

Ground-Based telescope Spectral Analysis of Saturn' s Atmosphere Using MSI (PIRKA)

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Saturn' s atmosphere is composed of complex cloud structures and methane-rich haze layers, which exhibit significant latitudinal variations. In this study, we conducted ground-based spectral observations of Saturn' s atmosphere in the methane absorption bands (700–952 nm) with a 3 nm spectral step size. The observations were carried out in Oct 2024 using the 1.6-m **Pirka Telescope** at Hokkaido University (Nayoro observatory), equipped with a Multi-Spectral Imager (MSI) and Liquid Crystal Tunable Filters (LCTF).

Our primary objective was to analyze the latitudinal differences in Saturn' s reflectivity across various methane absorption bands. By comparing spectral data at different latitudes, we aim to determine variations in methane content and haze depth. The MSI instrument provided spectral images with reliable spatial and high spectral resolution, allowing us to detect accurately changes in Saturn' s atmospheric composition. We developed an algorithm to automatically find the center of the multi-channel images of the telescope by reading the Fits files in MATLAB. As a result of this algorithm, it was possible to accurately determine the equatorial region and the spectral reflectance between latitudes. We also calculated the effect of the light reflection from Saturn's belts. The measurements were made between October 5 and 28, 2024, when Saturn's belts coincided with the equator from the observation point of view, and since there were no clouds or rain for several days, the images were successfully taken. Preliminary results suggest that tropospheric haze is thicker at equatorial latitudes compared to higher latitudes, which is consistent with previous studies. The temporal evolution of bright features in Saturn' s cloud layers was investigated to understand whether they are caused by storm activity, haze dynamics, or seasonal changes. This study contributes to the ongoing effort to map Saturn' s atmospheric properties using ground-based spectral imaging, providing valuable data for comparative studies with space-based missions.

Keywords: Saturn' s atmosphere, Methane absorption bands, Multi-Spectral Imager (MSI), Latitudinal reflectivity variations