Ground-based observations of the formation and periodical rotation of the global scale UV-feature on Venus cloud top

*Masataka Imai[1], Yukihiro Takahashi[1], Makoto Watanabe[1], Toru Kouyama[2]

1.Department of Cosmosciences, Graduate School of Science, Hokkaido University, 2.Artificial Intelligence Research Center National Institute of Advanced Industrial Science and Technolog

On Venus, the atmosphere moves rapidly in the westward direction, reaching velocities 60 times the rotation velocity of the solid globe. This atmospheric "super-rotation," was first detected in the 1960s, however, the mechanism of super-rotation remains mysterious. A planetary-scale bright and dark UV feature, known as the "Y-feature," rotates around Venus with a period of 4-5 days and has been long-time interpreted as a planetary wave. When assuming this, its rotation period and spatial structure might help to understand the propagation of the planetary-scale waves and find out their role in the acceleration-deceleration of the zonal wind speed, which is essential for understanding the super-rotation of the planet. The rotation period of the UV feature varied over the course of observation by the Pioneer Venus orbiter (PVO). However, last work issuing this crucial topic was made more than 15 years ago, and, since PVO was operated in nearly fixed inertial space, the periodicity variations on sub-yearly timescales (one Venusian year is ~224 Earth days) were obscured by the limitation of continuous dayside observations.

We newly conducted ground-based Venus imaging observations at 365 nm, which consists of six periods covering over half or one month from mid-August 2013 to the end of June 2014 and one continuous periods from mid-April to end of July 2015. Distributions of the relative brightness were obtained from the equatorial to mid-latitudinal regions in both hemispheres, and from the cyclical variations of these distributions we deduced the rotation periods of the UV features of the cloud tops albedo. The relative brightness exhibited periods of 5.2 and 3.5 days above 90% of significance. The relative intensities of these two significant components also seemed subject to temporal variations.

In 2013 and 2014, although the 3.5-day component persisted throughout the observation periods, its dominance over the longer period varied in a cyclic fashion. The prevailing period seems to change from 5.2 to 3.5 days in about nine months, what is clearly not-coincident with the Venusian year (224 days). The amplitude of relative brightness variation is weak during the transition periods of dominant-wave changing. It was indicated that the stability of the planetary scale UV-feature were observed only in the presence of single longer or shorter periodic waves. In 2015, 3.5-days and 5.2-days wave periods could be observed. We success to obtain the change of the first significant mode from 3.5-day wave to 5.2-day wave continuously. As the former observation results, Venus experienced the absence of dominant-wave mode during the transition periods, and the time scale of the transition is estimated about one month in that period.

Keywords: Venus, Y-feature, Ground-based telescope

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