# Searching minor species on Venus atmosphere using the high-dispersion spectra taken by IRTF/iSHELL

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Venus atmospheric chemistry can be divided into the following categories: photo-chemistry in the upper atmosphere (including the lightning-induced chemistry, if exists), cloud-related chemistry with heterogeneous reactions on the cloud droplets' surface, and thermal-equilibrium chemistry in the hot lower atmosphere. Precise measurements of the atmospheric composition give the fundamental information to understand these atmospheric chemistries. In addition, some of the minor species in Venus' lower atmosphere are considered to play a significant role as the greenhouse gas. Quantitative understanding of the minor species' distribution becomes important also from such a point of view.

The best remote-sensing approach to search for weak signals emitted/absorbed by the minor species is the high-dispersion spectroscopy at the infrared wavelengths. By using at the near-infrared wavelength, the stellar and solar occultation spectrometer SPICAV/SOIR onboard Venus Express has comprehensively obtained vertical profiles of the minor species in Venus' upper atmosphere (> ~70 km) such as $H_2O$, HDO, CO, $SO_2$, HCl, HF, and aerosols. The measurements were mostly limited around the morning and evening local times on Venus. Therefore, one of the still remained problem after the SPICAV/SOIR measurements is to understand any local time variability of these species which should be present if they are sensitive to photochemistry. And, any long-scale temporal variation of the minor species' abundance is also the subject to be studied continuously after the finish of the Venus Express mission in 2014. Motivated by these points, we carried out the high-dispersion spectroscopy (spectral resolving power ~ 75,000) of Venus' dayside hemisphere using a newly developed immersion grating Echelle spectrograph, iSHELL, attached to the IRTF 3-m telescope. The data were taken on August 6 –8, 2018 when Venus apparent diameter was 21.7 arcsec. We used three wavelength bands: L3 (3.20 –3.48 um), Lp2 (3.57 –3.95 um) and Lp3 (3.83 –4.18 um) in order to cover the absorption lines of several interested species like $H_2O$, HDO, HCl, $CO_2$, etc. The cross-disperser enabled us to measure the entire wavelength range with different dispersion orders within each of these wavelength bands. The derivation of the abundance of the observed species will be discussed in the presentation.

 