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Investigations of the thermospheric dynamics of H_2 and H_3^+ in Jupiter

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There have been many attempts to observe the Jovian thermospheric temperature with varying degrees of success. Early spectroscopic studies (e.g., Kim et al., 1990; Ballester et al., 1994) focused on the determination of the mean H_2 and H_3^+ temperatures or the vertical thermal structure in the northern and southern auroral regions. From high spectral resolution 2 um imaging observation, Raynaud et al., 2004 showed that the spatial distribution of the emission from H_2 and H_3^+ aurora are morphologically different. The origin of this morphological deference is still unknown. It potentially suggests the difference of emission altitude or the difference of energy injection to and the energy transfer between the neutral and plasma atmospheres.

We have studied this region 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 addition to the emission distributions, we focus on the temperature and wind velocity information to investigate neutral-ion coupling in the Jovian upper atmosphere: How and where does the energy input occur into the neutral and plasma upper atmospheres?

In Sep.-Oct. 2010, we conducted two observations using IRTF/CSHELL and SUBARU/IRCS. The IRTF/CSHELL observations were performed on Sep. 17, 19 and 26. Two different lines were observed alternatively, i.e., H_2 $S_1(1)$ 2.12 um and H_3^+ Q(1,0-) 3.953 um. The slit was positioned at the northern/southern polar region perpendicular to Jovian rotational axis. The high spectral resolution of CSHELL (R = 43,000) enable us the measurement of the line-of-sight velocity of H_3^+ and H_2.

Simultaneous H_2 and H_3^+ observations near 2.1 um took place on Oct. 12 using the SUBARU/IRCS. The slit is set along rotational axis (vertical to the auroral main oval) at northern/southern pole. In the polar region, H_2 emission lines $S_1(0)$, $S_1(1)$, and $S_1(2)$ at the wavelengths of 2.22, 2.12, 2.03 um and several $H\{3\}^+$ emission lines are detected. The wide spectral coverage and the high sensitivity of SUBARU/IRCS enable us the rotational/vibrational temperature measurement from the simultaneous observation of the distribution of emission lines.

We will report the difference in the spatial distributions of the emission, temperature, and line-of-sight velocity of neutral and plasma atmosphere, derived from the data of those observations.

Keywords: Jupiter, thermosphere, temperature, ionosphere, Infrared, spectroscopy