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Spatiotemporal variations of flickering aurora obtained from imaging observations with a high-speed EMCCD camera

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We conducted high-speed imaging observations of flickering aurora at 100 Hz sampling rate using electron multiplying charge-coupled device (EMCCD) in Alaska during 2009-2010 winter season. We detected various types of flickering aurora, including drifting and rotating features at a frequency below 15 Hz. We identified, for the first time, flickering stripes and some other unusual flickering events at frequency of higher than 20 Hz on the imaging observations. A dispersion relation derived from a statistical analysis of observed images is compared with the theoretical dispersion curve of O+ electromagnetic ion cyclotron (EMIC) waves. The frequencies and spatial scales calculated from a coherence/phase analysis based on an interference theory are consistent with the wave dispersion relation derived from the statistical analysis, suggesting that the obtained results are essentially consistent with the scenario that the interference of EMIC waves produces the observed dispersion relation of flickering aurora. Furthermore, flickering frequencies higher than 20 Hz are confirmed from our observations, which are higher than expected frequency of O+ EMIC waves at altitudes of several thousands km. We therefore suggest that high frequency waves such as He+ and H+ EMIC waves may also contribute to produce a significant fraction of flickering aurora.

Keywords: Flickering aurora, EMCCD, alfven waves, EMIC waves, magnetosphere, ionosphere