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Interchange and plasma injection events in Saturn's magnetosphere: Average properties, frequency, spatial distribution, and plasma transport

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During the Cassini spacecraft's first orbits around Saturn, numerous transient events were observed in the planet's inner magnetosphere. These events are characterized by an abrupt change in the magnetic field strength, a simultaneous disappearance of the low energy ion and electron populations and the appearance of a hot electron population with energies between one hundred and a few thousand eV. In some cases, these events are associated with time-dispersed energetic particle events. These characteristics are consistent with the rapid interchange of flux tubes and the injection of hot, tenuous plasma from the outer magnetosphere. This process, also observed by the Galileo spacecraft at Jupiter, is associated with the radial transport of plasma and the centrifugally-driven Rayleigh-Taylor instability. We present a statistical analysis of these events, describing their average properties, frequency of occurrence, and spatial distribution. The spatial distribution of these events identifies regions where the instability criteria is satisfied.