J233-002 **Room: Exibition hall 7 sub** **Time: May 18 9:15-9:30**

Use of CNA in the generalized aurora computed tomography

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The generalized aurora computed tomography (G-ACT) is a method to retrieve differential flux of incident electrons from auroral monochromatic images, electron density profile, and cosmic noise absorption (CNA), simultaneously observed with the ALIS (Auroral Large Imaging System) cameras, the EISCAT radar, and the imaging riometer. We have developed the inversion algorithm for the G-ACT based on the Bayesian inference. Furthermore, we tested the feasibility of this method by the numerical simulation, and confirmed that the addition of electron density profile to auroral images is effective to improve the differential flux of incident electrons over the EISCAT radar site.

In this study, we examine how to use CNA in the G-ACT. The imaging riometer at Kilpisjarvi consists of a 64-element dipole antenna and a butler matrix, which can form 7 x 7 effective beams, and measures the horizontal distribution of absorption of cosmic radio noise in the ionospheric D region. Since CNA is mainly caused by the high-energy electrons at several tens of keV, electron flux in this energy range may be improved by CNA data. However, there have been few studies that used CNA data for the quantitative estimation of electron energy spectrum.

The CNA used for inversion analysis was modeled by assuming the narrow beams and low sidelobe level of imaging riometer. In this case, CNA was calculated by a line-of-sight integration of a product of electron density and neutral-electron collision frequency. The energy range for numerical calculation was extended up to 100 keV. In the simulation, we especially focus on the following points; (1) How is the line-of-sight-integrated CNA effective for the reconstruction of high-energy electron flux? (2) What is the error due to the assumption of ideal narrow beams? (3) How does the reconstructed high-energy electron flux depend on the atmospheric parameters in the ionospheric D region.