Plasma d120 3/24/2021

Conductivity in a Magnetic Field

(1) We already calculated the thermal conductivity without or parallel to a magnetic field:

$$E_c = -\vec{\nabla}\cdot\vec{F_c} = -\vec{\nabla}\cdot(\lambda_0 T^{5/2}\vec{\nabla}T)$$

(2) But the mfp (mean free path) $\perp \vec{B}$ is far smaller than along the field. The plasma is frozen in

$$\lambda_{\parallel} \sim 10^{10}\,\lambda_{\perp} \quad !$$

(3) Hence perpendicular conduction losses can be ignored, and we have

$$\vec{\nabla}\cdot F_c = E_H - \beta^2\Psi(T)$$

E_H: heating; $\Psi(T)$: radiative loss

For a static 1D coronal loop