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In the rotational driven magnetosphere of Jupiter, the momentum and energy transfers between thermosphere and ionosphere is the key part of the magnetosphere, ionosphere and thermosphere (MIT) coupling. Jovian aurora, emitted from this region through this process, does not only shows the strength of magnetospheric activities but also affects to the ion-neutral interactions.
Previous observations have shown the morphological difference between plasma (H_3^+) and neutral (IR H_2) emissions. It suggests the difference between strong electron precipitating area exciting the plasma emissions and the heated area exciting the neutral emissions. In order to investigate their emission mechanisms and relationships to the energy injection processes, the comparison between H_3^+ fundamental (v2=1→0) and overtone (v2=2→0) lines is also important. The different emission altitude of both emissions is caused by their different sensitivity to surrounding atmospheric temperature and density.
We first executed the quasi-simultaneous comparisons of the horizontal and vertical emission profiles in H_3^+ fundamental, H_3^+ overtone, and H_2 polar emissions, by the near infrared spectroscopy of Jovian polar emissions using SUBARU/IRCS on 31 January 2015. H_2 IR emission and H_3^+ overtone emissions are seen simultaneously in K-band spectra (2.03-2.22 μm), and H_3^+ fundamental emission in L-band (3.31-3.98 μm) is quasi-simultaneously taken by short interval, ~5 min. We also simulateounly took the slit viewer image of the H_3^+ fundamental line or K-band filter. During these observations, we used the adaptive optics system (AO188) when Galilean satellites could be used as a guide star, and achieved high spatial resolution, ~0.2 arcsec (~320 km of Jupiter). The slit was set along the rotational axis when AO188 could be used.
First, we compared the horizontal flux profiles. The morphological difference between H_3^+ fundamental and overtone emissions are small. Both have clear main oval emissions like the averaged UV aurora profile. On the other hand, IR H_2 emission does not show clear enhancement at the main oval. We also derived the horizontal profiles of temperature and column density from those emissions. H_3^+ fundamental lines have a better correlation with column density. H_3^+ overtone lines are more related to temperature. On the other hand, IR H_2 emission intensity does not show clear correlations.
Next, we derived the vertical structures of their volume emissivity profiles by “onion peeling” method. We confirm the result of Uno et al. (2014), the similar emission peak altitude between IR H_2 and H_3^+ overtone emissions in K-band. We also found that the peak altitude of H_3^+ fundamental emission was lower than them. Although the derived H_3^+ vertical emission profiles are not contradict to the theoretical models, and their derived temperatures represent those of emission peak altitudes, it is hard to explain the vertical profiles of IR H_2 volume emissivity by a simple ‘thermal excitation model’. It is also hard to explain the fact that the derived temperature from H_2 emissions from higher altitude (~700 K) is lower than that from H_3^+ fundamental emission in lower altitude (~1,000 K). We are now investigating possible scenarios for those points.
In May 2016, we will observe Jovian IR emission again, simultaneously with UV aurora by Hubble

Space Telescope, EUV aurora and Io torus by Hisaki/EXCEED, and the upstream solar wind by NASA Juno spacecraft approaching to Jupiter. It will be the chance to solve the problems raised in this study.

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