

Sub-relativistic electron precipitation associated with pulsating aurora observed by sub-ionospheric radio propagation during recovery phase of substorm on 27 March 2017

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Recent studies on pulsating auroras (PsA) suggest that energetic electrons (up to several hundred keV) simultaneously precipitate into the atmosphere and they are caused by pitch angle scattering through wave-particle interaction with whistler mode chorus waves. However, the pulsating signature of the sub-relativistic electron precipitation with time scale of the main pulsation period of PsA (several seconds) has not been reported yet. Here, we report correlations between PsA and sub-relativistic electron precipitation with time scale of several second during recovery phase of substorm occurred on 27 March 2017. Energetic electron precipitation was detected by using sub-ionospheric propagation of VLF radio waves. The sub-ionospheric propagation is sensitive to the electron precipitation with energy higher than 100 keV. The VLF/LF radio waves from several transmitters has been observed at Athabasca with 0.1-sec time resolution. In this study, the transmitter at North Dakota (NDK, 25.2kHz) was used. PsA was observed by the THEMIS GBO all sky imagers at Athabasca (ATHA), The Pas (TPAS), and Pinawa (PINA) with 3-sec cadence. The radio propagation path from NDK to Athabasca is included in a convened field-of-view of the three imagers. We searched for correlations between aurora light curves at each pixel and amplitude variations in the received radio signal. The better correlations were found in the south-west part of the TPAS field-of-view than the other area. This is around the central point of the radio propagation path. The result shows that the sub-relativistic electron precipitation into the atmosphere has the pulsation signature and occurs associated with PsA.

Keywords: pulsating auroras, Sub-relativistic electron precipitation