

Small-scale auroral dynamics based on dual-spectral high-speed imaging data

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The spatial structure and temporal variation of optical aurora are useful to investigate the magnetosphere-ionosphere coupling process, and provide us information on the characteristics of precipitating electrons, acceleration processes, wave-particle interactions, and so on. Past ground-based optical data showed the small-scale feature of auroral arc (< 100 m) showing curls and folds, as well as the temporal variation in flickering and pulsating auroras. Some models explained these features based on field-aligned acceleration processes with double layer, inertial Alfvén waves, EMIC etc. However, these models assume the 1-D system along a magnetic field line, and therefore, 2-D and 3-D structures of small-scale aurora are not understood.

We carried out high-speed imaging measurements with a monochromatic camera at Toolik field station and Poker Flat Research Range, Alaska, during the winter period of 2009/2010. The optical system consists of ANDOR iXon DU-897 EMCCD camera, objective lens (Nikon f=50mm, F1.2), and an interference filter optimized for N2 1PG aurora at 670 nm. It achieved 100 Hz sampling imaging with the field-of-view (FOV) of 9.3 deg, bin numbers of 64 x 64, and spatial resolution mapping at 110 km altitude of 280 m. At Poker Flat Research Range, the Hamamatsu EMCCD camera was additionally operated to make high-speed imaging measurements at two different wavelengths. The specifications of Hamamatsu EMCCD camera are mostly the same as ANDOR camera, except for an auroral emission at O 845 nm aurora which is responsible for a soft electron precipitation, sampling rate of 110 Hz and bin numbers of 128 x 128. Therefore, the ratio of N2/O auroral intensities gives us the characteristic energy of precipitating electrons. Further, we installed the search coil magnetometers obtained with 400 Hz sampling to observe magnetic variations due to inertial Alfvén wave and EMIC. Initial results of small-scale auroras concerning on arcs, pulsating and flickering auroras will be reported in this presentation.

Keywords: aurora, high-speed imaging, acceleration, flickering, pulsating