Estimation of source region of pulsating proton aurora

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Pulsating proton aurora (PPA) is caused by pitch angle scattering of high-energy (several keV ~ tens of keV) ions via the electromagnetic ion cyclotron (EMIC) waves at the magnetic equator. EMIC waves propagate along the magnetic field line from the source region and are observed as Pc1 geomagnetic pulsations on the ground. We have been investigating the source region in the magnetosphere from the traveling time difference between PPA and Pc1 geomagnetic pulsations observed on the ground. We estimated the source region using the simultaneous ground-based observations of PPA and Pc1 geomagnetic pulsations at Athabasca, Canada (L value=4.3). The PPA events were observed by using an all-sky EMCCD camera (110 Hz sampling), and the geomagnetic pulsations were measured by an induction magnetometer (64 Hz sampling). In this study, we analyzed the source region for the two events of simultaneously observed PPA and Pc1 geomagnetic pulsations on 12 November, 2015 and 2 January, 2016. The observed Pc1 geomagnetic pulsations consist of rising-tone elements having the subpacket structures. The repetition period for the rising-tone element was approximately 100 seconds. The time variation for the subpacket structures was a few tens of seconds. The PPA intensity showed the same repetition period and fast modulation. In order to estimate the source region of PPA, we calculated the time difference between PPA intensity and Pc1 amplitude taking the cross-correlation between them. The observed time difference between PPA and Pc1 geomagnetic pulsations showed that the Pc1 geomagnetic pulsations arrived at the ground station faster than the PPA. We theoretically calculated the time difference between EMIC waves and energetic ions using the group velocity of EMIC waves and the resonance energy at each magnetic latitude. The source region was estimated by comparing between the observed and theoretically calculated time differences. The estimated results showed that the source region was in the magnetic latitudes around the equator. All of the obtained results are consistent with the scenario that the high-energy ions responsible for triggering the PPA was generated at the magnetic equator.
In the presentation, we will discuss the estimation results of source regions of PPA observed at Athabasca in detail.

Keywords: Pulsating proton aurora, Pc1 geomagnetic pulsations, EMIC waves

