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Electron Acceleration due to Lower Hybrid Waves in Magnetic Reconnection Regions

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Magnetic reconnection is widely believed to produce significant acceleration of particles to high energies. Little agreement exists as to how this is done. However, (1) recent Wind observations in and near a reconnection region in Earth's magnetotail show that electrons are energized to parallel speeds near c/2[1] and (2) lower hybrid (LH) waves are common in Hall-MHD simulations and Wind observations of current sheets and magnetic reconnection regions [1,2,3]. It is suggested here that LH waves are important in producing electron acceleration in reconnection regions: LH drify instability produces LH waves that resonantly accelerate electrons parallel to **B** via so-called "lower hybrid drive". Analytic theory is used to support this suggestion, finding that the mechanism can accelerate electrons up to about c/2 under solar and magnetotail conditions, not inconsistent with recent magnetotail observations [1], and that it should be much more efficient under solar conditions. The model is supported by the recent numerical simulations of Drake et al. [3], which show both LH waves by the recent numerical simulations of Drake et al. [3], which show both LH waves and an accelerated electron tail reminiscent of LH drive, as well as electron holes. It is shown that the LH waves are resonant with the electron tail, so that LH drive likely produces some of the electron acceleration found in the simulations.

Keywords: Electron acceleration; magnetic reconnection; lower hybrid drive; lower hybrid waves; wave-particle interactions; magnetotail; solar flares.

References

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