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电离层电导对地球磁层顶和舷激波尺度的影响

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摘要 本文在如下假定下分析电离层电导对地球磁层顶和舷激波尺度的影响：（1）对电离层采用球壳近似，Pedersen电导Σ_P均匀，Hall电导为零；（2）地磁偶极矩处于正南方向，行星际磁场（IMF）只有南向分量（B_z<0）.磁层顶和舷激波的尺度分别由它们与GSE坐标系三个轴的交点，即日下点、晨昏侧翼点和南北顶点的地心距离表征.对给定的太阳风条件、B_z和Σ_P，通过三维全球MHD模拟获得系统的准定态.结果表明，在大约1～5 S范围内，Σ_P值显著影响磁层顶和舷激波的尺度，而在该范围之外则几乎没有影响.随着Σ_P的增加，磁层顶和舷激波整体向外扩张，前者的扩张程度低于后者，以至磁鞘区的范围扩大.磁层顶的侧翼点的位置随Σ_P的变化与B_z的幅度有关：在弱南向IMF情况下磁层顶的侧翼点随Σ_P的增加向内移动，而在强南向IMF情况下则向外移动.上述结果表明，在构建磁层顶和舷激波的经验模型时，有必要计入电离层电导的影响.

关键词 地球磁层,电离层,磁层顶,舷激波

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Influence of the ionospheric conductance on the size of the Earth's magnetopause and bow shock

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Abstract This paper studies the influence of the ionospheric conductance on the size of the Earth's magnetopause and bow shock under the following assumptions: (1) the ionosphere, treated as a spherical shell, has a uniform Pedersen conductance Σ_P and a zero Hall conductance, and (2) the Earth's dipole moment is due southward and the interplanetary magnetic field (IMF) has only south component (B_z<0). The size of the magnetopause and bow shock is characterized by the geocentric distances of their intersection points with the three axes of the GSE frame, i.e., the subsolar point, the dawn-dusk flank point, and the north-south top point. Given the solar wind conditions, and the values of B_z and Σ_P, a quasi-steady state of the system is obtained by 3-D global MHD simulations. It is shown that the influence of Σ_P on the size of the magnetopause and bow shock is significant in the range of about 1～5 S but negligible otherwise. As Σ_P increases, the magnetopause and bow shock expand outward as a whole, and the former expands less than the latter so that the magnetosheath widens. The variation of the flank point position of the magnetopause with Σ_P depends on the magnitude of B_z: the flank point shifts inward with increasing Σ_P for weak southward IMF cases and outward otherwise. The above-mentioned results indicate that the effect of the ionospheric conductance should be incorporated in constructing empirical models of the magnetopause and bow shock.

Key words Earth's magnetosphere Ionosphere Magnetopause Bow shock

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