Statistical analysis and multi-instrument overview of the quasi-periodic 1-hour pulsations in Saturn's outer magnetosphere

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The in-situ exploration of the magnetospheres of Jupiter and Saturn has revealed different periodic processes. In particular, in the Saturnian magnetosphere, several studies have reported pulsations in the outer magnetosphere with a periodicity of about 1 hour in the measurements of charged particle fluxes, plasma wave, magnetic field strength and auroral emissions brightness. The Low-Energy Magnetospheric Measurement System detector of the Magnetospheric Imaging Instrument (MIMI/LEMMS) on board Cassini regularly detects 1-hour quasi-periodic enhancements in the intensities of electrons with an energy range from a hundred keV to several MeV. We present a survey of these relativistic electron injections observed during the first 10 years of the Cassini orbital mission. During this period, we identified 720 pulsed events in the outer magnetosphere over a wide range of latitudes and local times, revealing that this phenomenon is common and frequent in Saturn's magnetosphere. However, the distribution of the injection events presents a strong local time asymmetry with ten times more events in the duskside than in the dawnside. A statistical analysis of these pulsed events is carried out to investigate their properties. This analysis reveals that the mean interpulse period is 68 ± 19 minutes and that the events are made up of less than 9 pulses in general, but they can include up to 19 pulses. We have also investigated the signatures of each electron injection event in the observations acquired by other Cassini's instruments, in particular the Radio and Plasma Wave Science (RPWS) instrument and the magnetometer (MAG). Correlated pulsed signatures are observed in the plasma wave emissions, especially in the auroral hiss, for 12% of the electron injections identified in the LEMMS data. Additionally, in about 20% of the events, such coincident pulsed signatures have been also observed in the magnetic field measurements, some of them being indicative of field-aligned currents. This multi-instrument approach sets constraints on the origin and significance of the pulsed events.