R006-P22
ポスター１：11/24　PM1/PM2 （13:15-18:15）

高時空間分解能光学観測を用いたオーロラ微細構造に関する研究

#Winn Wandal[1), 細川 敬祐 [1), 大山 伸一郎 [2), 三好 由純 [2), 小川 泰信 [3), 田中 良昌 [3)
[(1] 電通大, [(2] 名大 ISEE, [(3] 極地研

Study of Auroral Fine Scale Structure Using High Spatio-Temporal Resolution Optical Observations

#Wandal Winn[1)], Keisuke Hosokawa[1)], Shin ichiro Oyama[2)], Yoshizumi Miyoshi[2)], Yasunobu Ogawa[3)], Yoshimasa Tanaka[3)]
[(1]University of Electro-Communications, [(2]Institute for Space-Earth Environement Research, Nagoya University, [(3]National Institute of Polar Research

Auroras are classified into two broad categories: the discrete aurora, which has a distinct arc-like shape, and the diffuse aurora, which has an indistinct patchy shape. Most of the diffuse auroras are known to show a quasi-periodic luminosity modulation called pulsating aurora (PsA). Recent observations with high temporal resolution have been advancing our understanding of the physical mechanisms causing PsA. The main driver of PsA are chorus waves (Nishimura et al., 2010), a type of electromagnetic wave which is generated near the equatorial magnetosphere. As electrons in the magnetosphere travel along geomagnetic field lines, they can resonate with chorus waves, giving them enough energy to reach Earth's atmosphere and generate PsA. Thus, patches of PsA in the Earth's atmosphere have a one-to-one spatial and temporal correlation with patches of chorus waves in the magnetosphere. However, the origin or formation process of these complex spatial structures remain unclear, which is mainly due to the insufficient spatial resolution of conventional fisheye lens-based all-sky camera systems used for auroral imaging.

To solve this problem, we have recently set up a high resolution optical system in Skibotn, Norway (a village in the northern Scandinavian Peninsula at 69°　23′　27″　N 20°　16′　02″　E) to resolve the fine-scale spatial structure of PsA in greater detail. This system is comprised of a Hamamatsu Photonics C15550-20UP (ORCA-Quest qCMOS camera) with a narrow field-of-view F1.4 lens (Kowa LM8HC). The C15550-20UP camera has spatial resolution of 4096 $\times$ 2304 pixels, which will allow us to resolve sub-kilometer scale structures of auroras near the zenith. We put a wide-band optical filter (BG3 glass filter) on top of the lens to remove contributions of slower aurora emissions, such as the ones at 557.7 nm and 630.0 nm, and capture sub-second fast modulations of aurora. Since the installation in October 2023, the camera has been routinely operated at a rate of 20 frames-per-second (FPS), which is accurately synchronized by GNSS. We have also begun initial analyses of the images transferred from Norway. We utilized the star constellations in the background of the images to determine the camera's field of view in the sky, a process called astrometric calibration. Combining this information with the time of the image and the camera's geographical coordinates, we were able to map the images from the camera onto the geographic coordinate system at a 100 km altitude. Upon inspecting the images from the camera, we identified a 10 minute segment for further investigation. At 00:53 UT on Nov 21, 2023, a PsA patch emerges and lasts approximately 15 seconds, corresponding to a single ON phase of the main pulsation. During this ON phase, while the center of the patch remains stable, the edges show sub-second modulations in brightness. Upon generating a keogram, the PsA patch appears to modulate at roughly 3 Hz. Further investigation may reveal how general this behavior is to all PsA patches, and reveal the composition of the chorus wave patches in the magnetosphere which cause them. In the presentation we will introduce the above-mentioned procedures of astrometric calibration, along with initial findings in the PsA imagery from the arctic.