Solar Wind - Jovian Magnetosphere Coupling

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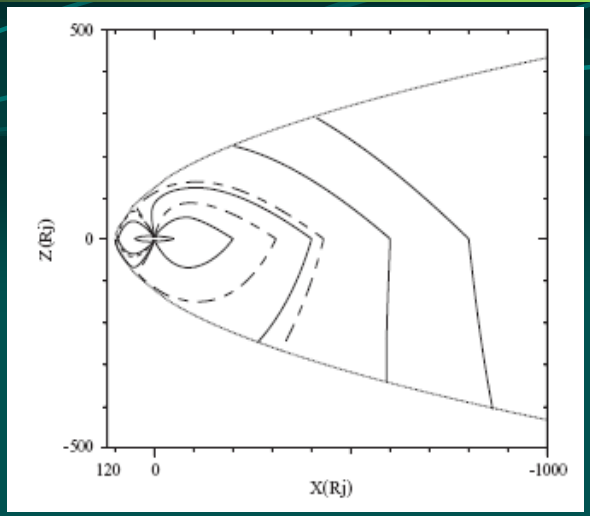
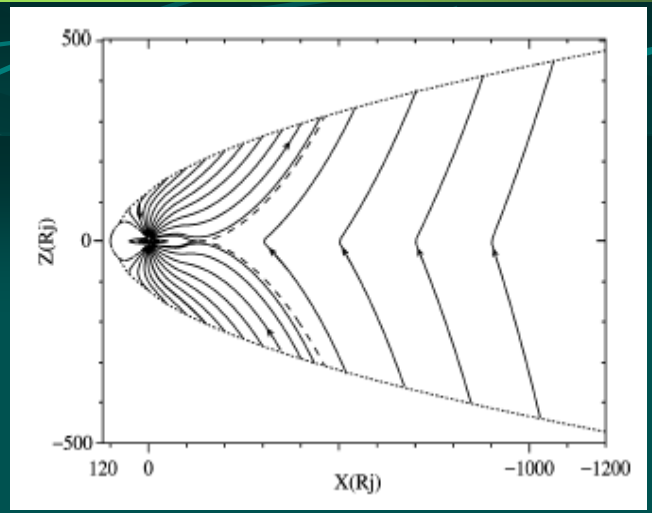
In spite of the large Jovian dipole moment and strong magnetodisc field, a penetrating solar wind magnetic field of very small strength is still significant for the global magnetospheric field line topology.

Southward IMF

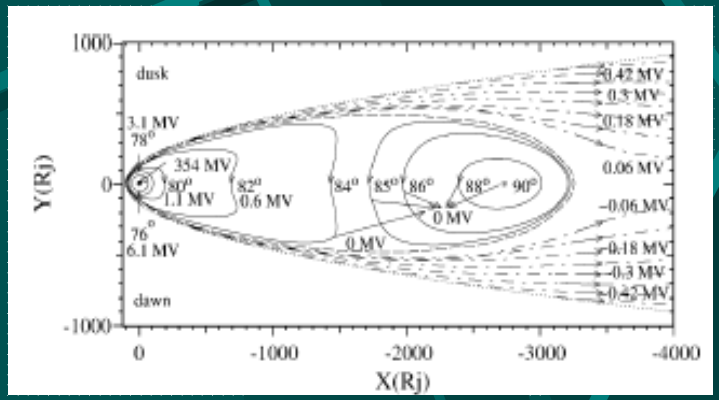


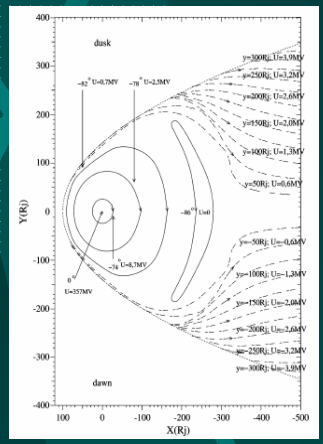
Northward IMF



IMF: (-0,3; 0; -0,5) nT, k_J =0.8

Influence of the strong IMF (CMEs or CIRs)





Increase of the IMF in 10 times (from 0.03 to 0.3 nT) shortens the distance to the rotation electric field breakdown from 1500 R_J to 150 R_J. In January 1993 Ulysses observed CIR with IMF 6-7 nT at 5 AU. For such event the corotation and penetrated from the solar wind electric fields could be comparable at 9.4 R_J for k_J=0.8 (at the Europa location). The penetrated solar wind electric field will create the potential drop across the tail ~60 MV, while the potential drop caused by the planet's rotation between latitudes from 0° to ~81°-84° is ~355 MV.

Thus, during the extremely strong IMF events, the Jupiter's magnetospheric plasma flow near Europa is controlled by mutual action of the planet's rotation and the solar wind electric fields. This perturbed plasma stream will modify the usual magnetic field disturbances at Europa inside its Alfven wings.

Generation of Alfven wings at Europa

- Europa interacts directly with the incident magnetized plasma. The temporal variations are caused by periodic variations of the magnetospheric plasma and magnetic fields at Europa.
- When conducting body moves relative to the magnetic field, this relative motion perturbs the magnetic field and plasma motion. The perturbation propagates with Alfven speed along the Alfven characteristics forming Alfven wings. Alfven wings are strongest when Europa is in the Jovian plasma sheet [*Neubauer, 1999*].
- The external magnetic field $\boldsymbol{B}_0$ applied to a satellite is given by the Jovian internal field modified by magnetospheric currents. For Europa the tilted dipole field gives the main contribution. The magnetodisk contribution becomes significant with increasing of the distance between Europa and Jupiter and for the cases of enhanced Io volcanic activity.
- A proper understanding of the electrodynamic interaction between the Jovian magneto-plasma and Europa's atmosphere-ionosphere system and its conducting interior would allow the exploration of the satellite interiors for electrolytically conducting oceans or related structures [*Neubauer, 1999*].
- Inside the Europa's Alfven wings magnetic field rotates (far from Europa) and its magnetic field strength increases (close to Europa) [*Volwerk et al., 2007*].