Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PEM31-01 会場:304 時間:5 月 23 日 15:30-15:45

電離圏加熱装置を用いて発生した電離圏イオン上昇流
Heater-induced artificial ionospheric ion upflow

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We have investigated force balance associated with ion upflow, by using the EISCAT UHF radar and heating facility in Tromsoe, northern Norway (69.6 deg N, 19.2 deg E). The heating facility enables us to induce not only enhanced electron temperature but also upward flowing ions in the F-region/topside ionosphere. The heater-induced artificial ion upflow is one of the most suitable events to estimate force balance of ionospheric ions quantitatively and also understand generation mechanisms of ion upflow. Furthermore, the heater-induced ionospheric data are potentially usable to estimate height profiles of ion-neutral collision frequency, neutral density, and horizontal neutral wind in the F-region/topside ionosphere.

We conducted the heater and radar observations as an EISCAT special program by UK and Japan between 17 and 20 November, 2011, and successfully obtained data including artificial ionospheric ion upflow. The UHF radar and heater beams were both pointed into the magnetic zenith, and pump cycle of the heater was 16 min on, and 12 min off. During heater on period electron temperature sometimes increased up to about 4000 K and upward ion velocity reached about 500 m/s at an altitude of 500 km.

In this paper, we show the detailed results of the heating experiment, and discuss quantitative force balance associated with ion upflow.

キーワード: 極域電離圏, イオン上昇流, イオン流出, EISCAT
Keywords: polar ionosphere, ion upflow, ion outflow, EISCAT

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PEM31-02 会場:304 時間:5 月 23 日 15:45-16:00

降下電子・電離圏加熱イオンと沿磁力線電流の相関：れいめい観測
Reimei observations on correlation of field-alinged current to precipitating electrons and accelerated ionospheric ions

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High-time and -spatial resolution data obtained by the low-altitude polar-orbiting micro satellite, Reimei, provide us with remarkable opportunities for revealing the characteristics of electrons and auroras based on the perfectly simultaneous and conjunction measurements of auroral emissions and particles.

The Reimei satellite has been making numerous notable observations in the nightside southern polar ionosphere during the winter seasons during 2005-2008. The first case shown in this paper is a comprehensive set of various fine-scale auroral activities, which shows four types of auroral forms and their variations taken by the multispectral auroral imaging camera (MAC): faint bands, streaming multiple arcs, shearing pair of arcs, and vortices/curls. The electron energy spectrum analyzer (ESA) covering a full pitch angle range observed various properties of electron energy-pitch angle distributions and their time variations, each of which is distinctive of the correspondent auroral activity. It is evident that the main energy fluxes responsible for the arc-type emissions are carried by the inverted-V electrons accelerated by (quasi-)electrostatic parallel potential structures above the satellite orbit. On the other hand, the rapidly rotating vortices are associated with the significant fluxes of spiky electron components with energy-time dispersions produced by dispersive Alfven waves. The field-aligned current signatures are also affected by these relations between auroras and precipitating electrons, which are controlled by difference of the upward and downward electron fluxes.

Another case presents unique correlative features between streaming fireball-type auroral globs at the poleward edge of the auroral bands and sharply field-aligned sporadic electron precipitations with clear energy-time dispersions embedded in the inverted-V electrons. The peak energies of the dispersive electron signatures at the start are almost equal to the characteristic energies of the inverted-V components. This correlation obviously designate the fine modification of the auroral forms/emissions in the larger structure driven by the strong dispersive Alfven waves at the similar altitudes with the parallel potential drop.

キーワード: オーロラ電子, 電離圏イオン加速, 沿磁力線電流, 衛星観測, 沿磁力線電場, オーロラダイナミクス
Keywords: auroral electron, ionospheric ion acceleration, field-aligned current, satellite observation, field-aligned potential, auroral dynamics

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PEM31-03 会場:304 時間:5 月 23 日 16:00-16:15

かぐや衛星 UPI-TEX による酸素イオン散乱光の空間分布の導出
Spatial Variations of O+ Rexonance Scattering Emission Estimated by the UPI-TEX on KAGUYA

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地球周辺の酸素イオンは，1980 年以降の衛星観測により多量に極域の電離圏から磁気圏へ散逸されていることが観測された．しかしながら，酸素イオンの散逸についてどのくらいの量のイオンがどのようなタイミングで散逸しているかは明らかになっていない．本研究では，月周回衛星かぐや（SELENE）に搭載されている極端紫外光望遠鏡（UPI-TEX）を用いて、地球周辺での O+の共鳴散乱光の空間分布とその時間発展を追う。ただし、O+散乱光の光は弱く、得られた画像のままでは空間分布が不明瞭である。今回は、フィルターサポートの陰の効果を除去し、空間方向に積分を行うことで、O+散乱光の空間変化の見積もりを行った。見積もりの妥当性と、地磁気活動度（AE）による散乱光分布の変化について議論を行う。

