

Periodicities in planetary magnetospheres

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Numerous properties of Earth's magnetosphere vary periodically on time scales ranging from seconds to years. Periodicity is apparent in seasonal and daily changes of the global configuration, variations of the intensity of geomagnetic activity (semiannual), substorm activity (quasi-periodic - hours), FTE recurrence (minutes), and a host of resonant geomagnetic pulsations (seconds to tens of minutes) as well as some quasi-hourly pulsations that may be imposed directly from the solar wind. Other magnetospheres reveal periodicities arising both from similar and planet-specific sources. In Jupiter's magnetosphere, the magnetospheric configuration changes periodically as the tilted internal field rotates (hours - SIII), and quasi-periodicity has been found in reconnection events (days), the appearance of polar flares (minutes), and the intensity of radio-frequency emissions and the orientation of the magnetospheric magnetic field (15 - 40 minutes). Variations at a period slightly longer than SIII (defined as SIV) are intermittently detected and still not fully understood. Because Jupiter's obliquity is small, variations of its magnetosphere with season are negligible, but Saturn's large tilt imposes distinct seasonal changes (years). As well, Saturn's magnetosphere varies globally at a period slightly longer than the period of rotation of its deep interior (hours). This periodicity (referred to as PPO or planetary period oscillation) is probably imposed by motions in the upper atmosphere, but evidence is indirect. On shorter time scales, Saturn also manifests quasi-one-hour pulsations in radio-frequency emissions, energetic particle intensities, and the orientation of the magnetospheric magnetic field. The magnetosphere of little Ganymede manifests variations on time scales of seconds, probably imposed by periodic reconnection at its magnetopause. These phenomena have attracted considerable attention in the magnetospheric community in recent years as we attempt to understand source mechanisms and control of occurrence and response frequency in different plasma regimes. A selective tour of solar system bodies will focus on the different mechanisms through which periodicity arises in planetary magnetospheres and discuss the parameters that control the observed periods.