Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM007-P01 会場:コンベンションホール 時間:5 月 27 日 15:00-16:15

ホイッスラーコーラスと高エネルギー電子との波動粒子相互作用：GEMSIS-RB Wave シミュレーション
Wave-particle interaction between whistler chorus and high-energy electrons: GEMSIS-RB Wave simulation

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Scattering process of high energy electrons by whistler chorus in the dipole field is studied to understand electron microbursts associated with whistler chorus by using GEMSIS-RB Wave code. Whistlers are assumed to propagate parallel to the magnetic field, and typical whistler chorus parameters, such as wave frequency, frequency drift rate, and wave amplitude, are assumed based on the spacecraft observations. By using the observed parameters, the GEMSIS-RB Wave code calculates the wave-particle interactions between whistler chorus and the high-energy electrons bouncing along the dipole magnetic field. The code can calculate the precipitation loss of energetic electrons during a few days, considering the micro wave-particle interactions with a few msec. This study focuses on the high energy electron precipitation loss associated with the scattering by whistler chorus with realistic parameters, and applies to understand a physics of high energy electron microburst.

キーワード: 放射線帯, ホイッスラーコーラス, 波動粒子相互作用
Keywords: radiation belt, whistler chorus, wave-particle interaction

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斜め伝播ホイッスラーモード波と放射線帯電子の相互作用に関する研究
Interactions between Oblique Whistler-Mode Waves and Energetic Electrons in the Earth's Radiation Belt

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We analyze the mechanisms of interactions between oblique whistler-mode waves and energetic electrons in the Earth's radiation belt. By the dispersion relation of whistler-mode wave, we calculate the refractive index in relation to propagation angle. We find that higher propagation angle makes the refractive index larger. Taking into account the dispersion relation, we perform the test particle simulations of energetic electrons interacting with oblique whistler-mode chorus. The source particles are assumed to be evenly distributed in gyro-phase. We calculate the trajectories of all electrons and energy exchanges, changing initial parallel velocity. The exponential terms appeared due to oblique propagation, in which include trigonometric function are calculated by using Bessel functions. We analyze energy changes and magnetic moment changes of electrons in case of Landau resonance and cyclotron resonance.

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Dayside chorus waves under quiet solar wind conditions: PENGUIn/AGO and THEMIS conjugate observations

Dayside chorus waves under quiet solar wind conditions: PENGUIn/AGO and THEMIS conjugate observations

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We study simultaneous observations of chorus waves in the magnetosphere and VLF waves in Antarctica on the dayside at high L-shells (L>7) under quiet solar wind conditions, using in-situ observations by THEMIS and ground-based VLF observations at automatic geophysical observatories (AGO) in Antarctica in the PENGUIn project. The scientific goal of this research is to identify where in magnetic latitude (MLAT), magnetic local time (MLT), and radial distance (or L-value) quiet-time dayside chorus waves can be preferably generated.

On 26 July 2008, the VLF receiver at the AGO P2 station (AP2: MLAT = -76.6 deg.) detected the intensification of VLF signals at the frequency range of 0.5-1.0 kHz between ~1400 and ~1700 UT. At the AGO P3 station (AP3: MLAT = -83.63 deg.), VLF signals increased at the 0.5?1.0 kHz frequency range between ~1400 and ~1800 UT; the increase rate was smaller than at AP2. The fluxgate magnetometer data confirmed that AP2 and AP3 were equatorward of the open-closed boundary.
During these intervals, THEMIS A, D, and E traveled in an outbound path at L = 7-10 and MLT = 11.5?13h. Both THEMIS A and D were magnetically conjugated to AP2 between ~1600 and ~1700 UT and to AP3 between ~1430 and ~1530 UT. THEMIS E was conjugated to AP2 between ~1530 and ~1630 UT. THEMIS A registered wave intensification at the frequency of 0.3 to 0.4 fce between ~1330 and ~1600 UT, where fce is the local electron gyrofrequency. THEMIS A wave burst data available during two intervals at ~14UT confirm that the waves were circularly right-handed polarized. Filter bank data from THEMIS D and E show wave intensification in the 287-1240 Hz band at ~1230 - ~1530 UT and ~1430 - ~1630 UT, respectively.

Using the above-mentioned conjugate observations, we examine spatial distributions of chorus wave power and properties with respect to L and MLT. Our preliminary results imply that chorus wave power was more enhanced around noon than the dawn and dusk sides. We discuss what process(es) can explain such non-uniform wave power distributions under quiet solar wind conditions resulting in steady-state magnetospheric conditions, by simulating motion of energetic electrons in realistic 3D magnetic field and global convection electric field models. The simulation will also enable us to examine where in MLAT chorus waves are preferably generated.

Keywords: dayside chorus, conjugate observations, THEMIS, Antarctic research

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Magnetopause Shadowing 効果による外帯電子消失：THEMIS 観測
Rapid flux losses of the outer belt electrons due to the magnetopause shadowing effect: THEMIS observations

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地球放射線外帯は相対論的電子によって構成されており、その構造は時間的に激しく変動することが知られている。この放射線帯外帯電子は磁気嵐主相および太陽風擾乱にともなって急速に消失することが知られているが、その消失過程は未解明ある。この原因の一つとして、惑星空間への消失 (MPS) が考えられている。しかし、MPS が放射線帯電子消失に与える影響を評価した研究は少なく、MPS の果たす役割は充分明らかにはなっていない。

本研究では、THEMIS 衛星と GOES 衛星を用い、2007 年 4 月から 2008 年 12 月までの期間での静止軌道での消失イベントについて、その外帯境界の変動を調べた。その結果、外帯境界位置が速い変動を示す消失イベントでは、外帯境界位置と磁気圏境界位置に相関が見られた。本研究グループによるこれまでの解析からは、MPS の効果のみをとりいれた放射線帯グローバルシミュレーション (GEMSIS-RB コード) と観測結果との比較の結果、統計解析から明らかにされたこれらの特徴は、MPS によって外帯の外縁付近の電子が消失するというプロセスと整合することが明らかになった。さらに THEMIS 衛星データを用いて動径方向の拡散係数を求めたところ、外帯消失が起きている期間における拡散係数は、過去の経験モデルから知られている値と調和的であることが明らかになった。したがって、外帯の消失は、まず MPS によって外帯外側の消失が起こり、その結果誘起される外向き拡散によって、さらに外帯全域での消失が起こるというモデルで理解されると考えられる。

キーワード: 放射線帯, 消失, 内部磁気圏, 粒子加速, 太陽風放射線帯相互作用
Keywords: radiation belt, loss, inner magnetosphere, particle acceleration, solar wind - radiation belt interaction