Fine scale morphology of flickering aurora

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The generation mechanism of flickering auroras has been considered as Landau resonance between electrons and electromagnetic ion cyclotron (EMIC) waves. The typical frequencies of the flickering aurora are 3-15Hz which correspond to oxygen ion cyclotron frequency at altitudes of 3000-10000 km. The necessary condition of the appearance of the flickering aurora remains unsolved. Recent cameras enable us to see the extreme situation and the moments when the flickering aurora appears or disappears. An sCMOS camera we used in this study has two advantages: a high spatial resolution and a high sampling rate. Observations taken the former advantage were already conducted during two winter seasons. The camera captures fine images at 50 frames per second (fps). The field of view and the spatial resolution at the 100 km altitude is 26.6 x 26.6 km and 52 m, respectively. We found that the modulation of small flickering patches less than 1 km occur in narrow frequency variations while the modulation of large flickering patches with a few kilometers scale occur in broad frequencies. Such a tendency is consistent with the dispersion relation of O+ EMIC waves. On the subject of the auroral intensity, the camera is capable of detecting extremely bright auroras without causing a saturation. The flickering aurora occur in the bright and extremely bright auroras. The ranges of the auroral intensity are roughly estimated approximately 10-100 kR at 557.7 nm by comparison with a keogram obtained from a meridian spectrograph at PFRR. We also found that the frequency ranges of the flickering aurora are constant, but the ratio of the flickering amplitude to the steady auroral intensity systematically increases with the decreasing of the steady auroral intensity . The result may suggest the slightly energetic electrons tend not to fulfill the resonance condition of EMIC waves. We also found some flickering auroras coincidentally occur with an isolated magnetic impulse in the Pc5 ULF range observed by magnetometer nearby PFRR. Such a tendency may indicate that mesoscale (of the order of 100 km) traveling current vortices are one of the necessary conditions to generate the flickering aurora. We will discuss on the relation between the excitation of EMIC waves and the traveling auroral arcs with the current centralization. To verify the possibility of EMIC waves as the generation mechanisms, we are now challenging a high-speed imaging at 320 fps which is taken the latter advantage. It has the potential to capture faster modulations by H+ and He+ EMIC waves. We will collect the data in April 2016, and will report initial results in this talk.

