{v}_{\perp} \times \boldsymbol{B})$$

$$\boldsymbol{v}_{\perp} = \boldsymbol{v}_{g} + \boldsymbol{v}_{E\times B}$$

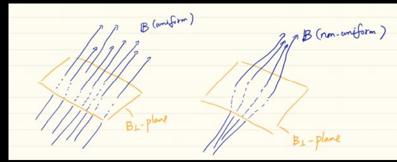
ExB drift of gyration center:

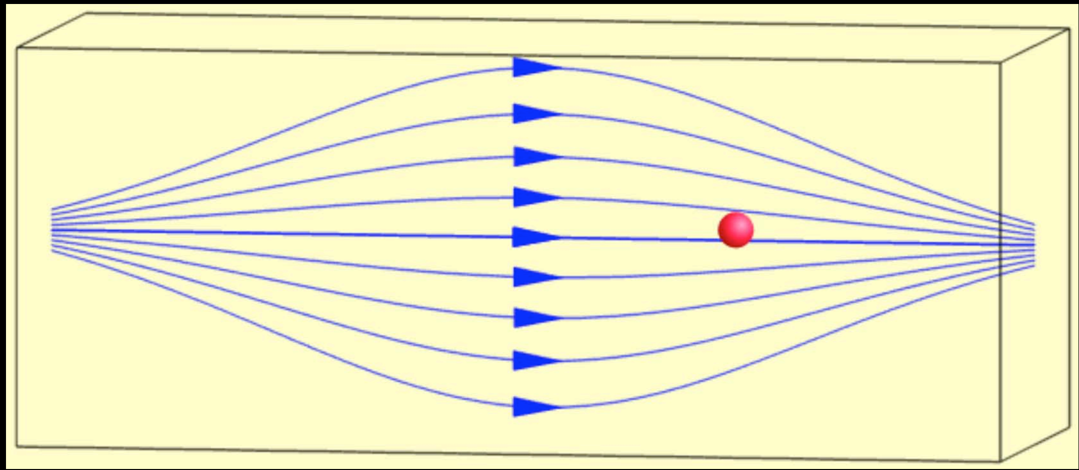
$$\boldsymbol{v}_{E\times B} \equiv \frac{\boldsymbol{E} \times \boldsymbol{B}}{B^2}$$

... perpendicular to both electric field and magnetic field

... does not depend on mass & charge of a particle => keep local charge neutrality

5. Interaction with non-uniform magnetic field





Mirror effect

Relatively low-energy charged particles are reflected at a region where magnetic field becomes strong.

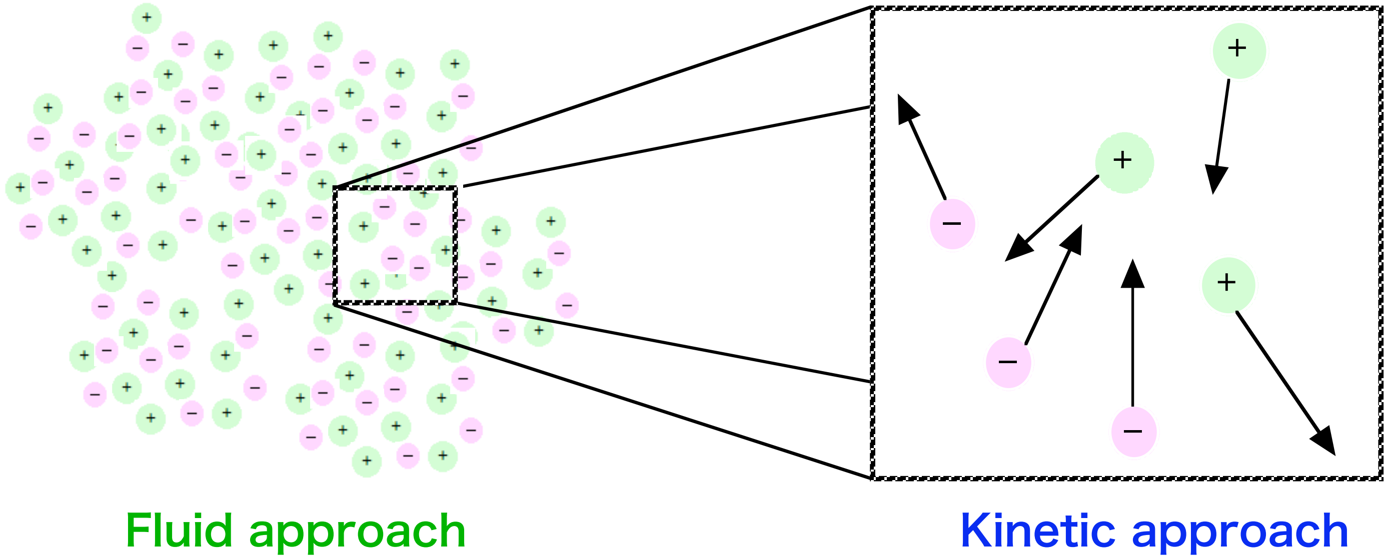
(This may cause particle acceleration when the region moves against an incident particle.)

Two approaches to plasma physics

Plasma... composed of <u>many particles</u>

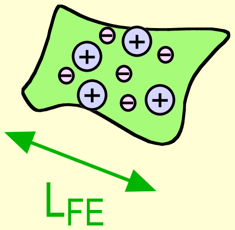
Focus on a selected local region → **Kinetic approach**

Focus on the whole region → **Fluid approach**



Kinetic approach → study microscale processes,
the behavior of particles

Fluid approach → study macroscale processes,
the behavior of fluid elements*



*fluid element... a virtual object containing a number of particles;
most of the particles keep staying inside this object (=> typical size L_{FE} >> l_{mfp}, r_G)

l_{mfp}: mean free path r_G: gyration radius