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等离子体片离子与太阳风及地磁条件的关联研究

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Correlation study of plasmasheet ions with solar wind and geomagnetic conditions

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摘要 本文根据搭载于Cluster卫星的CIS/CODIF和RAPID仪器的观测数据，统计研究了等离子体片中的H^+、O^+离子在磁暴期间的时间变化特性，及其对太阳风条件的响应.观测结果表明：(1) 磁暴开始前，O^+离子（0~40 keV）数密度保持在较低水平.随着磁暴的发展，O^+数密度缓慢上升，其峰值出现在D_{st}极小值附近：H^+离子(0~40 keV)数密度在磁暴开始之前的较短时间迅速增加并达到峰值，在磁暴开始之后迅速降低，并在整个主相和恢复相期间保持在相对较低水平.更高能量的离子则在磁暴开始后迅速增多，并在低能O^+离子达到峰值之前达到峰值.因此我们推测磁暴初期从等离子体片注入环电流的主要是H^+离子，主相后期O^+离子可能扮演更为重要的角色.(2)在地磁活动时期，太阳风密度和动压强与等离子体片中的H^+、O^+数密度存在一定相关性.等离子体片中的H^+离子对北向IMF B_z较为敏感，而IMF B_z南向条件下更有利于太阳风参数对等离子体片中O^+数密度的影响.在地磁活动平静期，太阳风条件对等离子体片中的离子没有明显影响.

关键词 等离子体片离子, 磁暴, 太阳风参数, 行星际磁场

Abstract: Observations obtained from CIS/CODIF and RAPID instrument onboard Cluster are used to investigate the temporal behavior of H^+ and O^+ ions in the storm time plasmasheet and the relationship between plasmasheet ions and solar wind conditions. It is found that: (1) The number density of O^+ ions (0~40 keV) is quite low before SSC, and increases slowly as D_{st} decreases, reaching its peak value at the vicinity of D_{st} minimum. The density of H^+ ions enhances greatly shortly before SSC, and decreases sharply after SSC. It keeps at a relatively low level during the whole main phase and recovery phase. Fluxes of energetic H^+ and O^+ ions enhance greatly after SSC and reach their maximum values before their low energy counterparts. It implies that ions injected into ring current at early storm time are mainly H^+ ions and only at later times O^+ ions could significantly affect the ring current. (2) During geomagnetic active times, solar wind pressure, density and electric field are positively correlated with simultaneous H^+ and O^+ number density in the plasma sheet. The dependence of H^+ number density on solar wind parameters is stronger under northward IMF (Interplanetary Magnetic Field), while O^+ number density favors southward IMF. During geomagnetic quiet times, there is no clear evidence for a correlation between solar wind conditions and ions in the plasmasheet.

Keywords Plasmasheet ions, Storm, Solar wind parameter, IMF

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