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Ground based multispectral imaging observation of Saturn's large storm

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Storms occur regularly in Saturn's atmosphere. Large storms called as Great White Spots(GWSs), which are about ten times larger than regular storms (300-3000 km in diameter), and occur about once per Saturnian year (29.5 Earth years). It is difficult to observe deep Saturn's atmosphere directly because Saturn's surface layer is covered by optically thick clouds. Observation of GWSs is one of the few method to get information about convective activity of Saturn's deep atmosphere [Hueso and Sanchez-Lavega, 2004]. In early studies, cloud structure of GWSs was estimated by radiative transfer calculation using images at several wavelengths in methane absorption bands [Acarreta and Sanchez-Lavega, 1999]. However, paucity of wavelengths in methane band have possibility to lead to ill-constrained cloud model parameters.

A new storm was detected on 5 December 2010, earlier than expected timing inferred from previous storm period by about ten years. The storm happened as a visible bright spot on northern hemisphere of Saturn (northern latitude of 37.7 degrees), and two weeks later, it's west-east size expanded 15,000 km. About two months after, it encircled the planet. This storm was observed by Cassini spacecraft. Cassini's images using three narrow bandpass filters (center wavelengths are 727, 750, 889 nm) showed horizontal variation of brightness at these wavelengths [Fischer et al., 2011]. However, the detail spectral information of the storm is still unknown. And also there is no comparison of spectrums in different periods.

In this study, an observation of the Saturn's storm used Multi-Spectral Imager(MSI) and a ground-based 1.6 m reflector named Pirka telescope operated by Hokkdaido University. MSI, which uses two Liquid Crystal Tunable Filters(LCTF) and an EM-CCD, was developed in Hokkaido University and enabled us to capture spectral images in a short time. Spectral imaging data of the storm, in the wavelength range of 400-1100 nm with FWHM of 5-10 nm, at 180 colors, were obtained within 30 minutes on 5 May 2011. Additionally on 6 June 2011, we observe Saturn in three methane bands at 88 colors.

We succeeded in deriving latitudinal variation of Saturn's spectrum in visible and near-infrared range. Methane absorption bands were confirmed and the rough shape of the spectrum is consistent with past observations [ex. Karkoschka, 1994]. And center-limb profile of spectrum at same latitude have possibility to provide characteristic of scattering, because of less longitudinal variation of spectrum.In addition, we drew a comparison between latitudinal variation of Saturn's absolute reflectivity in three methane absorption bands on 5 May and 6 June. In these datas, the reflectivity slightly changed In about a month. This period is fading phase of this GWS. Therefore detection of an absolute reflectivity variation at the latitude of the GWS lead to a fading speed information of the GWS. And a reflectivity of Saturn after the GWS fade outed is also important in terms of an influence on static cloud level by the GWS. Therefore, we are scheduled to observe Saturn in spring of 2012.

In future works we will observe Saturn's atmosphere regularly to derive temporal variation of spectrums and cloud structure using Pirka telescope.

Keywords: Saturn, great white spot, ground based observation, spectrum