

First simultaneous observation of the isolated proton aurora at subauroral latitudes by a highly sensitive all-sky camera and the Van Allen Probes satellite

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Isolated Proton Aurora (IPA) is the spotted aurora extending east and west at subauroral latitudes produced by energetic proton precipitation. Proton auroras are produced by energetic protons precipitating from the magnetosphere through charge-exchange collisions with atmospheric particles in the ionosphere. From previous studies, IPA has been considered to be generated by electromagnetic ion cyclotron (EMIC) waves which can scatter the pitch angle of energetic protons into the loss cone. However, simultaneous observation of IPA and its source plasma and electromagnetic fields in the magnetosphere has never been done before. Because EMIC waves are a key component contributing to the rapid loss of radiation-belt particles into the atmosphere, it is important to understand the mechanisms of EMIC wave-particle interaction. In the present study, we studied simultaneous observation events of EMIC-associated IPAs by ground all-sky camera at Athabasca and plasma and electromagnetic fields in the magnetosphere by the Van Allen Probes satellite. The EMIC waves were observed by the Van Allen Probes satellite at ~5:30 UT when the footprint of the satellite passed over an IPA on March 16, 2015. Proton flux from 5 eV to 20 keV observed by HOPE onboard the satellite increased rapidly at the time when satellite crossed the IPA. Electron flux at energies of ~500 eV also increased. The proton temperature anisotropy was 1.5-2.5 during the arc crossing. In addition, electron density observed by EMFISIS decreased from 4:20 UT to 6:20 UT, indicating that the IPA crossing was near the plasmopause. Electric field observed by EFW had no characteristic fluctuation associated with the IPA crossing. We will discuss these observations in relation to the possible IPA generation mechanisms.

Keywords: Isolated Proton Aurora, Electromagnetic Ion Cyclotron Wave, Inner Magnetosphere, Van Allen Probes Satellite