The Hall dynamics of ions and its role in kickstarting the ion outflow

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Abstract

The Hall term in the generalized Ohm's law leads to fast magnetic reconnection. In this study, we investigate the motion of ions due the Hall fields and try to quantify what role it plays in the formation of the outflow. We present a very simple Hall injection model based on the conservation of the total energy and the canonical momentum in the outflow direction. We argue that the ions should be injected into the outflow with a minimum outflow speed which depends on the relative amplitude of the Hall electric and magnetic fields as well as the speed, or energy, of the ion. We also discuss the relative importance of and interplay between the Hall and Speiser mechanism inside the ion diffusion region. Importantly, the Hall mechanism allows the ions to bypass the X line, and potentially opens up the outflow, potentially being an ingredient in fast reconnection.

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