Spectra of pulsating aurora emissions observed by an optical spectrograph at Tromsø, Norway

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Pulsating auroras are a diffuse-type aurora, and are characterized by a repetition of brighter (on-phase) and darker (off-phase) auroral emissions with periods of a few to a few tens of seconds. Optical observations for pulsating auroras have been widely performed for many years. Recent major activities in the optical imaging observation would be, for example, high-speed observations for faster modulations (3-Hz or higher) in the emission intensity during on-phases of pulsating auroras and ground network observations in association with satellites in the magnetosphere for source regions of pulsating auroras. While such imaging observations equipped with bandpass or cutoff filters are useful for observing several auroral emission lines and bands of specific atoms and molecules, there is relatively less information on optical spectra of pulsating auroras.

We have been investigating optical spectra of pulsating auroras observed by an optical spectrograph at Tromsø, Norway (69.6°N, 19.2°E). Our spectrograph is capable of measuring optical emission intensity in mainly visible range from 480 to 880 nm with a resolution of 1.6 nm. The aperture, i.e. F-number, is 4. The field-of-view (FOV) is 0.03°x2°, which is pointed at magnetic field-aligned direction. The time resolution is 1 second, and thus it can observe pulsating auroras, which have periods from a few to a few tens of seconds.

In this presentation, we show a pulsating aurora event occurred in morning hours on 6 March 2017. The event was a relatively long-lasting event within the FOV of spectrograph, and it allows us to make more data integrations to enhance signal-to-noise ratios. According to a time-series of observed auroral emission data, we integrated spectral data for on- and off-phases separately. After such data integrations, auroral emission lines, such as OI 557.7 nm, OI 630 nm, and OI 844.6 nm, as well as emission bands, such as N2 1PG, were clearly found in both integrated-optical spectra of on- and off-phases. Then, we calculated a difference spectrum between the optical spectra of on- and off-phases. In the difference spectrum, clear line-like shapes were found for the emission lines of OI 557.7 nm and OI 844.6 nm. On the other hand, a shape of the difference spectrum around 630 nm does not seem to be a line-like shape due to OI 630 nm, and it seems to be a part of band-like shape of the emission band of N2 1PG. These results would suggest an importance of spectral observations of pulsating auroras, in addition to imaging observations.