AST 552 – General Plasma Physics II, Part 1 Magnetohydrodynamics

Homework Set 2, Feb. 13, 2006

3. Internal energy equation for resistive MHD

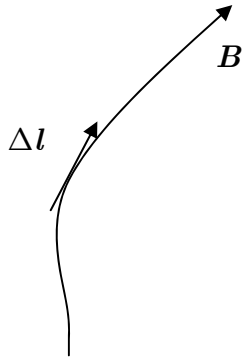
Show that for resistive MHD, the internal energy equation can be written as

$$\frac{dp}{dt} + \gamma p \nabla \cdot \boldsymbol{v} = (\gamma - 1)\eta \boldsymbol{j}^2,$$

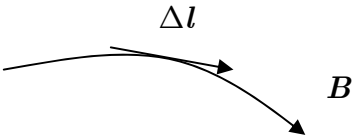
where $\eta$ is the resistivity, $\boldsymbol{j}$ is the current density, and $\gamma = \frac{5}{3}$ for adiabatic process.

4. Direct proof of field line freezing

For ideal MHD, prove that if $\boldsymbol{B} \times \Delta \boldsymbol{l} = 0$ at $t = 0$ for a short line element of the fluid $\Delta \mathrm{l}$, then $\boldsymbol{B} \times \Delta \boldsymbol{l} = 0$ for all $t$.




$t = 0$




$t > 0$