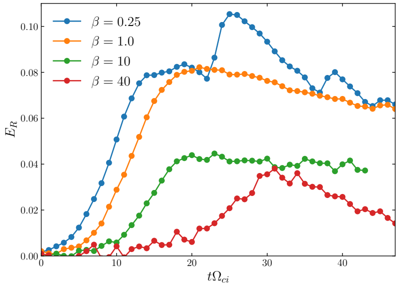
The Effect of Thermal Pressure on Collisonless Magnetic Reconnection Rate

Xiaocan Li, Yi-Hsin Liu

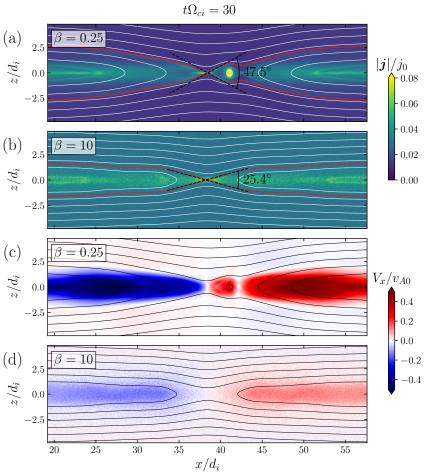
Dartmouth College

MMS 2020 FALL SWT

Reconnection rate decreases with plasma β

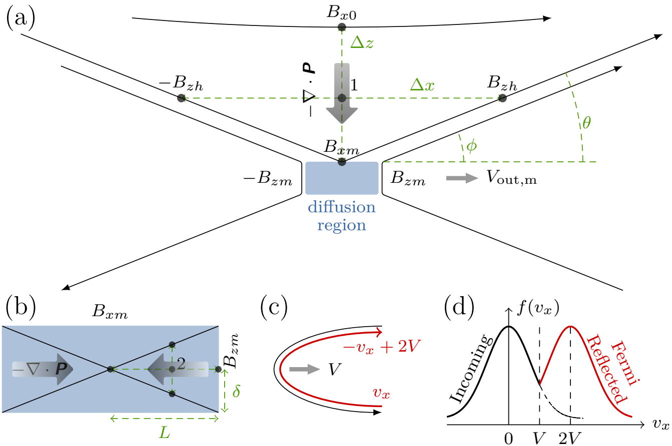


- $m_i/m_e = 400, T_i = T_e,$ $\omega_{pe}/\Omega_{ce} = 2, 1536d_e \times 1536d_e$
- Harris sheet, $B_g = 0, n_b = n_0$
- $\beta = 0.25, 1, 10, 40$ by changing T_b/T_0
- `VPIC` code



Slower outflow in high-β simulations

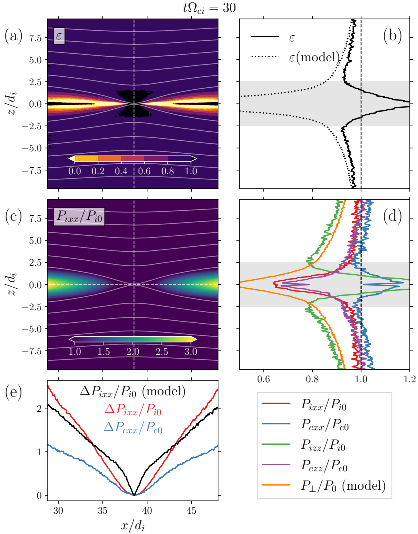
An extended model including pressure anisotropy and pressure gradient force (adapted from Liu et al., 2017)



$$nm_i \frac{\partial \boldsymbol{V}}{\partial t} + nm_i \boldsymbol{V} \cdot \nabla \boldsymbol{V} + \nabla \frac{B^2}{8\pi} + \nabla P_\perp \simeq \nabla \cdot \left(\frac{\varepsilon}{4\pi} \boldsymbol{B}\boldsymbol{B} \right)$$

$$\varepsilon = 1 - 4\pi (P_\parallel - P_\perp)/B^2$$

Thermal effects in the run with $\beta = 1$



- In the inflow region, we assume $P_{\perp} \sim B$ and $P_{\parallel} \simeq P_0$.
- In the outflow, $P_{\perp} \simeq P_{xx}$. The increases of P_{xx} is associated mostly with Fermi-reflected ions.

Model predictions