THE DRIPPING FAUCET MODEL OF THE MASS-LOADED KRONIAN MAGNETOSPHERE

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We present a global MHD model (BATS-R-US) of large-scale mass loading and plasma loss phenomena in the Kronian magnetosphere. The major internal plasma sources, the rings, the icy satellites and Titan are incorporated as mass loading source terms in the MHD equations. We show that for higher-than-average solar wind dynamic pressure, the loss of plasma in the magnetotail is more or less continuous. However, as soon as the dynamic pressure returns to medium level, plasmoids begin to be pinched off periodically along an X-line in the dawn side of the magnetotail in accordance with the Vasyliunas cycle. If we further decrease the dynamic pressure, the characteristic period of plasmoid ejection, as well as the size of plasmoids, is increasing, since in an expanding magnetosphere, more and more time, and more and more amount of internal plasma, is needed to fill up a recently emptied flux tube. When the dynamic pressure is getting low and very low, the ejection of plasmoids becomes first quasi-periodic then chaotic. This behavior of plasma loss can be readily described with the analogy of a dripping faucet. We conclude that quasi-periodic plasmoids or ”substorms” can be generated through purely internal instabilities in the Kronian magnetosphere without any additional external driving. Our model results are compared with actual plasmoid events observed by the Cassini spacecraft.

Saturn, plasmoids, periodicities

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