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PII: S0032-0633(14)00222-0
DOI: http://dx.doi.org/10.1016/j.pss.2014.07.016
Reference: PSS3792

To appear in: *Planetary and Space Science*

Received date: 25 February 2014
Revised date: 25 June 2014
Accepted date: 28 July 2014

Cite this article as: K. Grygorov, L. Přech, J. Šafránková, Z. Němeček, O. Goncharov, The far magnetotail response to an interplanetary shock arrival, *Planetary and Space Science,* http://dx.doi.org/10.1016/j.pss.2014.07.016

The far magnetotail response to an interplanetary shock arrival

K. Grygorov, L. Přech, J. Šafránková, Z. Němeček, O. Goncharov

Charles University in Prague, Faculty of Mathematics and Physics, V Holešovičkách 2, 180 00 Prague 8, Czech Republic.

Abstract

We present a study of the impact of the December 7, 2003 fast forward interplanetary (IP) shock on the distant tail of the Earth's magnetosphere. Using the data from the several spacecraft located in the solar wind/magnetosheath upstream the Earth, we monitor a propagation of the IP shock from the L1 point to the magnetosphere. A behavior of the far magnetotail is inferred from the Wind observations at $X_{GSM} \approx -230\,R_E$. Shortly after the shock arrival, Wind crossed consequentially southern and northern lobes and observed a flux rope and the tailward fast plasma flow ($\approx$ 780 km/s) within the plasmasheet. Moreover, a change of the solar wind V_Z component across the shock creates a huge kink of the tail magnetosphere that propagates down the tail with the IP shock.

Keywords: interplanetary shocks, substorms, reconnection, far magnetotail, flux ropes, plasmoid
PACS: 94.30.C-, 94.30.Lr, 95.05.Sd, 94.30.cl

1. Introduction

Interplanetary (IP) shocks are a frequent and important phenomenon in the solar wind. Fast forward IP shocks and the enhanced plasma densities downstream of them (Kennel et al., 1985) compress the magnetosphere when they impact it (Tsurutani et al., 1988) and this compression causes an intensification and inward motion of the Chapman-Ferraro magnetopause currents resulting in a sudden positive variation of the horizontal component of the low-latitude geomagnetic field. These ground-based features are called Sudden Impulses (SIs) (Siscoe et al., 1968; Smith et al., 1986).

The shocks have various sources like coronal mass ejections (CMEs) or corotating interaction regions (CIRs) and other transients in the solar corona. Due to the large scale of these events, IP shocks are usually considered as planar structures (Russell et al., 2000). They are characterized by abrupt changes of plasma parameters and the interplanetary magnetic field (IMF) strength and direction. According to changes of these parameters (Burlaga, 1971), shocks can

Email address: jana.safrankova@mff.cuni.cz (J. Šafránková)