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Magnetospheric storms at Saturn and Jupiter and their relation to rotational periodicities

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A magnetospheric storm is a well-known phenomenon in the terrestrial magnetosphere and leads to intensified plasma pressure, electrical currents and magnetic field perturbations. While terrestrial magnetospheric storms are externally driven predominantly by dayside reconnection with the interplanetary magnetic field (IMF), imaging of Saturn's magnetospheric energetic plasma distribution by Cassini/INCA reveals that storms occur during enhanced solar wind dynamic pressure. Galileo measurements in Jupiter's magnetosphere strongly suggest a similar dependence for Jovian magnetospheric storms. There is growing evidence that, at Saturn, the centrifugal forces acting on the cold, dense plasma of the inner magnetosphere forms plasmoids that travel down the tail. We show observational evidence for this plasmoid formation and its close relation to energetic particle injections and radio emissions.

We show that, at Saturn, the periodic magnetic field oscillations and saturn kilometric radiation (SKR) can be explained by the currents driven by the injected and energized plasma pressure distribution drifting around Saturn. The evolution of these pressure-driven currents is consistent with the evolution of the SKR. To quantify the magnetic field oscillations we estimate the distribution and strength of the plasma pressure from Cassini/MIMI and CAPS observations of hot and cold plasma. We find that the periodic magnetic field perturbations are consistent with the asymmetric hot plasma pressure distributions observed by the Cassini/MIMI/INCA. The major field depression, however, is consistent with a symmetric distribution of the cold plasma. We conclude that periodic plasmoid release is the central driver of the periodic signatures in fields, particles and SKR.