Development of the infrared echelle spectrometer for observation of the planetary atmosphere

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Jupiter has a giant magnetosphere and rotates every 10 hours. Its magnetic field drags the magnetosphere. Its motion delayed from the corotation generates the equatorward electric field in the ionosphere. Such electric fields should results in anti-corotational ion winds, which interacts with the upper neutral atmosphere.

Because the amount of Pedersen current depends on the relative ion velocity as seen from neutral atmosphere, the distribution of neutral winds is important for the estimation of the momentum and energy transportation from the ionosphere to the magnetosphere. Ion winds have been observed as H_3^+ line emission [Rego et al., 1999; Stallard et al., 2001; Lystrup et al., 2007]. However, there is no direct evidence for the neutral winds. The detection of its motion by neutral H_2 (2.12 um) emission is difficult, because of its low brightness (0.5×10^{-6} W/m^2/str, less than 1/100 of H_3^+ 3.9 um emission) and slow speed (100 m/s at 500 km height, 400 m/s at 1000 km in some models). In addition, the observation by public observatories is limited by machine time. Continuous several weeks or several months observations is essentially difficult.

For those targets, we are developing the infrared echelle spectrometer for the observation of Jovian ionospheric and neutral wind velocities that observed H_3^+ and H_2 emissions. The spectrometer is planned to be installed on the new telescope at Mt. Haleakara by Tohoku Univ., Univ. Hawaii, ETH, etc.

Our requirements are as follows: (a) H_3^+ (2.05 um) and H_2 (2.12 um) emissions with the luminosity of $0.5\text{-}1.0 \times 10^{-6}$ W/m^2/str, (b) slit length of 40 arcsec, (c) spatial resolution of 0.6 arcsec, (d) temporal resolution of 30 minutes, and (e) 60 m/s of error in velocity of the neutral wind. It is optimized for observation of winds of planetary atmosphere in near infrared wavelength (1-4 microns), with spectral resolution of 65,000. When the spectrometer will be completed, it can contribute to the investigation not only for Jupiter, but also Venus and Mars atmospheres.