Observational study of the Venus clouds

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We have conducted mid-infrared imaging observations of the Venus cloud with the 8.2 m-diameter Subaru telescope at the summit of Mauna Kea on the island of Hawaii in December 14-16, 2005.

The thick cloud of Venus covers the whole planet at altitudes from 45 to 70 km. It reflects, absorbs or scatters much part of both the solar incident energy and thermal emission from lower atmosphere. Therefore, since it has significant effects on the atmospheric thermal balance/structure, and plays a major role in controlling the planetary environment, addressing the cloud physics, such as the mechanism of the formation and the distribution, is indispensable in order to understand the Venus meteorology comprehensively. However, the information are limited and the further observational study is strongly needed.

Given this situation, the purpose of this study is the global mapping of small-scale structures in the Venus cloud with mid-infrared imaging observations. Observations with the 8.2 m-diameter Subaru telescope enable us to obtain the data with the spatial resolution less than 100 km and with the signal-to-ratio higher than 1000, which has never been past observations.

The analysis results show that there are small structures with the spatial scales of several hundred kilometers. In the high latitude region, the fluctuation shows zonally-aligned features with the widths of about 300 km. The amplitude of this structure is about 1 K in the brightness temperature, which corresponds to the fluctuation of the altitude of 300 m by conversion of the vertical lapse rate (-3 K/km) at an altitude around the cloud-top level. On the other hand, in the lower latitude, structures are patchy with the diameters of 300 km - 600 km, and the amplitude is about 0.5 K, less than that in high latitude, corresponding to 150 m variation in the altitude. These structure has the similarity to the UV images obtained by OCPP on board Pioneer Venus Orbiter. The detail spatial fluctuation brightness temperature at the cloud-top level, which approximately corresponds to the fluctuation of the cloud top altitude, is derived by this study for the first time, while the UV images show the distributions of some absorbing matter of the solar incident in the cloud.