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Energetic Electron Acceleration and Injection During Dipolarization Events in Mercury's Magnetotail

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Energetic particle bursts associated with dipolarization events within Mercury's magnetosphere were first observed by Mariner 10. The events appear analogous to particle injections accompanying dipolarization events at Earth. The Energetic Particle Spectrometer (3 s resolution) aboard MESSENGER determined the particle bursts are composed entirely of electrons with energies $\gtrsim$ 300 keV. Here we use the Gamma-Ray Spectrometer high-time-resolution (10 ms) energetic electron measurements to examine the relationship between energetic electron injections and magnetic field dipolarization in Mercury's magnetotail. Between March 2013 and April 2015, we identify 2,976 electron burst events within Mercury's magnetotail, 538 of which are closely associated with dipolarization events. These dipolarizations are detected on the basis of their rapid ($\sim$2 s) increase in the northward component of the tail magnetic field (ΔBz $\sim$30 nT), which typically persists for $\sim$10 s. Similar to those at Earth, we find that these dipolarizations appear to be low-entropy, depleted flux tubes convecting planetward following the collapse of the inner magnetotail. We find that electrons experience brief, yet intense, betatron and Fermi acceleration during these dipolarizations, reaching energies $\sim$130 keV and contributing to nightside precipitation. Thermal protons experience only modest betatron acceleration. While only $\sim$25% of energetic electron events in Mercury's magnetotail are directly associated with dipolarization, the remaining events are consistent with the Near-Mercury Neutral Line model of magnetotail injection and eastward drift about Mercury, finding that electrons may participate in Shabansky-like closed drifts about the planet. Magnetotail dipolarization may be the dominant source of energetic electron acceleration in Mercury's magnetosphere.