PEM04-P01 Room:Poster Time:April 28 18:15-19:30

Retrieval of plasmaspheric He+ density field-aligned distributions from EUV imaging data

KEIKA, Kunihiro[1*] ; BRANDT, Pontus C.[2] ; TOIGO, Anthony[2] ; ROBERT, Demajistre[2]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University, [2]The Johns Hopkins University Applied Physics Laboratory

We retrieve the spatial distributions of He+ density (n_{He+}) in the Earth ' s plasmasphere from EUV imaging data, by using a forward modeling technique. We use a parametric model for the density distribution to simulate line-of-sight integrated He+ densities (i.e., EUV images), and then find parameters that give the best fit to real EUV images. The parametric model used in this study is described as a function of L and magnetic latitude (λ): n_{He+} = n_0 $(L_0/L)^{alpha\_L}$ $\times$ $(r_0/L_0 \cos\lambda^2)^{alpha\_f}$, where n_0 and L_0 are He^+ density and L value at the inner boundary of this model (i.e., the topside ionosphere), and α_L and α_f are parameters that represent L and field-aligned dependence of He^+ density, respectively.

In this paper, we evaluated how well our forward model can retrieve the He^+ density spatial distribution, by performing the following analysis. (1) EUV emission intensities were simulated through the EUV camera response function, given a vantage point of the IMAGE satellite. (2) EUV images were simulated for a large number of (α_L, α_f) pairs: α_L was chosen from 4.0 to 6.0 with 0.1 increment, and α_f was from 0.0 to 2.0 with 0.1 increment. (3) The EUV image corresponding to the (α_L, α_f)=(5.0, 1.0) pair was chosen as our synthetic EUV image. After noise was added to the synthetic image, the forward modeling was applied to all simulated images made in (2). The reduced χ^2 (${\chi_r}^2$) was used to determine how well simulated image data fit to the synthetic image. The results of this analysis confirm that the He^+ density distributions can be retrieved with good certainty within |40 deg.|MLAT. However, beyond this magnetic latitude it is difficult to determine the L dependence or field-aligned dependence of plasmaspheric He^+ density.

Next, in order to decouple the synthetic data from the parametric formula, we will use density distributions provided by physics-based ionosphere/plasmasphere models as our synthetic data. We will also apply our forward simulation model to real EUV image data from the EUV imager onboard the IMAGE spacecraft.

Keywords: Plasmasphere, Helium ion density, Inner magnetosphere, Plasma refilling, Forward modeling

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Solar-cycle variation of the plasmasphere observed from the Akebono PWS data

HASEGAWA, Shuhei[1*] ; MIYOSHI, Yoshizumi[1] ; KITAMURA, Naritoshi[1] ; KEIKA, Kunihiro[1] ; SHOJI, Masafumi[1] ; KUMAMOTO, Atsushi[2] ; MACHIDA, Shinobu[1]

[1]Solar-Terrestrial Environmment Laboratory, Nagoya University, [2]Department of Geophysics, Graduate School of Science, Tohoku University

Plasmaspheric density structures have been studied for a long time. Although it has been clarified that the density is roughly constant along field lines in the outer plasmasphere, field-aligned density distributions of the inner plasmasphere has not been studied intensively. Moreover, continuous observations longer than one-solar cycle have not been reported. Consequently, long-term variations of the plasmaspheric density over a solar cycle remain unknown. In this study, using electron density data based on plasma wave observations from the PWS experiments on board the Akebono satellite from 1989 to 2008, we conduct statistical analyses on variations of structures of the plasmasphere and plasmatrough. In order to investigate the latitudinal distribution of the electron density, we assumed that electron density distribution along field lines are described by a power law form $N_e = N_{e0}(LR_E/R)\alpha, where N_{e0}$ is the equatorial electron density. Using the dataset during geomagnetically quiet periods and altitude higher than 4000 km, we derived solar cycle variations of the equatorial density N_{e0} and field-aligned density distributions α. N_{e0} and α are almost constant for the solar cycle ($N_{e0} \approx 2000$ cm^{-3} and $\alpha = 0 - 1$) in the inner plasmasphere at L = 2.1 – 2.3, which distribution is close to diffusive equilibrium. In contrast, $N_{e0}\sim 200$ cm^{-3} and α=0 – 1 at solar minimum which distribution is close to diffusive equilibrium and $N_{e0} \sim 30$ cm^{-3} and α= 2 – 3 at the solar maximum which distribution is close to collisionless in the outer plasmasphere at L = 4.2 – 4.7.

