Solar Wind Impact on Saturn's Magnetosphere

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We use a single-fluid global MHD model to study the solar wind control of large-scale mass loading and plasma release phenomena in the Kronian magnetosphere [1]. We show that at high solar wind dynamic pressure, the loss of plasma in the magnetotail is continuous. At medium dynamic pressure, plasmoids are pinched off periodically along an X-line in the post-midnight sector through a cascade of helical reconnection. Plasmoids have a magnetic topology of a helical flux rope with its ends anchoring in the polar regions of Saturn. With decreasing dynamic pressure, the repetition period of plasmoids gradually increases. A higher mass loading rate or a higher axial tilt of Saturn makes the repetition period longer. At low dynamic pressure, the release of plasmoids becomes quasi-periodic or chaotic. The pressure control of the repetition period is very similar to the behavior of a dripping faucet. The mass and volume of the closed magnetosphere is smaller at lower dynamic pressures due to a relatively longer X-line. In our simulations, large-scale plasmoids are responsible for less than 8 percent of the total mass loss, and the rest of the plasma is lost via cross-field diffusion or other small-scale mechanisms.

Keywords: Saturn, MHD simulation, mass-loading, plasmoids, helical reconnection.

References

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