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Ion heating during magnetic reconnection with a guide field: a threshold for pickup behavior J.F. DRAKE, University of Maryland, P.A. CASSAK, West Virginia University, M.A. SHAY, University of Delaware, M. SWISDAK, University of Maryland, E. QUATAERT, U. C. Berkeley — The acceleration of ions during magnetic reconnetion with a guide field is explored with simulations and analytic analysis. Ions crossing into Alfvénic reconnection outflows can behave like pickup particles and gain an effective thermal velocity equal to the Alfvén speed. However, with a sufficiently strong ambient out-of-plane magnetic field, which is the relevant configuration for most laboratory experiments and astrophysical systems, the ions can become adiabatic and their heating is then dramatically reduced. The threshold for non-adiabatic behavior, where ions are strongly heated, becomes a condition on the ion mass-to-charge-ratio, $m_i/m_pZ_i > 10\sqrt{\beta_{0x}/2}/\pi$, where m_i and Z_i are the ion mass and charge state, m_p is the proton mass and $\beta_{0x} = 8\pi nT/B_{0x}^2$ is the ratio of the plasma pressure to that of the reconnecting magnetic field B_{0x}. Thus, during reconnection high mass-to-charge particles gain energy more easily than protons. A simple model reveals that in the case of flares the abundances of high mass-to-charge ions are enhanced, which is consistent with observations. Implications for understanding ion heating during sawtooth events in the MST reversed field pinch are also discussed.

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