Keywords: plasmasphere, electron density, akebono satellite, solar-cycle

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Statistical analysis of EMIC waves in the inner magnetosphere from the Akebono observations

KATO, Yuichi[1*] ; MIYOSHI, Yoshizumi[1] ; SAKAGUCHI, Kaori[2] ; KASAHARA, Yoshiya[3] ; KEIKA, Kunihiro[1] ; KITAMURA, Naritoshi[1] ; SHOJI, Masafumi[1] ; HASEGAWA, Shuhei[1] ; KUMAMOTO, Atsushi[4] ; SHIOKAWA, Kazuo[1]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University, Japan, [2]National Institute of Information and Communications Technology, [3]Information Media Center, Kanazawa University, [4]Department of Geophysics, Graduate School of Science, Tohoku University

Electromagnetic ion cyclotron (EMIC) waves in the inner magnetosphere are important since EMIC waves cause the pitch angle scattering of ring current ions as well as relativistic electrons of the radiation belts. Although the spatial distributions of EMIC waves have been investigated by several spacecraft such as CRRES, THEMIS and AMPTE, there have been little studies on their latitudinal distributions. Up to this point, we developed the automatic detection algorithm to use the magnetic field data observed by the ELF instrument on board the Akebono satellite, and demonstrated that EMIC waves exist inside the plasmasphere. Since the Akebono satellite measures the thermal plasma density, we investigate the fp(plasma frequency)/fc(cyclotron frequency) dependence and derive the resonance energies of the observed EMIC waves. In this presentation, we report the spatial distributions of EMIC waves, and discuss the dependence of fp/fc and the resonant energy.

Keywords: Electromagnetic Ion Cyclotron, EMIC wave, Statistical analysis, inner magnetosphere

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Dispersion relation of Pc1 geomagnetic pulsations using ground-magnetometer observations

NOMURA, Reiko[1*] ; PLASCHKE, Ferdinand[2] ; NARITA, Yasuhito[2] ; GLASSMEIER, Karl-heinz[1] ; FUJITA, Shigeru[3] ; MANN, Ian[4]

[1]IGEP, TU Braunschweig, [2]Space Research Institute Austrian Academy of Sciences, [3]Meteorological College, Japan Meteorological Agency, [4]University of Alberta

Pc1 geomagnetic pulsation (Pc1) observed on the ground at subauroral latitudes (L$\sim$4) is the signature of ion cyclotron waves with frequencies 0.2-5.0Hz near the plasmapause. When the waves reach onto the ionosphere, they induce the Pedersen and Hall currents which generate both Alfven and fast mode waves in the ionospheric duct. On the ground we observe the variations of the magnetic field caused by both of the Alfven and the fast mode wave in the ionospheric duct. Previous studies based on the theoretical models showed the frequency dependence of attenuations, and the spatial distribution of wave polarisations, and furthermore, predicted the dispersion relation in the ionospheric duct. Especially for the characteristics of attenuations and polarisations, previous studies have been established using ground magnetometer observations. Yet, no study has demonstrated the Pc1 dispersion relation experimentally. In our presentation, we show the Pc1 dispersion relation obtained by the wave telescope analysis using CARISMA ground magnetometers.

Keywords: Pc1, EMIC waves, dispersion relation, ionospheric duct