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How the IMF By induces a local By component during northward IMF Bz and characteristic timescales

Paul Tenfjord (1), Nikolai Østgaard (1), Robert Strangeway (2), Stein Haaland (1,3), Kristian Snekvik (1), Karl Magnus Laundal (1), Jone P Reistad (1), Steve Milan (1,4), Michael Hesse (1), and Anders Ohma (1)

(1) University of Bergen, Department of physics and technology, Bergen, Norway (paul.tenfjord@ift.uib.no), (2) Institute of Geophysics and Planetary Physics, University of California, Los Angeles, (3) Max Planck Institute for Solar System Research, Germany, (4) Department of Physics and Astronomy, University of Leicester, University Road, Leicester, United Kingdom

We use the Lyon-Fedder-Mobarry (LFM) global magnetohydrodynamics model to study the effects of the interplanetary magnetic field B_y component on the coupling between the solar wind and magnetosphere-ionosphere system when IMF $B_z > 0$.

We describe the evolution of how a magnetospheric B_y component is induced on closed field lines during these conditions. Starting from dayside lobe reconnection, the tension on newly reconnected field lines redistribute the open flux asymmetrically between the two hemispheres. This results in asymmetric magnetic energy density in the lobes. Shear flows are induced to restore equilibrium, and these flows are what effectively induces a local B_y-component. We show the radial dependence of the induced B_y, and compare the results to the induced B_y during southward IMF conditions.

We also show the response and reconfiguration time of the inner magnetosphere to IMF B_y reversals during northward IMF B_z . A superposed epoch analysis of magnetic field measurements from seven Geostationary Operational Environmental Satellite (GOES) spacecraft at different local times both for negative to positive, and positive to negative IMF B_y reversals is presented. We find that local B_y responds in less than 16 minutes of the arrival of IMF B_y at the bow-shock, and it completely reconfigures in less than 47 minutes.