Proton aurora dynamics by spectroscopic observations at geomagnetic conjugate points

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Even the brightest proton aurora (486.1nm) is far weaker than electron auroras. When proton aurora is observed, strong emissions from nitrogen molecular ions excited by precipitating electrons may be a contamination. This is the reason why few conjugate observations of proton aurora have been conducted. The studies of proton aurora dynamics using monochromatic imagers in the past could not be definitively justified, because the contamination might remain after subtracting background emission simultaneously observed at a wavelength close to from the image. In this study a spectrum in a wide wavelength range that includes the wavelength of proton aurora is obtained by a proton aurora spectrograph (PAS) in order to precisely eliminate the background emission by electron auroras. PAS has a narrow field-of-view of 180˚ along a geomagnetic meridian, which is accomplished by a variable-width slit placed at the focal plane of an all-sky optics. Light that passes through the slit is converted to a parallel beam and fed into a transmission diffraction grating. Then a space vs wavelength image is projected on a CCD with 1024 × 1024 pixels. Pixel counts are increased by 2 ×2 pixel binning. PAS is designed to observe a wavelength range from 417 nm to 579 nm with a spectral resolution of 2 nm. PAS was installed at the optical observation site at Tjornes in Iceland in early September 2016. Continuous observation started on September 27, 2016, and will end on April 26, 2017. An image was obtained every 3 min with an exposure time of 177 sec from September 27, 2016 to December 8, 2016 and every 1 min with an exposure time of 55 sec from December 12, 2016. The difference in the exposure time is due to increase of sensitivity by updating the CCD camera. The slit width is set to be slightly wider than the designed value, and moreover it is not constant with the zenith angle. Therefore, the slit will be adjusted or replaced to increase the spectral resolution so that the background emission can be perfectly eliminated before the next observation season. An identical system will be developed in early 2017, and will be installed at Syowa Station, where is the geomagnetic conjugate point of Tjornes, during the 2017/2018 summer season. Then conjugate observations of proton aurora will be started from the spring season in 2018.
An example of the spectral data obtained from September 27, 2016 to April 26, 2017 will be introduced and discussed in the presentation.

