Observation of localized ion heating during driven collisionless magnetic reconnection

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Abstract

The Versatile Toroidal Facility (VTF) is a magnetic reconnection experiment. It allows plasma to be generated in a magnetic cusp field by ECR heating. An additional set of toroidal magnetic coils, which provides highly reproducible conditions and allows for measurements of the ion velocity distribution function (IVDF) with high spatial and temporal resolution by means of laser induced fluorescence (LIF). In the present scheme, ArII metastable ions are excited tangentially to the magnetic guide by a diode laser field at a wavelength of 668 nm and the fluorescence light at a wavelength of 442 nm is collected. Phase resolved analysis on the timescale of the reconnection drive reveals strong ion heating at the X-line during driven reconnection. Averaged measurements yield strong ion heating within a reconnection cycle and the heating is found to scale with the reconnection drive amplitude. These findings are consistent with Monte Carlo simulations and with strong evidence that reconnection causes ion heating at the X-line during driven reconnection.

Diagnostics

- LIF setup
- Diagnostics VTF at MIT
- Phase resolved IVDF
- Averaged IVDF
- Time resolved IVDF
- Light emissions
- Summary

Summary

- IVDF was measured during reconnection with LIF outside the reconnection region (the X-line) and inside the reconnection region. Time averaged measurements yield strong ion heating at the X-line only.
- Time resolved measurements reveal a correlation between ion heating and driven reconnection.
- Phase resolved analysis yields the same time evolution of the IVDF and the ion temperature inside the reconnection region on both sides of the X-line.
- Time averaged measurements yield a strong ion heating at the X-line only.
- Time resolved measurements reveal a correlation between ion heating and driven reconnection.
- Phase resolved analysis yields the same time evolution of the IVDF and the ion temperature inside the reconnection region on both sides of the X-line.

Bibliography


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