近赤外波長における北欧2地点光学観測：昼側へのオーロラ・大気光観測の拡張

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Near infrared optical observations in the Northern Europe: Extension of dayside aurora and airglow measurements from the ground

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Dayside aurora, polar patch, and airglow are key phenomena for the understanding of dayside magnetosphere, ionosphere, and neutral atmosphere coupling process. Those phenomena have been mainly monitored by active/passive radio remote sensing such as HF/VHF/UHF radar, GNSS receiver, and imaging riometer, but spatial and temporal resolutions by those measurements are basically not so good in comparison to optical measurements. Near infrared (NIR) wavelength are crucially important because lower background sky radiation by Rayleigh scattering may allow us to conduct ground-based optical observation even in dayside. However, NIR aurora has a total lack of its spectral information with enough resolutions to make a feasibility study in comparison to that in visible wavelength.

We are planning to install two different type of imaging spectrometers at two observatories in the Northern Europe to evaluate and establish optical measurements in NIR for dayside aurora and airglow. The detail of the spectrographs is as follows.

Czerny-Turner type imaging spectrometer at Kiruna (67.85^{o}N, 20.21^{o}E):

It is a narrow field spectrometer with medium-high spectral resolution that mainly consists of a Czerny-Turner type imaging spectrometer (HORIBA, iHR320) with a gold coated off-axis parabolic mirror, a NIR long-pass filter, two blazed gratings (600 and 150 gr/mm) and 1D InGaAs array (1024 pixels). Spectral range and that per pixel with a 600 gr/mm grating are 119 nm and 0.11 nm/pixel, respectively. It is going to be installed at IRF Kiruna in the end of August 2019. This spectrometer focuses on continuous measurements of aurora (N_2^+ Meinel) and airglow (OH 3-1 band) spectrum around 1.5 microns. Although auroral emissions in this wavelength is thought to be not so strong compared to airglow, its detailed spectral feature is not fully understood. On the other hand, P1(2) and P1(4) emissions in OH 3-1 band allow us to estimate OH rotational temperature near mesopause. Additionally, the airglow measurement has a possibility to collaborate with an all-sky monochromatic OH imager planned by IRF/Kiruna and MATS satellite founded by Swedish National Space Agency, which is scheduled for launch late 2019.

Meridional imaging spectrometer at Longyearbyen (78.21^{o}N, 15.55^{o}E):

We have designed a new imaging spectrometer for NIR wavelength ranging from 1.09 to 1.25 microns that covers strong auroral emissions in N_2^+ Meinel band (1.1 microns) and N_2 1st Positive band (1.2 microns). It mainly consists of three camera lenses, a few selectable slits, a NIR long-pass filter, a volume phase holographic grating (950 gr/mm) and 2D InGaAs array (640 x 512 pixels). Fast CCTV lenses (F1.4) for security purpose are used as two objective and one collimating lens. FOV and angular resolution are 55 degree and 0.11 degree per pixel, respectively. If a 30-microns slit is used, wavelength resolution at 1.17 microns is 2230, and signal-to-noise ratio for 1 kR emissions can get larger than 1.0 in a few seconds exposure time. Therefore, we can investigate temporal variability of dayside phenomena such as dayside reconnection and pulsating auroras in sufficient sampling rates of a few seconds. After development and calibration, this spectrograph will be installed at The Kjell Henriksen Observatory/The University Centre in Svalbard. Taking a great advantage of its location, 24-hours continuous observations can be expected (solar zenith angle lager than 96 degrees) near the winter solstice. Additionally, collaborative studies with active/passive radio remote sensing such as EISCAT ESR and GNSS receiver network will be done in near future to evaluate spatial and temporal characteristics of dayside aurora.