Spatial distribution of periodicies of pulsating aurora: multi-point high-speed optical observations in Scandinavia

*Yuki Kawamura[1], Keisuke Hosokawa[1], Shin-ichiro Oyama[2], Yoshizumi Miyoshi[2], Yasunobu Ogawa[3], Satoshi Kurita[2], Ryoichi Fujii[4]

1. Department of Communication Engineering and Informatics, University of Electro-Communications, 2. Institute for Space-Earth Environmental Research, Nagoya University, 3. National Institute of Polar Research, 4. Research Organization of Information and Systems

Pulsating aurora (PsA) is a kind of diffuse aurora which almost always appears in the morning side during the recovery phase of auroral substorm. PsA typically has two characteristic temporal variations. One is so-called main pulsation whose period ranges from a few to a few tens of seconds. The other is a few Hz modulation (internal modulation), which is often seen during the ON time of main pulsation. Previous studies have suggested that the temporal variation of PsA is characterized by wave-particle interaction between whistler-mode chorus waves and high energy electrons in the magnetosphere. Especially, it has been indicated that there is one to one correspondence between the amplitude variation of chorus waves and the luminosity modulation of PsA.

PsA is known to show a wide variety of spatial structure. In general, their shapes are divided into the following two broad categories, 1) patch with irregular shape and 2) arc elongating in the east-west direction. Recent studies revealed the occurrence distribution of the periodicity of main pulsation. However, there have is no study which has analyzed the spatial distribution of the main pulsation and internal modulation.

To reveal the spatial characteristics of the main pulsation and internal modulation, we need to perform a frequency analysis of the main pulsation and internal modulation by using data from high speed optical instruments having wide spatial coverage.

For this purpose, we analyze images taken from highly sensitive all-sky EMCCD cameras operated in Sodankyla and Kevo, Finland with the sampling rate of 100 Hz, which is sufficient to identify both the main pulsation and internal modulation.

We computed periodicities of the main pulsation of two pulsating patches appeared along the east-west alignment from 00:10 to 00:15 UT on 29 March 2017. The periodicity of the eastern patch is about 15 s, while that of the western one is about 6 s. Similarly, we computed periodicities of the two patches appeared along the north-south alignment, and found that periodicity of the northern one is about 3 s, while that of the southern one is about 10 s. These results indicate that the periodicity of the main pulsation has longitudinal and latitudinal difference. Following these pilot case studies, we also computed the periodicity of the main pulsation from each pixel of the EMCCD cameras and derived the spatial distribution maps of the periodicity of main pulsation. By using such a map of dominant pulsating periodicity, we will identify the dependence of both main pulsation and internal modulation on longitude and latitude (MLT and L-value, respectively).

In the presentation, we discuss what factors control the difference of the PsA periodicities by taking into account their latitudinal and longitude dependences.

