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Energetic electron flux enhancements in Mercury's magnetosphere: An integrated view with multi-instrument observations from MESSENGER

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One of the fascinating observations by Mariner 10 during its March 1974 flyby of Mercury was the detection of intense bursts of energetic particles in Mercury's magnetosphere—apparently in association with substorm-like magnetic field reconfigurations. A full understanding of where, when, and how such particle bursts occur was not possible, of course, from the limited Mariner 10 data. Considerable theoretical speculation about this topic has nonetheless filled the four decades since Mariner 10's first Mercury flyby. The MESSENGER mission to Mercury has provided a wealth of new data about energetic particle phenomena. With observations from MESSENGER's Energetic Particle Spectrometer, as well as signals arising from energetic electrons and recorded by the X-Ray Spectrometer and Gamma-Ray and Neutron Spectrometer instruments, we have greatly extended our understanding of the acceleration, transport, and loss of energetic electrons at Mercury. The combined data sets include measurements from a few keV up to several hundred keV in electron kinetic energy and have permitted extremely good temporal resolution (of order 10 ms sampling) for many events. We review the spatial and temporal occurrence of energetic electron bursts, and we place these events in the context of solar wind and magnetospheric forcing at Mercury.