Harris Sheet Prachanda_Hw+note.

A 1D current sheet equilibrium is the harris Sheet. The magnetic field in harris sheet is typically described by

$B_n(y) = B_0 \tanh(x/\delta)$

$B_0 \rightarrow$ magnetic field strength

$\delta \rightarrow$ half thickness of current sheet

$\nabla \cdot B = 0 \rightarrow$ no source or end

We know that

$B_y = B_0 \tanh(x/\delta)$

$E = -\vec{V} \times \vec{B} + \eta \vec{J}$

$\vec{J} = \nabla \times \vec{B}$

$\nabla \times E = 0$

$\nabla E =$ constant

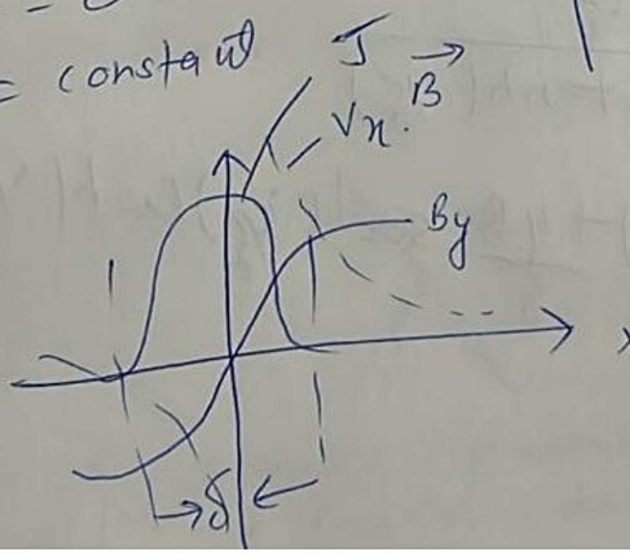
From standard equation

$\partial_t \vec{B} = \vec{\nabla} \times \vec{V} \times \vec{B} + \eta \Delta \cdot \vec{B}$

magnitude $= \frac{VB}{L}$ & $\frac{\eta B}{l^2}$

$R_m = \frac{\frac{VB}{L}}{\eta B / L^2}$

$R_m = \frac{Vl}{\eta} = 10^{14}$



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current density $(J) = \nabla \times \vec{B}$

$$= \nabla \times (B_0 \tanh(x/\delta)$$

$$= \frac{B_0}{\delta} \sec^2 h(x/\delta) \cdot \hat{z}$$

for $x = 0,\ B = B_0$

$x = +ve,\ B = +B_0$

$x = -ve,\ B = -B_0$

Now, for calculating E

$$E_z = V_x B_y + \eta J_z$$

$$E_z = -V_x B_y + \eta J_z \quad \Big| \ \vec{J} \cdot \vec{z} = |J|$$

$$= -V_x B_0 \tanh(x/\delta) + \eta \frac{B_0}{\delta} \sec^2 h(x/\delta)$$

$$= V_x = \frac{\eta \frac{B_0}{\delta} \sec^2 h\left(\frac{x}{\delta}\right) - E_z}{B_0 \tanh(x/\delta)}$$

$$V_x = \frac{-E_z}{B_0} \coth\left(x/\delta\right) + \frac{\eta B_0}{\delta} \operatorname{sech}(x/\delta) \cosh(x/\delta)$$