Reversibility in Magnetic Reconnection

Max Xuan, Marc Swisdak, Jim Drake

University of Maryland

MMS SWT

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Reversibility in Magnetic Reconnection

- While reversible in principle – see the Vlasov equation

$$\frac{df}{dt} = 0$$

 – collisionless reconnection observationally has a preferred direction.
- Reversible = constant entropy. See *Liang et al.* (2019, 2020) for entropy in (supposedly) collisionless PIC codes.
- In practice, reconnection, like Landau damping, is irreversible: phase space is overwhelmed by "noise"
- To see this:
  - Test particle orbits in analytic field model
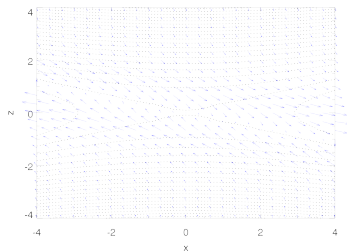 - Reversal of full PIC simulations
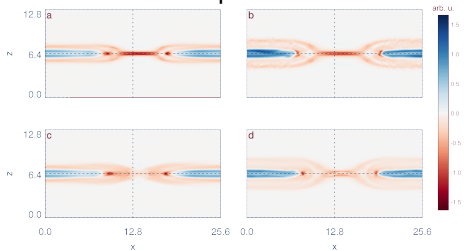
Test Particles

Anti-parallel
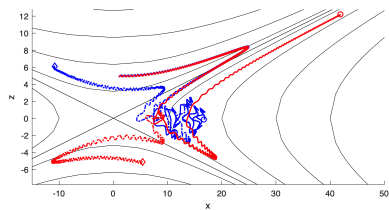
$B_g = 1$
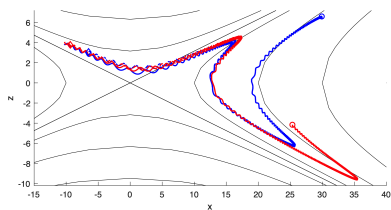
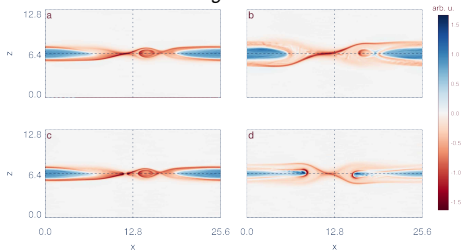
- Irreversibility: demagnetization and turning points.

- Larger guide field $\rightarrow$ more reversible.

PIC Simulations

Anti-parallel

Reconnected Flux versus Time

$B_g = 1$