**R005-08**
**B 会場 ：9/24　 PM2 （15:45-18:15）**
**16:00〜16:15**

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# A multi-event study of auroral intensifications in N2+ (0,0) Meinel band at 1.1 um observed by the NIRAS-2 and the NIRAC

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Dayside aurora and polar patch are the key phenomena for understanding of the dayside magnetosphere-ionosphere-atmosphere coupling process. These phenomena are being monitored by ground-based optical instruments in high latitude region corresponding to polar cap and cusp, but the observations are done at limited geographic location and in limited season for avoiding strong photon intensity of sky background. Alternatively, active/passive radio remote sensing such as HF/VHF/UHF radar, GNSS and LF wave receiver are effective, but spatial and temporal resolutions by those measurements are not sufficient generally in comparison to optical measurements.

We present simultaneous observations of $N_2^+$ Meinel (0,0) band (hereafter, $N_2^+$ (M)) aurora by cutting-edge short wavelength infrared (SWIR) imaging spectrograph (NIRAS-2) and monochromatic camera (NIRAC) installed at Kjell Henriksen Observatory (78$^o$N, 16$^o$E). NIRAS-2 is a 2-D imaging spectrograph with a fast optical system and high spectral resolutions to challenge twilight/daytime aurora measurements from the ground. It is designed for SWIR wavelength from 1.1 to 1.3 microns in which sky background intensity is weaker than in visible subrange. In addition, NIRAC have been developed focusing on aurora emissions of $N_2^+$ (M). $N_2^+$ (M) is about two orders brighter than the $N_2$ 1st negative band at 427.8 nm (Remick et al. 2001), which means that the band can be a good indicator of energetic electron precipitations. Total optical system is fast (F-number 1.5) and its FOV (84$^o$ x 68$^o$) is slightly wider than that of the NIRAS-2. Thus, the NIRAC is used as a twin instrument to the NIRAS-2 to help in interpreting meridional scan data obtained from the NIRAS-2.

On January 21 2023, $N_2^+$ (M) intensification of associated with a band-shape aurora structure was observed by the NIRAS-2 and the NIRAC by temporal resolutions of 30 seconds and 20 seconds, respectively. Additionally, the European incoherent scatter Svalbard Radar (ESR) also observed electron density variations at the same time. Electron density measured at altitude ranges from 100 km 120 km changed in the same way as $N_2^+$ (M) intensity, which implies that a primary source of $N_2^+$ (M) emissions is direct collisions of $N_2$ by precipitating electrons penetrating down to around 100 km altitude (up to 10 keV). However, the observation also demonstrated moderate correlations between $N_2^+$ (M) intensity and electron density above 140 km, which implies that different $N_2^+$ (M) generation process, $N_2$ charge exchange with $O^+$, may work up to near 160 km and make a non-negligible contribution to $N_2^+$ (M) emissions. This hypothesis would be verified with further radar observations or stereo imaging observations useful to estimate the vertical distribution of the emission layers.

The observed $N_2^+$ (M) spectrum show fine structures due to $N_2^+$ rotational motions and it was successfully reproduced by common molecular models for diatomics and non-linear least squares fitting. The estimated $N_2^+$ rotational temperature with 30-sec cadences mostly ranges from 200 to 400 K, which agrees with one in NRLMSIS 2.1 at 100 and 120 km altitude, respectively. During a period where strong aurora intensification was seen, the rotational temperature was about 210 K with an error of 15 K (1-sigma). In addition, the ESR demonstrated that a peak altitude of electron density also got down to 100 km. These results are consistent with that a center altitude of $N_2^+$ (M) emission layer gets lower associated with more energetic particle precipitations. In this study, further analysis results based on the above case study and several similar events will be presented.