A detailed case study of dayside diffuse aurora using GEOTAIL, FAST, and South pole all sky imager

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It has been thought that the source of diffuse auroral emissions is scattered electrons into the loss cone by some wave-particle interactions. Both ECH waves and whistler-mode chorus have been thought to be the contributors to the production of diffuse auroral electrons. A question which wave mode dominantly contributes to the production of diffuse auroral electrons has been discussed for more than four decades and there is still controversy. Multi-point observations along a field line using low-altitude satellites and spacecraft around the magnetic equator are important to investigate the contributor to the generation of diffuse aurora since the properties of diffuse auroral electrons depend on the wave mode that causes electron pitch angle scattering. In this paper, we show an event study of multi-instrument analyses for dayside diffuse auroras, precipitating electrons, and plasma waves using the South Pole all sky imager, FAST, and GEOTAIL observations, respectively. At the beginning of the event, GEOTAIL observed enhancements of both ECH waves and whistler-mode waves on the dayside magnetosphere. The all sky imager detected concurrent increase in the auroral intensity around the GEOTAIL footprint estimated by the Tsyganenko 01 model. During the event, FAST passed over the GEOTAIL footprint and observed precipitating electrons in the energy range of 0.1 to 5 keV, whose pitch angle distributions showed that the scattering by waves approaches strong diffusion limit. Our analysis shows that the auroral intensity around the GEOTAIL footprint was well correlated with the wave intensity of ECH waves rather than that of whistler-mode waves. Furthermore, estimation of the resonance energy reveals that resonance energy of whistler-mode waves was too high to scatter the electrons below 10 keV, while ECH waves could resonate with the electrons in the energy range of 0.1 to 5 keV. These results suggest that generation mechanism of diffuse aurora in this event was pitch angle scattering driven by ECH waves rather than whistler-mode waves.