地上望遠鏡観測による木星熱圏イオン・中性大気ダイナミクスの研究

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Investigation of Jovian thermospheric dynamics by using ground-based telescopes

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Jupiter, the largest planet, has the strongest and largest magnetosphere in the solar system. It is driven by the dynamical and electromagnetic coupling between the Magnetosphere, Ionosphere, and Thermosphere. This 'MIT coupling system' is the key element for the energy transfer from planetary rotation to overall electromagnetic activities like Jovian aurora.

We have studied this system by numerical simulations (e.g., Tao et al., 2009) and have compared them with multiple wavelength observation data of 'infrared aurora' (2-4 um) taken with a ground-based telescope. In our last run at IRTF/CHELL in Aug.-Sep. 2009, we succeeded to get the maps of brightness and drift velocity of Jovian H_3^+ aurora in its 3.95 um emission line. During this observation, we also performed a test snapshot of Jovian H_2 aurora at 2.12 um for two nights. Consequently, we clearly detected the obvious morphological difference between H_2 and H_3^+ auroras (cf. Raynaud et al., 2004). It can potentially suggest the difference of energy injection to and the energy transfers between the neutral and plasma atmospheres.

For further progress, we need to know the temporal variations of auroral distributions, temperatures, and wind profiles for both H_2 (neutral) and H_3^+ (plasma) lines. In Sep.-Oct. 2010, we will conduct two observations using IRTF/CSHELL and SUBARU/IRCS. The high spectral resolution of IRTF/CSHELL (R = 43,000) enable us the measurement of the line-of-sight velocity of H_3^+ and H_2. The wide spectral coverage and the high sensitivity of SUBARU/IRCS enable us the temperature measurement from the simultaneous observation of multiple H_3^+ and H_2 emission lines.

From those results, we will derive the origin of the difference in the spatial distributions of neutral and plasma auroras, supported by temperature (from IRCS) and velocity (from CSHELL) field profiles. It will tell the heating and energy transfer processes, which connects the Jovian MIT coupling system.

And in this presentation, we will report our developing high-resolution near-infrared echelle spectrometer, which is optimized for observation of Jovian aurora in 1-4 um, with spectral resolution of 45,000.