Degenerate induced magnetospheres

Stas Barabash¹, Andrii Voshchepynets¹, Mats Holmström¹, Futaana Yoshifumi¹, and Robin Ramstad²

¹Swedish Institute of Space Physics, Kiruna, Sweden (stas@irf.se)
²University of Colorado, Laboratory for Atmospheric and Space Physics, Boulder, USA

Induced magnetospheres of non-magnetized atmospheric bodies like Mars and Venus are formed by magnetic fields of ionospheric currents induced by the convective electric field $E = -V \times B/c$ of the solar wind. The induced magnetic fields create a magnetic barrier which forms a void of the solar wind plasma, an induced magnetosphere. But what happens when the interplanetary magnetic field is mostly radial and the convective field $E \approx 0$? Do a magnetic barrier and solar wind void form? If yes, how such a degenerate induced magnetosphere work? The question is directly related to the problem of the atmospheric escape due to the interaction with the solar and stellar winds. The radial interplanetary magnetic field in the inner solar system is typical for the ancient Sun conditions and exoplanets on near-star orbits. Also, the radial interplanetary field may provide stronger coupling of the near-planet environment with the solar/stellar winds and thus effectively channels the solar/stellar wind energy to the ionospheric ions. We review the current works on the subject, show examples of degenerate induced magnetospheres of Mars and Venus from Mars Express, Venus Express, and MAVEN measurements and hybrid simulations, discuss physics of degenerate induced magnetospheres, and impact of such configurations on the escape processes.