キーワード: かぐや衛星, UPI-TEX, 酸素イオン散逸, 太陽風, 地磁気活動度
Keywords: KAGUYA Satellite, UPI-TEX, Oxygen ion outflow, Solar wind, Geomagnetic activity

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PEM31-04 会場:304 時間:5 月 24 日 09:00-09:15

遮蔽/過遮蔽時の電離層電流パターン：電離圏ポテンシャルソルバーの応用
Ionospheric current patterns during the undershielding and overshielding deduced by a global ionospheric potential solve

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Toward the understanding of the magnetosphere-inner magnetosphere-ionosphere coupled system, we have developed a two-dimensional ionospheric global potential solver (GEMSIS-POT). Our model basically follows a methodology of the so-called ”thin shell model.” The important extension from previous studies is that our model covers the pole-to-pole ionosphere without placing any boundary at the equator. By using the solver, we investigated how the ionosphere changes from under-shielding condition to over-shielding condition as the FAC distribution changes. Calculations are performed by changing j0, R2 / j0, R1 (the ratio of peak current density of R2 and R1-FAC) and moving R2-FAC toward the nightside with dLTR2-R1 (the local time deference between the R1 and R2-FAC peaks) relative to the fixed R1-FAC. In the previous talk, we reported the calculation results focusing on the electric field structure. In the present study, we analyze the ionospheric current and equivalent magnetic field perturbation of the calculation examples representing the undershielding and overshielding.

We separate the ionospheric current into the diagonal and non-diagonal components in terms of the thin shell approximation. In the polar region, where the dip angle of the geomagnetic field is close to zero, the diagonal and non-diagonal components are nearly equivalent to Pederson and Hall currents, respectively. However, in the low latitude region with the finite dip angle, they cannot be simply reduced to Pederson and Hall currents because of the mixture of Pederson, Hall and parallel conductivities in the conductivity tensor arising from the thin shell approximation of Jz=0 (vertical ionospheric current is assumed to be zero).

The calculation results show that the non-diagonal part is the major part of the ionospheric current in the polar region, whereas, in the equatorial region, the diagonal component becomes the major part. In this talk, we discuss how the current circuit from the polar to equatorial region is described by the pair of diagonal and non-diagonal components and also discuss the derived current circuit in relation to the pair of Pederson and Hall currents.

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PEM31-05 会場:304 時間:5 月 24 日 09:15-09:30

SuperDARN レーダーによる電離圏昼夜境界効果の検出
Detection of the ionospheric day/night terminator effect by SuperDARN radars

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電離圏電気伝導度の非一様には電離圏の対流構造を変形させる効果があることが良く知られている。例えば、極域における電離圏対流パターンには朝夕非対称があることが知られているが、これは、昼夜境界の電離圏電気伝導度の非一様によって生じる電荷の蓄積、及び、2 次電場の発生による対流の変形の結果であると推測される。

これまでに、我々は、SuperDARN Syowa East レーダーで取得されたデータを用いて、昼夜境界効果による電離圏対流の急峻な変化を検出しようと試みた。統計解析により、我々は、昼夜境界がちょうどレーダーの視野を横切る 2、3 月と 9、10 月の期間に、特徴的な対流パターンを発見した。しかしながら、この特徴的な対流の方向は、昼夜境界効果から期待される方向とは反対であり、寧ろ、電離圏プラズマがレーダーの視野を横切って一定速度で流れるとき視線方向の速度が見かけ上変化するという解釈で説明される。また、昼夜境界がレーダー視野を横切る時間帯がちょうど真夜中のオーロラ帯に当たることから、得られた結果の解釈が困難であるという問題もあった。そこで、本研究では、ポーラーキャップ領域を観測している SuperDARN レーダーデータを用いて、電離圏昼夜境界効果の検出を試みる。

キーワード: SuperDARN レーダー, 電離圏, 電気伝導度, 昼夜境界, 対流
Keywords: SuperDARN radars, ionosphere, conductivity, day/night terminator, convection

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PEM31-06 会場:304 時間:5 月 24 日 09:30-09:45

電離圏に於け入反射 Alfven 波の分離
Walen Separation in the ionosphere

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Global ionospheric current and convection system couples to the magnetospheric dynamics. Transmission of electromagnetic energy, momentum and current from the magnetosphere to the ionosphere for driving and maintaining the ionosoheric current system against to the Joule dissipation should be mediated via shear Alfven wave. Fundamentally, the above fact won't be changed even for quasi-static state. This means that the ionospheric current and convection system is formed as a result of incident and reflection process of shear Alfven wave at the ionosphere.

