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Cluster探测到磁尾等离子体注入的特征

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摘要 利用Cluster卫星2001～2004年磁尾运行期间RAPID仪器的数据，确定了115例磁尾等离子体注入事件，借助时序叠加法统计研究磁尾等离子体注入现象的特征.注入事件主要分布于磁地方时夜晚20时至凌晨04时.与同步轨道区观测到的粒子注入事件类似，可以将磁尾粒子注入事件分成五类：（1）只有离子注入；（2）离子先于电子注入；（3）离子和电子同时注入；（4）电子先于离子注入；（5）只有电子注入.磁尾粒子注入时，质子（能量范围0～40 keV）的温度和数密度同时显著增加，沿地球径向的传播速度也明显增大.统计分析磁尾注入期间同时观测到的晨昏对流电场，发现电场可分为两类：（A）注入后电场突然增大，电场强度为正；（B）注入后电场突然增大，电场强度为负.利用磁层磁场（T89c）和电场（Volland-Stern）模型模拟粒子注入后赤道面的电漂移速度矢量，模拟结果与统计结果基本一致，表明晨昏对流电场引起的电漂移是驱动磁尾（$-18R_E<R<-10R_E$）等离子体沿地球径向注入的机制之一.

关键词 磁尾等离子体注入, 晨昏对流电场, T89c磁场, Volland-Stern电场, 电漂移

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Characters of the magnetotail plasma injection surveyed from Cluster observation

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Abstract The properties of proton (0 eV<E<40 keV) in the plasma sheet are examined by means of a superposed epoch analysis, using 115 magnetotail plasma injection events which are identified from Cluster magnetotail orbit time in between 2001 and 2004. All events distribute in magnetic local time from 20 p.m. to 04 a.m. Five classes of magnetotail injection events are found to be similar with the geosynchronous observation: (1) pure ion injections; (2) ion injections followed a few minutes later by an electron injection; (3) simultaneous ion and electron injections; (4) electron injections followed a few minutes later by an ion injection; (5) pure electron injections. Proton shows a significant increase in temperature and density at the onset, and injects earthward with an increasing velocity more than the pre-injection average one. Superposed epoch analysis on the simultaneous observation data of dusk-dawn electric field from the EFW (Electric Field and Waves) instrument, we found two different electric field configurations: (1) electric field increases suddenly at the onset and the value is positive; (2) electric field changes the direction at the onset, and turns into a negative value. The simulation results of velocity vector after injection in equatorial plain, calculated in static magnetic (T89c) and electric (Volland-Stern) field models, agree with the statistical results mostly, and that suggests the electric drift caused by dawn-dusk convection electric field is one of the mechanisms of the particles injected earthward in magnetotail($-18R_E<R<-10R_E$).

Key words Magnetotail plasma injection Dawn-dusk convection electric field T89c magnetic field Volland-Stern electric field Electric drift

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