地上高空間分解能観測による、木星近赤外オーロラ発光の高度分布導出

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The altitude distribution of Jovian near-IR auroral emission using highly spatial resolved ground-based observation

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The altitude distribution of IR auroral emission of H_2 and H_3^+ is well discussed by the theoretical model (e.g., Kim et al., 1988; Grodent et al., 2001), however, observational study is limited, because the spatial resolution was limited by the atmospheric seeing. The newly Adaptive Optics (AO) system, installed on SUBARU telescope, makes it possible to observe with the resolution of nearly diffraction limit. The observation of vertical distribution of H_3^+ column density and vibrational-rotational temperature are only reported by Lystrup et al., 2008. And there is no vertical-resolved observation of H_2 emission. The origin of the morphological deference of H_2 and H_3^+ (e.g., Raynaud et al., 2004) is still unknown. It may be caused by the difference of heating altitude and/or difference of precipitation energy. The altitude emission profile is important to understand that why the IR emission from H_2 and H_3^+ are morphologically different.

Based on the model calculation, it is thought that the difference of IR emission altitude between H_2 and H_3^+ is about 500-1000 km (Grodent et al., 2001). It is impossible to separate this vertical difference by ground-based observation, because the typical seeing of 0.6 arcsec is corresponding to the vertical resolution of about 1800 km at the Jupiter. The recent technique of Adaptive Optics (AO) makes it possible to get the high spatial resolved data about 0.1 arcsec, corresponding to the vertical resolution of about 300 km.

The data were performed on 1 Dec. 2011 at the Hawaii observatory of National Astronomical Observatory of Japan on Mauna Kea in Hawaii. The IRCS (InfraRed Camera and Spectrograph) instrument (Kobayashi et al., 2000) on the 8.2-m SUBARU telescope was used. IRCS consists of two parts, as its name says, a near-infrared camera and a cross-dispersed echelle spectrometer that operates in the wavelength of 1 - 5 micron. The part of near-infrared camera also serves as an infrared slit-viewer for the echelle spectrograph. IRCS optimized for high-resolution images with adaptive optics (AO). The typical pixel plate scale is 0.055 arcsec/pixel. Array size is 1024x1024 pixel. AO188 is installed at the IR Nasmyth platform of SUBARU telescope (Hayano et al., 2008; 2010). It is equipped with a 188-element wavefront sensor and a 188-element bimorph mirror. The slit is set along rotational axis (vertical to the equator) at northern pole. Using Europa for the guide star for AO system, we succeeded the limb observation of Jupiter H_2 and H_3^+ IR auroral emissions. In the polar region, total 6 H_2 emission lines include S1(0), S1(1), and S1(2) at the wavelengths of 2.22, 2.12, 2.03 um and total 81 H_3^+ emission lines include R(6,7), R(7,7), Q(6,2) at 2.11 um are detected. Using ”onion peering method”, we derive the vertical distributions of those emissions, and temperatures, number densities derived from the set of those emission lines. We will report the results of this analysis.

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