



## **Magnetic field characters of returning flux tubes in Saturn's magnetosphere**

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Deep in the Saturnian magnetosphere, water-group neutrals are ionized after being released from the plume of Enceladus at 4 RS. This forms a plasma disk from 2.5 to 8 RS around Saturn and the typical source rate is 12~250 kg/s. Such plasma addition must be shed to the solar wind ultimately to maintain the plasma density in the magnetosphere in long term average. In this plasma transfer process, the magnetic flux also convects outward. To conserve the total magnetic flux imposed on the magnetosphere by the planet's internal dynamo, the magnetic flux has to return to the inner magnetosphere. Flux tubes are found to be the major form of such return. Determining such flux tubes is essential in understanding the breathing of Saturn magnetosphere. We investigated 10 years of Cassini magnetometer data to identify over six hundred flux-returning events between 4 and 18 in L. Statistical properties are presented, to constrain the origin, transport and evolution of these flux tubes.