Applying the concept of Walen relation of incompressible MHD disturbances to the ionospheric current and convection system, we develop the methodology that describes the ionospheric current and convection system as a superposition of incident and reflected components of shear Alfven wave. Extracted incident component corresponds to the driving force of ionospheric current system, while reflected component corresponds to the feed back component to the magnetosphere that is excited as a result of magnetosphere ionosphere coupling process. The Walen separation also enables to extract the Cowling channel from the ionospheric current and convection system.

In this presentation we will discuss about how the Walen-separation technique can be applied to the realistic ionospheric data and show a specific result of separation analysis.

キーワード: 磁気圏電離圏結合, アルヴェーン波, 電離層電流, 電離層対流
Keywords: magnetosphere-ionosphere coupling, Walen relation, Alfven wave, ionospheric current, ionospheric convection

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PEM31-07 会場:304 時間:5 月 24 日 09:45-10:00

EISCAT レーダーを用いた地磁気擾乱時のイオン－中性大気衝突周波数の推定
Ion-neutral collision frequency from EISCAT observations in the polar lower ionosphere during geomagnetic disturbances

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One of the fundamental processes in the thermosphere-ionosphere coupled system is collision between ions and neutral particles. The collisional process contributes to, for example, ion drag and Joule heating. Ion drag transfers momentum of ions to neutral particles, and may temporally modulate thermospheric dynamics, in particular, at F-region heights. The ion-drag process can also be defined as increasing flow velocity of a bulk motion of neutral gas along the mean ion velocity. Collisions also result in increases of thermal energy of both ions and neutral species. These processes are called frictional heating and Joule heating, which elevate the ion temperature first then the thermospheric temperature. The ion-neutral collision frequency is an essential parameter to represent equations related to the ion drag and frictional/Joule heating. Then the ion-neutral collision frequency was estimated using data from the European Incoherent Scatter (EISCAT) radar at Tromsoe, Norway during the Dynamics and Energetics of the Lower Thermosphere in Aurora 2 (DELTA-2) campaign in 2009. Vertical component of the ion velocity in the lower ionosphere (106-135 km) and the ion momentum equation were applied to the calculation. The calculated ion-neutral collision frequency was approximately equivalent to that predicted using modeled density data. However, notable increases were found above 126.8 km during natural ionospheric heating events. An obvious depression in calculated values was also found between 114.6 km and 126.8 km just after cessation of another heating event. This paper discusses contributions of the vertical thermospheric motion to variations of the ion-neutral collision frequency.

キーワード: 電離圏, 熱圏, 高緯度, イオン－中性大気衝突周波数, 欧州非干渉散乱レーダー
Keywords: Ionosphere, Thermosphere, High latitude, ion-neutral collision frequency, EISCAT radar

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PEM31-08 会場:304 時間:5 月 24 日 10:00-10:15

Akebono 衛星で観測される THR 放射の出現頻度について
The occurrence rate of THR emissions observed by the Akebono satellite

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This is a report on the occurrence rate of Terrestrial Hectometric Radiation (THR), auroral radio emissions emanating from the topside ionosphere in the MF and HF ranges. Data shown in this paper were obtained by the Plasma waves and sounder experiment (PWS) mounted on the Akebono satellite. The Akebono/PWS measurements show that THR emissions are sometimes observed in two frequency bands near 1.5-2.0 MHz and 3.0-4.0 MHz when the satellite passes over the auroral latitudes; however, their occurence rate has not yet been invesigated. Statisitical studies using the Akebono/PWS data show the spatial distribution of THR occurence; THR is detected at all magnetic local times and most often during premidnight hours (2100-2400 MLT) in a wide magnetic latitude range ($|\mathrm{MLAT}| > 30$deg). During daytime hours (0600-1500 MLT), the distribution of its occurence is confined in higher latitude ranges ($|\mathrm{MLAT}| > 70$deg). The explanation of this spatial distribution is that THR is favorably generated in the night-side auroral latitudes near 1000-km altitude.

