Medium frequency auroral radio emission observed in the polar region

Yuka Sato[1]; Takayuki Ono[2]; Masahide Iizima[3]; Natsuo Sato[4]; Hiroshi Miyaoka[5]

[1] Department of Astronomy and Geophysics,Tohoku Univ.; [2] Department of Astronomy and Geophysics, Tohoku Univ.; [3] Geophysical Inst., Tohoku Univ.; [4] NIPR; [5] National Inst. Polar Res.

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The polar ionosphere has been well known as the source region of various radio and plasma wave emissions. In the decades, vigorous and copious observations have been carried out for understanding physical mechanisms of VLF/LF auroral radio emissions such as auroral hiss and auroral kilometric radiation (AKR); however, there are unsolved problems remained in MF range auroral radio emissions. In order to understand the generation mechanisms of the MF range auroral radio emissions based on the observational approach, we developed a new instrumentation (ARS), which was established at the Husafell station in Iceland (invariant latitude 65.3 deg) in September, 2005, and was further developed in September, 2006. The ARS was designed to identify the spectrum and polarization character of radio waves appearing in the frequency range of 2fce - 3fce.

After the system improvement in September, 2006, one auroral roar event and two MF burst events have been detected successfully. These observed events clearly show that both the 3fce roar and the MF bursts are left handed polarized waves. Polarization character of the MF bursts is consistent to the previous observation result by Shepherd et al. [1997] and 3fce roar is verified for the first time to be L-O mode electromagnetic wave. This observational evidence supports the proposed generation mechanism of the auroral roar emission; namely, it is probably generated as upper hybrid wave taking a process of mode conversion along their propagation path.

The ARS observation revealed the propagation characteristics of MF bursts. In the first event on September 23, 2006, auroral breakup occurred about one minute after the disappearance of the MF burst. The geomagnetic disturbance and strong cosmic noise absorption at 30 MHz started simultaneously at the Husafell station with the onset of the auroral breakup. So, the MF burst is strongly suggested to be emitted in the southern auroral arc region; it propagated to the observation site and disappeared with the start of strong auroral ionization.

The auroral roar observed on November 10, 2006 wasn't associated with any auroral breakup phenomena. Particle observation by the DMSP satellites indicates that the occurrence of auroral roar is related to relatively low energy electrons (less than ˜1 keV). These precipitating electrons cause ionization in relatively high altitude region of the ionosphere, so it is interpreted that auroral roar is generated as upper hybrid waves by the low energy electrons above the observation point and propagate downward being converted to the L-O mode radio wave due to the inhomogeneous distribution of ionospheric electron density. Comparing with the situation of the MF burst event, there is no severe collisional damping effect in the lower altitude region for the condition of the auroral roars.

There is a basic question whether auroral roar and MF burst observed at the ground-level have the same generation mechanism as THR observed by satellites. Based on the ARS observation, it will become possible to establish a picture of auroral radio emissions by comparing the results from present ground-based observation and the Akebono satellite observation. We will show statistical analysis results of THR observed by the Akebono satellite and discuss its spectrum, polarization, and so on, comparing with some recent researches of the ground-based observation.