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Quasi-adiabatic transport in Mercury's magnetotail

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MESSENGER observations have revealed that the magnetotail of Mercury is fairly dynamical, possibly subjected to series of magnetic field line dipolarization on time scales of a few seconds. Because of the sharp reversal of the magnetic field, ions may not travel adiabatically in this region of space, and their behavior can be organized according to different categories. Among these categories, quasi-adiabatic (Speiser) ions are such that they experience negligible net change of magnetic moment upon crossing of the field reversal and can thus travel back to low altitudes. We examine the robustness of this quasi-adiabatic behavior during magnetic field line dipolarization where ions are subjected to a large induced electric field. We demonstrate that, although this surging electric field possibly yields substantial nonadiabatic heating, quasi-adiabaticity is robust for ions with velocities larger than the peak ExB drift speed, a behavior that we refer to as "strong" quasi-adiabaticity (as opposed to "weak" quasi-adiabaticity that is violated during dipolarization). We show that the impulsive energization of such quasi-adiabatic ions during dipolarization events can lead to prominent energy-time dispersion structures at low altitudes.