Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

PEM09-03 Room:302 Time:May 27 11:30-11:45

Cusp aurora as a backward-elongated image of the moving region of electron precipitation

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We present high time resolution observations of the red-line moving cusp aurora made on 27 November 2011 by an all-sky imager at Longyearbyen, Svalbard, and their comparison with EISCAT observations. The EISCAT radar pointing in the magnetic field-aligned direction detected several enhancements of electron temperatures whose durations are 1-5 min. The all-sky imager data obtained with a time resolution of 4 s allowed us to determine a one-to-one correspondence between electron temperature enhancements and cusp aurora intensifications. The radar beam entered the moving cusp aurora structure from its forward side, and exited from the backward side in some events, while in others the beam skimmed the moving aurora. Further analyses of the former events revealed that the enhancement of the electron temperature, which was produced by the intense electron precipitation, terminated 60-90 s earlier than the exit of the radar's field-of-view from the moving aurora. This duration is consistent with the lifetime of the O(^{1}D) state. Our observation provides evidence demonstrating that the cusp aurora is a backward-elongated image of the moving region of electron precipitation. The enhancement of ion temperature was also found to be in the moving cusp aurora structure. On the basis of these results we discuss the spatial relationship between electron precipitation and fast plasma flow, which causes the ion temperature enhancement.

Keywords: aurora, cusp, plasma flow, electron precipitation, electron temperature, ion temperature