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利用地磁脉动预报地球同步轨道相对论电子通量的方法研究

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Study on a forecasting method of the relativistic electron flux at geostationary orbit using geomagnetic pulsation data

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摘要 本文利用低纬地磁台站的Pi1、Pi2地磁脉动（Pi1-2）资料和地球同步轨道的Pc5地磁脉动资料，对2004年1月到2006年12月38个磁暴事件的地磁脉动参数进行了统计分析.在此基础上，考虑相对论电子的局部加速机制，并加入损失机制，建立了一个初步的磁暴期间地球同步轨道相对论电子通量对数值的预报模型.利用该模型，我们对上述38个磁暴事件进行预报试验，最优化结果是：相对论电子通量对数值的预测值和观测值之间的线性相关系数为0.82，预报效率为0.67.这说明该模式具有较好的预报效果，也表明利用地磁脉动参数进行相对论电子通量预报是可行的.

关键词 磁暴，地球同步轨道，相对论电子通量，地磁脉动

Abstract: Relativistic electron fluxes measured at constant energy undergo large dropouts and enhancements during geomagnetic storms. As far as we know, there are two substantial preconditions for the relativistic electron flux enhancement in the outer radiation belt during geomagnetic storm: the first and the most important is that there must be enough low energy electron (on the order of tens to hundreds of keV), the so-called seed electron; second, kinds of waves which can contribute to the electron acceleration by wave-particle interaction are necessary. Geomagnetic field data observed by Memambetsu (L=1.57) observatory are used to extract Pi1-2 pulsations during geomagnetic storm. The relativistic electron data at geostationary orbit are from GOES satellites observation. We investigate the relationship between Pi1-2 pulsation duration and relativistic electron flux during the recovery phase, and find that the relativistic electron flux increases with the Pi1-2 pulsation duration. The Pc5 pulsation at geostationary orbit has the similar result, the duration and amplitude of Pc5 pulsation can also impact the relativistic electron flux. Due to this statistic analysis result, a model was developed to forecast the relativistic electron flux at geostationary orbit during the recover phase of the geomagnetic storms. The model uses the duration and amplitude of Pi1 pulsation and Pc5 pulsation as input. Parameters in the model are set by optimizing prediction efficiency (PE) for 38 events during 2004.01~2006.12, and the optimized linear correlation coefficient and PE for these events are 0.82 and 0.67, which means this method is viable.

Keywords Geomagnetic storm, Geosynchronous orbit, Relativistic electron flux, Geomagnetic pulsation

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