A04-P06

FURTHER OBSERVATIONS OF 4FCE AURORAL ROAR

Yuka Sato *(National Institute of Polar Research, Japan)*
Akira Kadokura *(National Institute of Polar Research, Japan)*
Yasunobu Ogawa *(National Institute of Polar Research, Japan)*
Atsushi Kumamoto *(Tohoku University, Japan)*
Yuto Katoh *(Tohoku University, Japan)*

sato.yuka@nipr.ac.jp

Conventional auroral roar is a relatively narrow band emission ($\delta f/f < 0.1$) near harmonics of ionospheric electron cyclotron frequency ($2f_{ce}$ and $3f_{ce}$). Both harmonics are commonly attributed to mode conversion to the L-O mode of upper hybrid waves excited under the condition of $f_{UH} \sim nf_{ce}$ (n = 2 and 3) in the bottomside ionosphere by auroral electrons. The recent observational accomplishment relevant to auroral roar is discovery of higher harmonics: $4f_{ce}$ roar [Sato et al., 2012] and $5f_{ce}$ roar [LaBelle, 2012]. Both were detected in sunlit conditions, which had not been expected because $2f_{ce}$ and $3f_{ce}$ roars appeared almost exclusively during local darkness and are most common in the premidnight hours. However, the explanation could be based on the existing theory on auroral roar generation, including the idea that high F-region densities are required to achieve the condition $f_{UH} \sim nf_{ce}$ (n = 4 and 5), and such higher frequency waves can reach ground level without severe absorption even in dense sunlit D- and E-regions. The resulting polarization of $4f_{ce}$ roar was expected to be L-O mode. Sato et al. [2012] also mentioned another possibility of $4f_{ce}$ roar generation: nonlinear wave-wave coupling between two upper hybrid waves with opposite k vectors generated under the matching condition of $f_{UH} \sim 2f_{ce}$ makes R-X mode electromagnetic waves near $4f_{ce}$. This idea had been proposed by Sato et al. [2010] for the generation of second harmonic Terrestrial Hectometric Radiation (THR), which is an auroral roar-like signal emanating from the topside auroral ionosphere. However, no observational work has ever clarified the sense of the polarization of $4f_{ce}$ roar, which is absolutely essential for the understanding of its generation mechanism. In this paper, we present the first-ever polarization measurements of $4f_{ce}$ roar using a ground-based passive receiver (Auroral Radio Spectrograph/ARS) using orthogonal loop antennas installed at Husafell Station in Iceland (65.5 invariant latitude). ARS detected 11 events of $4f_{ce}$ roar from September 2011 to May 2014. The conclusion is not so simple, but arouses further interest, because is it not a matter of choosing between L-O and R-X modes. In 9 cases out of 11, $4f_{ce}$ roars were left-handed polarized, namely L-O mode waves. The L-O mode $4f_{ce}$ roars were observed under both sunlit and dark ionospheric conditions during geomagnetic storms. Satisfaction of the matching condition $f_{UH} \sim 2f_{ce}$ for L-O mode $4f_{ce}$ roar generation requires high density F-region ionosphere, which might be attributed to polar patches during darkness-hour geomagnetic storms. In two cases, right-handed polarized $4f_{ce}$ roars were observed during darkness hours and main phase of magnetic storm. This polarization indicates that nonlinear coupling of two upper hybrid waves may also works in the bottomside auroral ionosphere to generate R-X mode $4f_{ce}$ roar. We also present our achievements obtained from 5-year observations using a similar passive receiver installed in Svalbard (75.2 invariant latitude).