地球物理学报　2009 52 (3): 591～598　ISSN: 0001-5733 CN: 11-2074/P

空间物理学★大气物理学★大地测量学

行星际激波的传播及其相应的地磁效应

苏振鹏, 熊明, 郑惠南,王水

中国科学院基础等离子体物理重点实验室
中国科技大学地球和空间科学学院, 合肥 230026

收稿日期 2008-3-21 修回日期 2008-12-17 网络版发布日期 2009-3-20 接受日期

摘要　基于 2.5 维理想磁流体力学（Magnetohydrodynamic，MHD）方程组分析了行星际激波在日球层子午面内的传播过程及其相应的地磁效应.日球层电流片（Heliospheric Current Sheet，HCS）-日球层等离子体片（Heliospheric Plasma Sheet，HPS）对于行星际激波的传播具有一定的阻碍作用.当行星际激波相对于HCS 倾斜传播时，相对于扰动源位于HCS 异侧的激波强度较同侧的明显减弱.局地激波面的法线（或形状）对通过激波阵面的磁力线发生偏转的程度和方向起决定性作用.沿激波传播方向其为准平行激波，磁场偏转程度较小，而其两侧部分则为斜激波，磁场偏转程度较大.位于HCS-HPS 位置处的波前形成凹槽，磁力线偏转程度明显加强.行星际激波对磁场的偏转效应是其驱动地磁暴的重要机制，而且地磁效应的强度与地球相对于HCS 的角距离 $\Delta\theta_p$ 有明显关系.数值模拟结果表明：任何行星际激波，$\Delta\theta_p=0^\circ$ 处均无法形成较大强度的地磁效应；沿HCS 传播的行星际激波，地磁效应最强的区域位于HCS 两侧；相对于HCS 倾斜传播的行星际激波，地磁效应最强的区域位于HCS 异侧.

关键词　磁流体力学　行星际激波　空间天气　地磁暴
分类号 P352
DOI:

扩展功能
本文信息
- Supporting info
- PDF(1800KB)
- [HTML全文](0KB)
- 参考文献

服务与反馈
- 把本文推荐给朋友
- 加入我的书架
- 加入引用管理器
- 引用本文
- Email Alert
- 文章反馈
- 浏览反馈信息

相关信息
- 本刊中 包含“磁流体力学”的 相关文章

本文作者相关文章
- 苏振鹏
- 熊明
- 郑惠南
- 王水

Propagation of interplanetary shock and its consequent geoeffectiveness

SU Zhen-Peng, XIONG Ming, ZHENG Hui-Nan*, WANG Shui

CAS Key Laboratory of Basic Plasma Physics, School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, China

Received 2008-3-21 Revised 2008-12-17 Online 2009-3-20 Accepted

Abstract Using 2.5 dimensional ideal magnetohydrodynamic (MHD) equations, the propagation of the interplanetary shock and its consequent geoeffectiveness are studied. The heliospheric current sheet (HCS)-heliospheric plasma sheet (HPS) structure has some negative influences on the propagation of the interplanetary shock. When the shock propagates aslant the HCS, the segment on the opposite side of HCS with respect to shock nose is weaker than the other segment on the same side. The bending effect of the interplanetary shock on the magnetic field is an important mechanism that can cause geomagnetic storm. The local normal (or shape) of the shock front exerts a crucial influence on the strength and direction of the bending effect. In the propagating direction of shock nose, it is a quasi-parallel shock mode and the strength of the bending effect is very weak. But on the edge of the shock nose, it is an oblique shock mode and the strength of the bending effect is strong. A concave is formed at the shock front across the HCS-HPS, at which the bending effect is efficiently intensified. The geoeffectiveness caused by the bending effect remarkably depends on the angular distance $\Delta\theta_p$ away from the HCS. The numerical results suggest that: whatever the direction of the interplanetary shock propagates in, there is no notable geoeffectiveness at the shock nose; when the shock propagates along the HCS, the most geoeffective regions are on the edge of HCS-HPS; when the shock propagates aslant the HCS, the most geoeffective region is at the opposite side of HCS.

Key words Magnetohydrodynamic; Interplanetary shock; Space weather; Geomagnetic storm

通讯作者:
郑惠南 hue@ustc.edu.cn
作者个人主页: 苏振鹏; 熊明; 郑惠南;王水