

Spatiotemporal variations and generation mechanisms of flickering aurora

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Flickering aurora is characterized by the intensity modulation with a dominant frequency of about 8-15 Hz and by the horizontal scale with a range of several kilo-meters. It has been suggested that electromagnetic ion cyclotron (EMIC) waves and/or inertial Alfvén waves (IAW) contribute to generate the flickering aurora via the interference. However, the supporting evidence was limited up to ~16 Hz, the Nyquist frequency of video sampling rate, in the past imaging measurements, and the further extension to higher frequency domain is still unknown. Here we conducted ground-based measurements of EMCCD camera and ELF search coil magnetometers in Alaska from December 2009 to April 2010. Imaging data were obtained with a sampling rate of 100 Hz, and its field of view and spatial resolution are 16km x 16km, 260m x 260 m, respectively, mapping at an altitude of 100 km. The ELF search coil magnetometers were installed at the same place and operated with 400 Hz sampling rate.

In this study we quantitatively clarify the small-scale flickering spots with a few km and their frequency variation higher than usual ranging up to 50 Hz as obtained with our new measurement system, which are important to understand the generation mechanisms of flickering aurora in broader frequency range than obtained in the past. We apply a two-dimensional FFT analysis on each image to estimate the spatial wavelength of flickering structure. Also, we apply FFT coherence and phase analysis to investigate the temporal variation of a series of images. We discuss several types of flickering aurora in detail; one is characterized by unusually frequency range of 30-40Hz with small spot-like structures of 2-3km scale and the other types are line-like aurora, rotating flickering etc. We suggest hypothesis that He⁺ or H⁺ EMIC waves may contribute to generate the 30-40Hz flickering aurora by similar mechanisms operated in the O⁺ EMIC waves generating 8-15 Hz variation. We will extend the analysis to the other events to generalize the hypothesis and to elucidate the fundamental mechanisms of flickering aurora.