磁層副暴之迫振模式

The Forced Resonance Model of Magnetospheric Substorm

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本文係利用磁尾等效電路來探討磁層副暴之發展過程。在滋長相中，滋長時間會受中性片電阻 R_N 與橢圓圈電阻 R_I 之影響；當行星際磁場之擾動頻率接近磁尾共振頻率時，電漿片內有效擾動電壓將達最大值。當 $R_N \gtrsim R_I$ > 臨界電阻，膨脹相將發生，乃有極光弧之突亮現象；其後 R_I 及 R_N 逐漸減小，當 R_N 遠小於 R_I 後，磁尾能量不再輸入電離層而步入復元相之階段。文中指出，迫振現象易使磁層達不穩定狀態，而 R_N、R_I 之變化更決定副暴活動性之大小。當 R_I 小時，副暴容易連續發生，形成磁暴。另外，迫振現象主要發生於膨脹相開始之前後，並可加速衝往極區之粒子。只有單一副暴下，迫振易伴生。

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ABSTRACT

On the basis of a new equivalent circuit of the magnetotail, the substorm sequence is studied. It is shown that the growing time depends on the neutral-sheet resistance R_N and the auroral oval resistance R_I. The effective amplitude of the perturbed voltage across the plasma sheet reaches maximum, if the perturbed frequency of IMF approaches the resonance frequency of the tail circuit. When $R_N \gtrsim R_I > R_c$ (critical resistance), the expansive phase occurs. Sudden brightening of an auroral arc in the midnight sector is manifested. It is quite possible that the auroral particles are accelerated due to the forced resonance. During the late stage of the expansive phase, R_I and R_N decrease. The recovery phase begins when R_N is far less than R_I. The energy transfered from tail to oval is ceased. It is pointed out that the substorm activity strongly depends on R_N and R_I. The forced resonance will enhance R_N. It is also shown that if $R_I < R_c$ the growing time is very short, and successive substorms will occur during the time of high magnetic activity; this will form a magnetic storm though there is no resonance. A single substorm is suggested to be accompanied by forced resonance easily.