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多波長スキャンニングフォトメータによるプロトンオーロラ・ドップラープロファイルの研究

The Doppler profile of proton auroras obtained by the multi-wavelength scanning photometer

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Precipitating protons become neutral hydrogen atoms in excited states through charge-exchange in the upper atmosphere. The neutralized hydrogen emits the Balmer lines of hydrogen, called proton aurora. The proton auroras have significant differences from electron auroras in their spectral shape. They show Doppler-shifted and broadened spectra; the spectra has a Doppler-shifted (~0.5 nm shorter) peak and both blue wing (2-4 nm) and red wing (~1.5 nm) extending. Energy spectra of precipitating protons can be estimated from this shape. Although it is very useful for investigating the magnetospheric dynamics to estimate the energy spectra of protons from the ground, quantitative analysis has not been performed enough. In order to establish a method to estimate energy parameters of precipitating auroral protons and to investigate the dynamics of magnetospheric protons during substorms, we have developed a new type of meridian scanning photometer (MSP). This instrument has advantages of both spectroscopic and photometric observations. We set up two MSPs at Husafell station in Iceland and Syowa station in Antarctica.
The MSP developed in the present study is designed to identify the Doppler profiles of the H-beta proton emission with a high time resolution using the 5 photometer units, that equip different wavelength filters and photo-multipliers. We also install other 3 photometer units in the MSP to measure electron auroras in wavelengths of OI 630.0 nm, N21PG 670.5 nm and OI 844.6 nm. Calibration techniques and results were also shown after above system description. In the analysis of MSP data, the van Rhijn effect and atmosphere extinction are corrected. The corrected data are fitted to Doppler profile function introduced by Lummerzheim and Galand [2001]. About a month after we set up the MSP at the Husafell station, a hardware trouble occurred by water exposure, and then 3 channel units in the MSP could not be used. In spite of our efforts to repair it, we had to stop the operation at the Husafell station. Therefore, we analyzed only data obtained at the Syowa station.
We establish a method to estimate average energy of auroral protons from Doppler profiles of proton aurora obtained with the ground-based observation. Using the developed method, we can estimate the average energy along the magnetic meridian with a high time resolution. In order to obtain the energy spectrum distribution of magnetospheric protons, it is necessary to model proton aurora theoretically and to compare model results with the in-situ particle measurement in a higher energy range (> 30 keV). In addition, the developed method verified in present study is essential in future studies.

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