Spatial characteristics of the internal modulation of pulsating aurora: multi-point high-speed optical observations in Scandinavia

*Yuki Kawamura[1], Keisuke Hosokawa[1], Shin-ichiro Oyama[2,3], Yoshizumi Miyoshi[2], Yasunobu Ogawa[3], Satoshi Kurita[2], Satoshi Ebukuro[1], 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 brightness modulation (internal modulation) which is often seen during the ON time of the 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.
Recent studies revealed the occurrence distribution of the frequency of the internal modulation. However, there have been no studies which analyzed the spatial distribution of the internal modulation.

To reveal the spatial characteristics of the internal modulation, we need to perform a frequency analysis of the internal modulation by using data from high speed optical instruments having wide spatial coverage. For this purpose, we make use of highly sensitive EMCCD cameras which have been operated in Sodankylä and Kevo in Finland, Tromsø in Norway, and Tjautjas in Sweden. In these observations, all-sky images are taken with a sampling rate of 100 Hz, which is sufficient to identify temporal variations of the internal modulation.

In the frequency analysis, we have employed all-sky images taken on March 15, 2018 (00:00 –01:30 UT) in Sodankylä, Kevo, Tromsø, and Tjautjas. We computed the average frequency of the internal modulation from each pixel of the EMCCD cameras and derived the spatial distribution of their dominant frequencies. Regardless of the latitude, each pulsating patch was fluctuating at a similar frequency. We also derived the frequency spectrum of several pulsating patches existing at different positions in the north-south direction and found that those frequency spectrums of pulsating patches have peaks at about 3 Hz. These results indicate that the frequency of the internal modulation does not depend on the magnetic latitude, and the frequency of the internal modulation is collimated on 3 Hz.
In the presentation, we discuss why the frequency of the internal modulation concentrate on 3 Hz by taking into account the time of flight of PsA electrons.

Keywords: Pulsating aurora, Internal modulation

