Magnetic reconnection in Saturn's magnetotail: A comprehensive magnetic field survey.

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Abstract

Magnetic reconnection is a fundamental process throughout the solar system, significantly shaping and modulating the magnetospheres of the magnetized planets. Within planetary magnetotails reconnection can be responsible for energizing particles and potentially changing the total flux and mass contained within the magnetosphere. The Kronian magnetosphere is thought to be a middle ground between the rotationally dominated Jovian magnetosphere and the solar wind driven terrestrial magnetosphere. However, previous studies have not been able to find a statistical reconnection x-line, as has been possible at both Jupiter and Earth. Additionally the standard picture of magnetotail reconnection at Saturn, developed by Cowley et al. [2004], suggests a potential asymmetry between the dawn and dusk flanks, caused by different reconnection processes dominating.

This work centers on the development of an algorithm designed to find reconnection related events in spacecraft magnetometer data, aiming to reduce the bias that manual searches could inherently introduce, thereby ensuring the validity of any statistical analysis. The algorithm primarily identifies the reconnection related events from deflections in the north-south component of the magnetic field, allowing an almost uninterrupted in-situ search (when the spacecraft is situated within the magnetotail).

The new catalogue of candidate reconnection events, produced by the algorithm, enables a more complete statistical view of reconnection in the Kronian magnetotail. Well-studied data encompassing the deep magnetotail and dawn flank (particularly from orbits in 2006) were used to train the algorithm and develop reasonable criteria. The algorithm was then applied to data encompassing the dusk flank (including orbits from 2009, for which plasma data have been examined by Thomsen et al. [2014]). This combination enables a robust, and global, comparison of reconnection rates, signatures and properties in the Kronian magnetotail.