キーワード: オーロラ現象, オーロラ電波, 電波伝搬, オーロラ電離圏
Keywords: auroral phenomena, auroral radio emissions, radio propagation, auroral ionosphere

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PEM31-09 会場:304 時間:5 月 24 日 10:15-10:30

低緯度 Pi2 観測時の磁気圏内での空間的磁場変動
Spatial distribution of the magnetic perturbation in the magnetosphere at the times of low-latitude round Pi 2's

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Pi2 地磁気脈動は周期が 40-150 秒で定義される減衰振動型の磁場変動である。これらはサブストームの爆発相の開始とともに地上磁力計や衛星で観測される。
本研究では ETS-VIII 静止軌道衛星と THEMIS 衛星の磁場データを用いた。100 個の孤立した Pi 2 を 2009 年 1 月 1 日から 5 月 31 日の期間で MAGDAS 観測点の YAP の磁場データから選定した。この期間 THMIS 衛星の遠地点は夜側の 9-30Re の間に位置した。我々は YAP での H-component Pi 2 の最大振幅時の前後五分の期間において衛星で観測された磁場変動の Z 成分 (compressional) 成分の最大振幅を統計的に調べた。解析の結果、大きな磁場の変動 (>10nT) は 8-10Re の 22-24LT の領域で最も高い頻度で観測されることが初めて明らかになった。この領域の場所は Uozumi et al. [2007] の地上観測から推定された Pi2 のソースの位置と一致する。また Fast mode 磁気音波の振幅は距離と共に減衰することから考えると、Pi2 に関連する compressional pulse の発生源は 8-10Re の 22-24LT の領域に存在すると考えられる。

キーワード: Pi 2 地磁気脈動, Pi 2 の発生源, 多点観測, 伝播
Keywords: Pi 2 magnetic pulsation, Pi 2 source, multi point observation, propagation

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PEM31-10 会場:304 時間:5 月 24 日 10:45-11:00

ビーズ状オーロラの南北地磁気共役性
Magnetic conjugacy of northern and southern auroral beads

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Auroral beads, i.e. azimuthally arrayed small-scale bright spots resembling a pearl necklace, have recently drawn the attention of researchers as a possible precursor of explosive activation of the aurora. Here we used simultaneous, ground-based, all-sky camera observations from a geomagnetically conjugate Iceland-Syowa Station pair to demonstrate that small-scale auroral beads evolve synchronously in the northern and southern hemispheres and have good magnetic conjugacy for ˜7 min before an auroral breakup. The synchronous conjugate auroral beads undergo a two-step evolution: in the first ˜4 minutes, well-organized bead structures move eastward with an almost constant speed of 1 km/s or less, and subsequently they develop dramatically into brighter and larger auroral forms with faster propagation speed of 2-6 km/s. Our observations strongly suggest that, for the auroral beads, the magnetosphere plays a fundamental role in the determining their temporal evolution, while the ionospheric contribution that can induce asymmetric auroral behavior in the two hemispheres is minor or not significant.

キーワード: ビーズ状オーロラ, 南北共役性, サブストーム
Keywords: auroral beads, magnetic conjugacy, substorm

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PEM31-11 会場:304 時間:5 月 24 日 11:00-11:15

磁気シア効果を考慮したオーロラアークの安定性解析
Stability analysis of auroral arc with magnetic shear effects

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磁気圏-電離圏結合系におけるオーロラアークの発達を磁気流体不安定性、及びその非線型発展の観点で理解しようとする研究が近年まで盛んに行われている。その一つがフィードバック不安定性であり [Sato, 1978; Lysak, 1991]、対流電場の形成に伴って電離層上を伝播する密度波と共鳴して、シアアルヴェン波が不安定化する。近年では、２次元シミュレーション（磁力線方向とアークを跨ぐ方向、双極子磁場配位）により、微細なアークや電離圏キャビティモードの形成が示された [Streltsov and Lotko, 2004; Lu et al., 2008]。非線型効果を適切に取り入れた３次元シミュレーション（スラブ磁場配位）では、磁気圏側で Kelvin-Helmholtz 型の渦構造が自発的に発生することが示された [Watanabe, 2010]。さらに、磁力線方向のアルヴェン速度非一様性を取り入れた線型解析では、磁力線共鳴とキャビティモードの成長率の関係が明らかになり [Hiraki and Watanabe, 2011]、それに基づく非線型シミュレーションにより、オーロラの渦構造発生との関連が調べられている。

