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Temperature variation of the cloud top of Venus obtained by photometry observation by LIR onboard Akatsuki

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The Japanese Venus Climate Orbiter called Akatsuki was designed to study the meteorology of the Venusian atmosphere, which differs to that of the Earth in composition, density and circulation. Akatsuki was to orbit around Venus in an elongated equatorial orbit with almost the same angular velocity during most of the orbital period as that of the super rotation of the atmosphere at the cloud top altitudes, like a geosynchronous satellite. A 3-D structure of the atmosphere was to be reconstructed by multi-depth imaging using four cameras operating in the mid-infrared to near ultraviolet regions and using the radio occultation technique. The Longwave Infrared Camera (LIR), which mounts an uncooled micro-bolometer array (UMBA), is one of a suite of cameras onboard Akatsuki, designed to take mid-infrared images of Venus with a single band-pass filter of 8?12 um. LIR detects thermal radiation emitted from the layer where the cloud optical depth equals unity. The noise equivalent temperature difference (NETD) of LIR is 0.3 K and absolute temperature can be determined with an accuracy of 3 K. In addition, a cloud tracking technique could retrieve the horizontal wind vector field at the cloud-top height. Unfortunately, Akatsuki failed to enter the orbit because trouble occurred with the propulsion system on December 7, 2010. At present the spacecraft is orbiting the Sun, and it will have a chance to encounter Venus in 2015. During the spacecraft cruising, LIR successfully acquired 52 photometry data of day-side Venus between February and March 2011 at a distance of 1.2-1.7x10ˆ7 km. The spatial resolution of LIR and an apparent diameter of Venus being almost equivalent, Venus' disk in the image extends to several pixels that include both Venus and the background radiation. All brightness pixels that included Venus were summarized and the background radiation component were removed from them to estimate a Venus' brightness component. Furthermore, it has been converted to the brightness temperature by using calibration data acquired in the laboratory before the launch and brightness temperature variation of the disk have been obtained. However, the discrete data set has large data gaps. Then, the Lomb-Scargle periodgram, which is better suitable than Fast Fourier Transform, has been applied and been obtained a spectrum. The result shows spectrum peaks at 5-day and 8-day period. The 5-day period may be caused by the super rotation, and the 8-day period may be a planetary-scale wave that has the phase velocity of ˜50 m/s.

Keywords: Venus, atmosphere, Akatsuki, LIR