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Resistive magnetic reconnection in a plasma stream

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Magnetic reconnection is a fundamental process in plasma physics which plays an essential role for various space and astrophysical explosive phenomena. It is one of the most important issues in plasma physics to elucidate the physical mechanism of fast magnetic reconnection in high Lundquist number plasmas. In recent years, using high-resolution MHD simulations, it has been shown that a new fast magnetic reconnection process may be driven by a secondary instability in a thin current sheet involving a plasma stream (Sweet-Parker-type current sheet) [1]. Moreover, state-of-the-art very-high-resolution MHD simulation indicated that Petschek-type magnetic reconnection may dynamically be triggered by a complicated interaction with the plasma stream around the current sheet [2]. Therefore, we can expect that magnetic reconnection in the plasma stream becomes a key process for fast magnetic reconnection in high Lundquist number plasmas.

Although several theoretical and numerical studies for the tearing instability in an anti-parallel magnetic field including a field-aligned plasma stream, i.e., the streaming tearing instability, have been reported so far [3], the nonlinear dynamics of well-developed magnetic reconnection in the plasma stream has not been clarified yet. Thus, the objective of this paper is to explore the nonlinear dynamics of resistive magnetic reconnection in the plasma stream using the MHD simulation. In this study, nonlinear magnetic reconnection was triggered by a large perturbation in the Harris-type equilibrium with a localized field-aligned plasma stream. The results indicated that the current sheet structure of the reconnection point is varied depending on the bulk speed of the localized plasma stream. We found that the current sheet can be localized when the bulk speed is less than the Alfven speed.

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