本研究では、再びオーロラアーク、シアアルヴェン波の線型安定性に立ち戻る。サブストーム発生前のアークの時間発展をみると、高緯度で発生して緩やかに伝播し、低緯度で不安定化により急激に増光することが知られる [Mende et al., 2009]。この現象を“ 対流電場に対するアークの向きの変化による安定性のスイッチング現象 ”として理解できないか、を吟味する。真夜中の対流電場は、大域的には２セル構造をもち東西に印加されるが、低緯度では Harang 構造により強い南北成分が形成される [e.g., Zou et al., 2009]。これまでの解析では、フィードバック不安定性の成長率は主に対流電場の強度で制御され、電離圏電流方向に波数をもつモードが最大となる。しかし、アークに伴う沿磁力線電流が作る磁気シアを考慮した場合、シアに直交するモードに対して安定化効果をもつことが解析的に示され、成長するモードに強い指向性を作ると期待される。本発表では、磁気シアを考慮したアークの安定性とその電場や電気伝導度に対する依存性の結果を紹介する。

キーワード: オーロラアーク, フィードバック不安定, 磁気シア
Keywords: auroral arc, feedback instability, magnetic shear

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カスプにおけるクレーター型のレッドオーロラ
Crater red aurora in the cusp

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A new high-resolution all-sky imager (Longyearbyen, Svalbard) detected the formation of ”crater red aurora” in the cusp and the immediate ejection of the narrow auroral form from the crater during an interval of southward IMF on 29 December 2011. The crater red aurora can be defined as a circular-shaped region in which 630-nm dayside auroral emissions weaken. The emission data obtained continuously with an exposure time of 4 s show that the circular shape whose diameter was approximately 150 km at F region heights was formed for 2 min after the initial weakening at a smaller region. Immediately after the circular-shape was formed, a latitudinally-narrow (˜40 km) auroral form was ejected from the inside wall of the crater in the azimuthal direction. The speed of the leading edge is estimated to be approximately 1.5 km/s. These observations strongly suggest that the crater red aurora is the ionospheric signature of a crater flux transfer event, which has been studied recently with data from spacecraft near the dayside magnetopause. Considering that the scale of a crater flux transfer event reflects the size of a flux transfer event itself, the present observation shows that the ionospheric signature of a flux transfer event is much larger than the ejected narrow auroral form. Such an auroral form, which has been regarded as a so-called poleward moving auroral form, would represent the structure inside a flux transfer event, not the whole structure of a flux transfer event.

キーワード: レッドオーロラ, F層, カスプ, プラズマ対流
Keywords: red aurora, F region, cusp, plasma flow

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PEM31-13 会場:304 時間:5 月 24 日 11:30-11:45

全天カメラと EISCAT レーダーによるポーラーパッチの同時観測
Simultaneous observation of polar cap patches with all-sky imager and EISCAT radars

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The airglow intensity of polar cap patches is related to the local electron density profile of the polar cap ionosphere as well as the profiles of neutral gases that contribute to optical emission. Concurrent operation of an all-sky imager and incoherent scatter radars enables simultaneous observations of optical intensity of polar cap airglow and ionosphere parameters. An all-sky airglow imager equipped with a high sensitivity EMCCD detector has been deployed in Longyearbyen, Svalbard (78.1 N, 16.0 E) since October 2011. The imager's fine time and 2D resolution and its proximity to the EISCAT Svalbard radar (ESR) provide opportunities to study the relationship between the optical intensity and electron density of polar cap patches. By virtue of the spatial resolution of approximately 2 km per pixel, it is possible to identify a fine structure of the electron density in the region where the ESR beam crosses at a particular altitude. A 4-second exposure time of the imager combined with its high spatial resolution allows us to detect rapid changes in patch structures which have not been possible to identify with radar-alone observations.

In this study we analyze a storm time polar cap patch event combining the data obtained by the all-sky imager and two radars, the ESR and mainland EISCAT UHF radar. An interval between 17 UT and 24 UT on 22 January 2012 is studied. The variations of optical intensity and electron density show a good agreement, which enables us to cross-calibrate the two parameters. Cross examination of optical intensity and electron density reveals steep gradients and sharp edges of patch structures as narrow as a few kilometers. Temporal variations obtained from the two EISCAT radars suggest that some patches were transported antisunward from the polar cap to lower latitudes, which is in good agreement with the all-sky imager observation. These facts suggest that electron density structures may travel across the polar cap from the cusp region to the night side auroral zone keeping their sharp density gradients.

