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Venus cloud top structure seen by the coordinated Subaru and Akatsuki observations

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Abstract

We carried out the coordinated observations of Venus cloud top with Subaru Telescope and Japanese Venus orbiter, Akatsuki, in January 2017. In this presentation, we will present the observational results and discuss the interpretation of them.

1. Introduction

The first sequential mid-infrared images taken by Longwave Infrared Camera (LIR) onboard Akatsuki after its insertion into Venus orbit on December 7, 2015 [1] revealed that a planetary-scale bow-shaped structure exists at Venus cloud top and has been fixed in a position above Aphrodite Terra for at least four Earth days. This stationary structure has been suggested to result from an upward-propagating mountain gravity wave generated by the interaction of atmospheric flow with the topography [2]. Up to the present, small and large stationary bow-shaped structures possibly originated from similar mechanism have been detected above various highlands in not only mid-infrared but also UV images. Here, we report the coordinated Subaru and Akatsuki observations conducted to obtain a better understanding of the atmospheric dynamics at the cloud top including the newly discovered stationary structure.

2. Observations

We observed Venus at the solar phase angle of ~90˚, with evening terminator in view, with the Cooled Mid-infrared Camera and Spectrometer (COMICS) mounted on the 8.2-m Subaru Telescope atop Mauna Kea, Hawaii, during the period of January 11-14, 2017 (UT). The narrow band imaging (8.66 μm and 11.34 μm) and N-band (8-13 μm) low spectral resolution (R~250) spectroscopy were carried out to investigate the cloud top morphology and several atmospheric parameters such as cloud top temperature and altitude, etc. During the period, Akatsuki was approaching to the periapsis and the local solar time at the sub-spacecraft point shifted from 13 h to 15 h. LIR and Ultraviolet Imager (UVI) took Venus images at intervals of one and two hours, respectively.

3. Results

The obtained COMICS images with good signal-to-noise ratio and with high spatial resolution (~200 km at the sub-observer point) provide several observational findings.

- As seen in Figure 1, the images at both wavelengths after high-pass filtering clearly show that a stationary bow-shaped structure distributed in the equatorial region appears above the highland named Maat Mons (0.5˚N and 194.6˚E) in the early night and survives through the observation period. It is noteworthy that a stationary structure similar to those discovered by LIR was also observed by another different instrument, COMICS.

- Several streaks are also found to be distributed over the entire disk and some of them are not fixed to the topography.

- The images on January 14 have a horizontal Y-shape feature resembling that seen in UV.

- Venus mid-infrared images in 2007 showed the possibility that the westward rotation of the

polar features is synchronized between the northern and southern hemisphere [3]. However, we could not see such phenomenon this time.

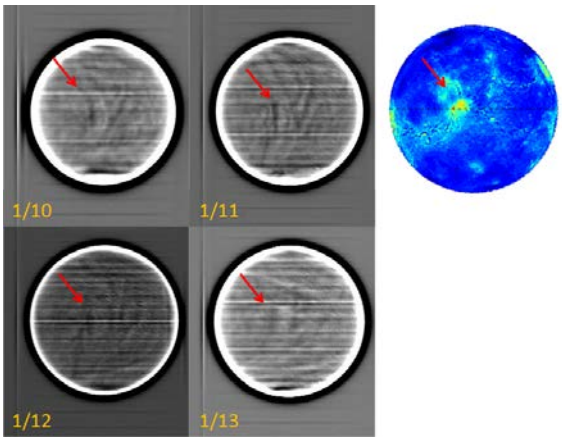

Figure 1: Day-to-day variations of residual patterns at 11.34 μm after high-pass filtering. The upper right image illustrates the topography seen from the Earth during the observation period.

4. Summary and Future work

The coordinated Subaru and Akatsuki observations of Venus cloud top were conducted during the period of January 11-14, 2017. By using a large-aperture ground-based telescope, we could confirm a stationary bow-shaped structure fixed in a position above the highland (Maat Mons). As a next step, we will compare the morphologies seen in images taken by COMICS, LIR, and UVI. The absolutely calibrated COMICS images can also be helpful to validate the absolute calibration of LIR images.

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