Introduction

Magnetic fluctuations in plasma devices can give rise to a variety of relaxation mechanisms. In many confinement devices, including the reversed field pinch, spheromak, and the field reversed configuration, global and near-axis helicity can be observed. This can lead to the spontaneous evolution to a lower energy state (kinetic or magnetic).

Current and Momentum Relaxation in the MST Reversed Field Pinch

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Relaxation Theory

- Global and near-axis helicity can give rise to a variety of relaxation mechanisms. In many confinement devices, including the reversed field pinch, spheromak, and the field reversed configuration, global and near-axis helicity can be observed. This can lead to the spontaneous evolution to a lower energy state (kinetic or magnetic).

Relaxation Observations in MST

Current Profile

- Important relaxation mechanisms are observed during reconnection events.
- A need for another term in the momentum equation to account for relaxation.

Flow Profile

- Component of the parallel dynamo measured in the edge flips sign at the reversal surface.
- Component of the MHD dynamo flips sign at the reversal surface and decreases in the core.

Measurements of Relaxation Mechanisms

Hall Dynamo ($\nabla \times j > 0$)

- Measure the rate of momentum change during reconnection events.
- Magnetic stresses in the core and near-axis helicity are important during reconnection events.

Summary

- Relaxation occurs during impulsive reconnection events associated with periodic reconnection events.
- Decrease of stored magnetic energy.
- Increase of magnetic fluctuations.
- Flux profile remains constant as momentum-stress and magnetic-fluctuation peaks decrease.
- Profile flattens during reconnection as predicted by the quasi-linear theory.

Diagnostics available on MST

- Measurements of correlated fluctuating parameters in MST determine when relaxation mechanisms are important.
- Relaxation mechanisms are observed in MST devices where the magnetic axis is not aligned with the magnetic field.

Array of diagnostics available on MST and on plasma devices.

Maxwell Stress ($\nabla \times (B \times j) < 0$)

- Measurement of the Maxwell stress in the core indicates an important magnetic stress contribution to the momentum equation.
- Magnetic stresses in the core may be significant for understanding relaxation mechanisms.

Reynolds Stress ($\nabla \times B < 0$)

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