キーワード: 極冠パッチ, 高緯度電離圏, EISCAT, 全天カメラ, 電離圏電子密度構造, 大気光
Keywords: polar cap patches, high-latitude ionosphere, EISCAT, all-sky imager, ionospheric electron density structures, airglow

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A coordinate analysis of dayside diffuse aurora: GEOTAIL, FAST, and South Pole auroral observations

A coordinate analysis of dayside diffuse aurora: GEOTAIL, FAST, and South Pole auroral observations

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It has been thought that the source of diffuse auroral emissions is scattered plasma sheet electrons into the loss cone by some wave-particle interactions. Both ECH waves and whistler-mode chorus have been thought to be the contributors to the production of diffuse auroral electrons since they can resonate with plasma sheet electrons. A question which wave mode dominantly contributes to the production of diffuse auroral electrons has been discussed for more than four decades and there is still controversy. A recent study done by Thorne et al. [2010] reveals that whistler-mode chorus is dominantly responsible for the production of diffuse auroral electrons. While, there are some observational suggestions that ECH waves cause diffuse auroral electron precipitations. [e.g., Nishimura et al., 2010; Liang et al., 2010]. Multi-point observations along a field line using low altitude satellites and spacecraft around the magnetic equator are important to investigate the contributor to the generation of diffuse aurora since the properties of diffuse auroral electrons depend on the wave mode that causes electron pitch angle scattering.

This study shows a coordinate analysis of dayside diffuse auroras using the data obtained from a reliable ground-spacecraft conjunction event. During the event, diffuse auroras were observed by the South Pole all sky imager. At that time, GEOTAIL located in the dayside magnetosphere at a radial distance of ~ 10Re, at 1000 MLT and its ionospheric footprint was inside the diffuse aurora. Furthermore, the FAST spacecraft passed over the footprint of GEOTAIL. The FAST observations showed the precipitating electrons in the energy range of 0.1 to 10 keV and the pitch angle distributions revealed that electron scattering rates reached strong diffusion limit in the energy range of 0.1 to 5 keV. PWI/SFA onboard GEOTAIL observed both whistler-mode waves and ECH waves around the conjunction event. More likely wave mode contributing to the electron precipitations was investigated by estimating resonant energies for whistler-mode waves and ECH waves, respectively. Based on the observed frequency distributions, minimum resonant energy for whistler-mode waves were too high to scatter the electrons in the energy range below 10 keV, while ECH waves can resonate with the electrons in the energy range of 0.1 to 10 keV. This result suggests that generation mechanism of diffuse aurora in this event was pitch angle scattering driven by ECH waves rather than whistler-mode waves.

キーワード: ディフューズオーロラ, 波動粒子相互作用, ホイッスラー, ECH wave
Keywords: Diffuse aurora, wave-particle interaction, whistler-mode waves, ECH waves

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オーロラ爆発開始時における降下電子の２衛星観測
Two satellite observations of precipitating electrons associated with auroral breakup

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オーロラ爆発開始時に、どのような電子が降下しているかを調べる。これまで、擾乱時のオーロラを作り出すのは主として、静電場により加速され、数 keV 程度の特徴的なエネルギーを持つ、inverted-V 型の降下電子と考えられてきた。一方、オーロラ極側境界では、アルベン波によって加速された、数 10eV-数 keV に渡る broadband な降下電子がしばしば観測される。極側境界だけではなく、オーロラ爆発開始地点でも、開始直後に broadband 型の電子が観測されたことが 1 例報告されている。

本研究では、Polar 衛星のオーロラ観測を用いて同定した、オーロラ爆発の開始時刻・開始地点付近において、FAST 衛星と DMSP 衛星が、降下電子を準同時観測した例を示す。オーロラ爆発の開始 6 分前に、FAST 衛星がオーロラ爆発の開始地点を通過し、1keV 以下の broadband 型の電子と、10keV 程度の diffuse 電子の共存を観測した。また、開始 7 分後には、DMSP 衛星が開始地点の西 (15 度) において、拡大してきたオーロラの前面 (surge horn) を通過した。そこで観測された電子は、開始 6 分前に観測された電子と比較して、broadband 型の電子と diffuse な電子が共存していた部分が、inverted-V 型の電子に置き換わっていた点が異なっていた。以上の観測結果により、オーロラ爆発開始時における、diffuse オーロラから discrete オーロラへの変化の過程で、diffuse 電子と broadband 電子が共存する段階があると考えられる。

キーワード: オーロラ, オーロラ爆発, サブストーム, 沿磁力線電流
Keywords: aurora, auroral breakup, substorm, field-aligned current