Relationship between Azimuthal Wave Number of Pc5 and Relativistic Electron Flux at the Radiation Belt

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In order to understand how ULF pulsations accelerate relativistic (MeV) electrons in the outer radiation belt, magnetic variation data observed at Antarctic stations are analyzed. One possible explanation of the acceleration model of the relativistic electron is the drift resonance model (Elikinton et al. 2003). The toroidal oscillation of the magnetic field in the inner magnetosphere with the period of 150-600s, which corresponds to PC5 pulsations, could resonate with the drift motion of the electrons and invoke the radial diffusion of the electron.

In this study, the magnetic data observed at H057 (MLat.=-66.42, MLong.=72.29) and Skallen (MLat.=-66.42, MLong.=70.53) in Antarctica are used to estimate the azimuthal wave number (m). These two stations are located at the same latitude and spread in longitudes of 1.7 degrees. In general, the estimation of the azimuthal wave number of the PC5 pulsations is difficult due to a strong latitudinal dependence of the field line resonance of the Pc5. The pair of the stations used in this analysis is quite suitable to estimate the azimuthal wave number.

We selected 24 CIR (Corotating Interaction Region) events with the condition that the relativistic electron flux observed by GOES satellites exceed 10^3. For these 24 events, the superposed epoch analysis is conducted for the horizontal component of the magnetic field data. As a result, several important features are cleared in the relationships between the PC5 observed on the ground and relativistic electron flux variations at geosynchronous orbit. First, although the power spectrum density (PSD) of the Pc5 pulsations increases corresponding to the increase of the solarwind velocity, the H/D ratio of the PC5 power shows obvious change after 0.5 days from enhancement of the PSD, which corresponds to the apparent start time of relativistic electron flux enhancement (REE). This indicates that the toroidal oscillation of PC5 becomes predominant in the inner magnetosphere at the start time of the REE. Second, although the phase difference between two stations largely fluctuates before the start of REE, it shows certain values with small variances during the REE events. The estimated azimuthal wave numbers (m) of the H and D components are 1.62+/-0.99 and -2.25+/-2.86, respectively. The eastward propagation of the toroidal Pc5 with the low m number of 1.62 suggests that the relativistic electrons at the inner magnetosphere are accelerated by the drift resonance with the toroidal PC5 pulsations.