Estimating the energy of pulsating aurora electrons: simultaneous observations with multi-wavelength all-sky imagers and EISCAT

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One of the primary objectives of the ARASE/ERG satellite mission is to better understand the wave-particle interaction between whistler mode chorus waves and hot electrons in the morning side magnetosphere. As a result of the pitch-angle scattering by the chorus waves, relatively high energy electrons precipitate into the lower latitude part of the auroral region on the dawn side and cause diffuse aurora. It is well-known that the majority of diffuse aurora in the morning side changes its luminosity quasi-periodically, which is known as pulsating aurora (PsA). Such optical pulsations are believed to be caused by the intensity modulation of chorus waves in the magnetosphere. In addition, PsA electrons are known to be high-energy, whose energy ranges from a few to a few hundreds of keV. To discuss the relationship among wave-particle interaction in the magnetosphere, scattering of high energy electrons, and appearance of PsA in detail, it is demanded to monitor the characteristic energy of precipitating electrons continuously during PsA.

To derive the characteristic energy of precipitating electrons during PsA, we have been operating four sets of monochromatic all-sky imagers in Tromsø (69.60N, 19.20E), Norway since October 2016. By employing highly-sensitive EMCCD cameras (Hamamatsu C9100-23B), we succeeded in capturing PsA with a temporal resolution of 10 Hz. The wavelengths that we observe are 427.8 nm, 673 nm (N_2 1st positive), 777.4 nm and 844.6 nm. The former (latter) two wavelengths are associated with high (low) energy electron precipitation. By comparing the absolute optical intensities at these wavelengths, we have tried to estimate the characteristic energy of PsA electrons. We also carried out several special experiments for simultaneous observations of the multi-wavelength all-sky imagers with the EISCAT radar in October/November 2016, and January in 2017. In addition, we plan to conduct an another campaign observation in March/April during which the footprint of ARASE/ERG satellite is located near Tromsø.

In the presentation, we report the results of the comparison of the characteristic energy of PsA electrons derived from the multi-wavelength optical observations with the energy distribution estimated from the electron density measurement of EISCAT through the CARD method [Brekke et al., 1989; Fujii et al., 1994]. We then discuss what parameter/process controls the energy of PsA electrons in close association with the pitch-angle scattering through wave-particle interaction.