Observational study of Jupiter's cloud structure using liquid crystal tunable filter

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Jupiter emits 1.67 times more radiation than it receives from the Sun indicating substantial internal heat source unlike in the case of terrestrial planets, and hence presumably vigorous convection. It is important to understand the distribution and optical and physical properties of clouds and haze particle. They play a major role to clarify the atmospheric dynamics such as stratospheric circulation and tropospheric meteorology.

Sun light reflects ammonia ice and / or ammonia sulfide cloud deck in troposphere which has been considered by the equilibrium cloud condensation model (ECCM) of Jupiter. Methane, third component of Jupiter's atmosphere, is considered that its altitude distribution is uniform through global scale because methane doesn't condense in Jupiter's atmosphere. Amount of methane absorption observed in methane absorption bands (727nm, 890nm) indicates column density of methane to cloud top altitude. Using this principle, in many previous works Jupiter's cloud structure has been derived using imaging data, obtained by ground-based telescopes, Hubble Space Telescope and spacecrafts, at only two wavelengths in each methane band : at the band center and adjacent continuum.

The traditional observational methods for cloud structure estimation need many assumptions because of low spectral-resolved information, resulting in remaining large ambiguities.

To derive more realistic cloud structure by more spectral-resolved observation in each methane absorption band, we have established observational method using Varispec^{TM} LCTF (liquid crystal tunable filter) manufactured by CRI and Hamamatsu EM-CCD camera (C9100-12) at Iitate observatory, Fukushima, Japan, operated by Tohoku University. LCTF, full width at half maximum of which is typically 7nm, can tune at once and continuously in 650-1100nm spectral ranges at 1nm step. Therefore, the observation system with LCTF is appropriate to our purpose because we don't need to exchange filters.

We will install our observational system at the Cassegrain focus of the 2-m reflector optical telescope at Nishi-Harima astronomical observatory and are planning to observe Jupiter in May, 2008 as the collaborate investigation. Atmospheric seeing is expected to be stable at nearly 1 arcsecond there in May. Because the 2-m reflector optical telescope can achieve sufficient light intensity of Jupiter in short exposure time (several tens of milliseconds) in which atmospheric seeing doesn't change, it is feasible to acquire Jupiter's images with high-spatial resolution and narrow band imaging in each methane absorption band by summing a lot of Jupiter's images obtained in short time. We also have been developing a radiative transfer model using doubling-adding method to evaluate observational results. We intend to consider some cloud structure model and derive clouds and haze distribution and optical and physical properties for each cloud structure.

In this presentation, we will show preliminary report of this observation and analysis results at Iitate observatory.